Smallholder farmers' adoption decision-making processes in the utilization of soil conservation practices in South Africa: the case of Qamata Irrigation Scheme, in the Eastern Cape

BY

IGHODARO IKPONMWOSA DAVID

(201004920)

A thesis submitted in full fulfilment of the award of Doctor of Philosophy (PhD) in Agriculture, Agricultural Extension

Department of Agricultural Economics and Extension, Faculty of Science and Agriculture, University of Fort Hare, South Africa

Supervisor: Professor Abyssinia Mushunje

June, 2016

Declaration

I, MR IGHODARO IKPONMWOSA DAVID, the undersigned, declare that this dissertation is my original work and has not been presented for a degree in any other university, and that all sources of materials used for this dissertation have been duly acknowledged.

Signature: .....

Date: .....

Acknowledgements

Success is not an accident; it is the result of a diligent and careful search. A study such as this no doubt is a precipitate several efforts. This is why certain personalities deserve some recognition. Among these is my supervisor Professor Abbyssinia Mushunje, who was willing to accept me for supervision when my former supervisor moved to another school, and has been indeed wonderful in the whole process of executing this study. Also to be acknowledged is Professor Francois S. Lategan, my initial supervisor for the study, who also assisted me in the conceptualization and proposal process.

Also to be acknowledged are my wonderful and lovely wife Dr Mrs Beauty Etinosa Ighodaro and my three lovely children: Osamudiame David (Jnr) Ighodaro, Osarieme Praise Ighodaro, and Uwa Jubilee Princess Ighodaro, for all the support I enjoyed from them. Other persons that cannot be left out are my senior pastor, Pastor P.C. Heart and all members of Global Faith Ministries, South Africa; Dr. Sam Usadolor, my mother in-law Mrs Omoruyi; Apostle Napoleon Enadeghe, who is more or less like a father to me, and whose brief impact in my life is beyond quantification. Furthermore, to be included are people like Rev. Abel Osemete, Evang. Fred Uzzi and his family, and all my friends. May God richly bless you all for the diverse ways you have contributed to my life. Another person that cannot be left out of this list is Mafu Nozipho, the extension officer that assisted me with my data collection at Qamata Irrigatiion Scheme, Chris Hani District Municipality, Eastern Cape.

Dedication

I would like to dedicate this great work to God Almighty and to my Lord and Saviour Jesus Christ, who also is the source of my living and achievements. Also, I dedicate this study to my wonderful late parents Mr. and Mrs Ighodaro Ogiemudia, whose memories remain so dear in my heart, my lovely wife Mrs Etinosa Beauty Ighodaro, and to my loving and God-given children, Osamudiame David (Jnr) Ighodaro, Osarieme Praise Ighodaro, and Uwa Jubilee Ighodaro.

Abstract

The goal of this study was to determine the nature and factors influencing smallholder farmers in their adoption decision-making regarding the use of soil conservation practices introduced by extension practitioners in South Africa, using the case of farming at Qamata Irrigation Scheme, Eastern Cape. Using a central argument (thesis statement), the study argued that an adequate understanding and definition of smallholder farmers' adoption decision-making process is very crucial to solving the problem of soil erosion/ degradation problem amongst smallholder farmers. Adopting the case study research design, information from 70 crop farmers (in a farmer focus group interviews) form the basis of the study. Basic models of analysis were the multiple, probit and logit, as well as the binary logistic regression analyses.

According to the empirical results, perception was found very relevant in adoption decision-making, interacting positively and significantly with eight of the seventeen adoption variables chosen for the study. The indication therefore is that age ($p<0.050$), education ($p<0.0030$), and marriage ($p<0.036$), have more potentials to improve farmers' perception. Similarly, higher farmer incomes (from crops [$p<0.017$], off-farm [$p<0.038$] and overall [$p<0.011$] income) also have a likelihood to improve farmers' perception regarding soil conservation, for improved adoption. Further indication is that farmers who are aware ($p<0.015$) of the soil practices introduced by extension are also those who participate in their use ($p<0.041$).

Employing the binary logistic, probit and logit regression models, results suggest that the nature of adoption decision-making processes of smallholder farmers is complex (not straight), being influenced by multiple factors. While age ($p<0.099$), gender ($p<0.031$), total income ($p<0.081$) impacted positively significant on smallholder farmers' adoption decision-making, marital status ($p<0.025$), sources of land ($p<0.063$), length of continuously farming on same piece of land ($p<0.013$), and level of crop production ($p<0.002$) impacted negatively. The indication therefore was that older farmers preferred their own practices to the recommended practices by extension, which is in line with literature. Also as expected, more females preferred their own practices to extension recommended, while more males preferred the recommended practices. Similarly, marriage, land ownership, farming continuously on a spot for a long period, as well as increase in the level of crop production, all had a propensity to influence farmers toward the adoption of extension recommended practices as against farmers' practices.

Further results indicate, that farmers' education ($p<0.032$), household size ($p<0.37$), and income (off-farm [$p<0.036$] and total [$p<0.004$]), measures used to measure farmers' livelihood standards in the study, were positively significant in association with adoption. The indication was that, adoption decision-making is potentially capable of improving education level of farmers; increase the size of household, thus providing easy family labour; and as well improve level of income for the farmer.

Based on the foregoing, the suggestion therefore is that any technology intervention programme that will succeed must begin with a clear understanding and analysis of farmers' adoption process. This is better achieved when the adoption process is seen as a four-stage process, where the farmer first forms a view about the innovation (perception stage), and then decides whether or not to use it (adoption stage), as well as how much of the innovation to adopt (level of adoption stage), and finally how much is this innovation going to affect my livelihood (impact of adoption stage). Also, due to the particular relevance of perception in the adoption decision-making process, technology disseminators (extension), researchers and policy makers alike must never conclude on the rejection of any technology, not until factors determining perception of individuals have been well studied. The notion here is that, even at the confirmation stage of the adoption process of an individual adopter, when a rejection is confirmed, for an example, analysing factors of the adopter's perception at play at the particular time of the innovation in question, could go a long way to redirecting the course of the adoption process of the said individual.

Key words: Smallholder farmers; adoption decision-making process; soil conservation technologies; Qamata Irrigation Scheme; Eastern Cape

Table of contents

List of tables

List of figures, plates and boxes

List of acronyms and abbreviations

ADOPTLIVE	Adoption livelihoods
AWARESCP	Awareness of soil conservation practices
BENADOPT	Adoption benefited
CA	Conservation agriculture
CROPPROD	Crop production
EDU	Education
EXTMREP	Extension most recommended practices
FARMYRS	Farmers' years of experience
HHSIZE	Household size
ICTs	Information and communication technologies
INCOMAGC	Income from agricultural crops
INM	Integrated soil nutrient management
IPM	Integrated pest management
ISCT	Improved soil conservation technology
LANDOWN	Land ownership
LENTFARM	Length of time of continuously farming on one spot
LIVEPROD	Livestock production levels
NGO	None governmental organization
NT	No-till
OFFINCOM	Off-farm income
PARTEXT	Participation in extension
PHL	Postharvest losses
R & D	Research and development
RMPs	Recommended management practices
RSFR	Renewable soil fertility replenishment
SCP	Soil conservation practice
SIZEFARM	Size of farm
SOM	Soil organic matter
SOURLAND	Sources of land
SPSS	Statistical Package for the Social Sciences
SSA	Sub-Saharan Africa
TOT	Total income

TOTALINC	Overall income of farmers
TV	Television

CHAPTER ONE

Introduction

1.0. Background to the study

Land or soil degradation caused by soil erosion and other processes is a severe environmental threat to a sustainable agricultural production (Barungi & Maonga, 2011) and food security. Declining soil fertility and low macro-nutrient levels are fundamental hindrances to agricultural growth and a negative social externality in sub-Saharan Africa (Ajayi *et al*., 2007, citing Vanlauwe & Giller, 2006; Sanchez, 2002). According to Vrieling (2007), soil erosion (a form of soil degradation) is one of the menaces to the sustainability ideal. The consequence of soil degradation is dire, not just to the farmer alone, but to the entire society. Speaking on this, Lal (2009) posits that soil degradation, in close association with poverty, is an important reason for food insecurity, malnutrition, social/ ethnic conflicts and civil political unrest. Relating soil degradation impact and health, Lal (2009) reiterated that through its adverse effects on the quantity and quality of food produced, soil degradation affects human nutrition and health.

The soil is an important element in nature. According to FAO (1998), cited by Pimentel (2006), more than 99.7% of human food (calories) comes from the land. In the opinion of Lal (2009), the soil is the essence of terrestrial life-form. The soil is degraded when its quality is reduced. In other words, soil degradation refers to the attenuation of soil's current or potential ability to carry out ecosystem functions, especially the production of food, feed and fibre by reason of one or more degradation processes (Lal 2009). Principal soil or land degradation processes according to Lal (2009), citing Lal (1993 & 1997), are (1) physical processes like decline in soil structure, crusting, compaction, accelerated erosion; (2) chemical processes like nutrient depletion, elemental imbalance, acidification, salinization; and (3) biological processes like depletion of soil organic matter (SOM), reduction in the activity and species diversity of soil microorganisms.

Due to the effect of various factors, primarily that relating to inappropriate agricultural practices, the soils of the world are deteriorating or degrading at an alarming rate. For example, each year, about 10 million ha of cropland are lost due to soil erosion (Pimentel, 2006). In sub-Saharan Africa, soils are said to be depleting at a yearly

rates of 22 kg/ ha for nitrogen, 2.5 kg/ ha for phosphorus, and 15 kg/ ha for potassium (Ajayi *et al*., 2007, citing Smaling *et al*. 1997). Ajayi *et al*. (2007) maintain that apart from the major effects of decreasing per capita food production, poor soil fertility triggers other side-effects on-farm such as lack of fodder for livestock production, reduction in fuel-wood and increased deforestation rates (because farmers are forced to abandon poor soils for more fertile forest areas). The inevitable consequence, according to Ajayi *et al*., is accelerated degradation of natural resources which offer very little potential for agricultural sustainability.

According to Chirwa and Quinion (2012), reporting Scoones and Toulmin (1999) and Sanchez *et al*. (1997), the main hindrance to agricultural productivity in Africa, and mostly southern Africa, is soil nutrient deficiency. Le Roux, Newby and Sumner (2007) arguing along this line, state that in South Africa, the loss of topsoil is one of the principal soil degradation problems confronting agriculture. Annual soil loss in South Africa is estimated at 300- 400 million tons, and the equivalent amount needed to replace the soil nutrients carried to sea by rivers each year in South Africa, with fertilizer is estimated at R1000 million (Kumar & Ramachandra 2003). Another side of the problem, as indicated by Garland, Hoffman and Todd (1999), cited by Hoffman, Todd, Ntshona and Turner (1999), is that the rates of soil formation in South Africa are thought to be about 30 times slower than the rates of soil loss. Similarly, the Eastern Cape which constitutes the study area, is considered as one of the three most degraded provinces in South Africa; Limpopo and KwaZulu-Natal are the other two (Department of Environmental Affairs, Republic of South Africa, 2007).

Sequel to the above, the need for adequate adoption of improved soil management practices that will both control soil degradation and allow for quick restoration of soil nutrients is very imperative. Without appropriate adoption of soil management technologies, agricultural yields will persistently decline, which in turn will affect the food security status of the entire nation (Barungi & Maonga, 2011). Soil management technologies are modern and improved agricultural practices of sustainable use of the soil that aim to increase agricultural production but does so with the most environmental-friendly means, allowing for future generations' use. In the words of Lal (2009), "ecologically restored and judiciously managed, global soil resources are adequate to meet the essential needs of the present and future populations".

Horrigan *et al*. (2002), reported by Lal (2009), speaking on the importance of sustainable agriculture (use of appropriate soil management practices), said that sustainable agriculture has the potential of addressing both environmental concerns and human health issues.

Lal (2009) indicates that the adoption of proven soil management technologies has a potential of increasing to fourfold production of food crop staples in sub-Saharan Africa (SSA) and also improve their nutritional quality. Similarly, Ingram *et al*. (2008), opine that the adoption of recommended management practices (RMPs) globally, has the potential to enhance average cereal grain yields from 3.4 t/ha in 2008 to 4.2 t/ha in 2020.

Despite the potential benefits inherent in the use of modern soil management technologies, research indicates that farmers' adoption has been low, which calls for great concern. According to Toborn (2011), the adoption decision-making behaviour of farmers is one of the most important factors influencing the spread or dissemination of innovations in agriculture. Commenting on the adoption decision-making behaviours of farmers, Paudel and Thapa (2004), as reported in Tiwari *et al* (2008), state that in the mountains of Nepal, despite the availability of various technological options for soil conservation and land management, adoption by farmers remains low, and as such soil fertility continues to deteriorate in the area. In terms of Africa, Giller, Witter, Corbeels and Tittonell (2009), citing Tittonell *et al* (2008), suggest that in sub-Saharan Africa, we often see that options for soil management that show great potential gain little foothold in real practice.

An individual farmer is always surrounded with several decision options in relation to farming. Beginning from the thought to engage farming as a business or just for part time; whether to go commercial or subsistence; decisions relating to the location of the farm; size of the farm; management related decisions; the type of farming system to adopt; et-cetera. The farmer continuously engages his/ herself in these decision options throughout his/ her life cycle as a farmer. And these decisions impact significantly on the soil and the overall production outcome of the farm.

Many factors prevail on farmers' adoption decision-making. According to Lategan (2007), in a decision-making environment such as that relating to the game ranching industry, the perception of risk is a crucial factor that creates a profitable and sustainable enterprise. From Garcia (2001) view, as cited by Tiwari *et al* (2008),

farmers' adoption of improved soil conservation technology (ISCT) is affected by interactive effects of household socio economic factors, resource availability, physical characteristics of the land and institutional support provided by the public or NGO sector.

Farmers are expected to, in the adoption decision making process, compare the merits and appropriateness of different soil conservation technologies, based on the existing resources at their disposal and their opportunity for profit (Tiwari *et al*., 2008). In view of this assertion, the factors of available capital and potential profit/ gain to the individual farmer are basic factors influencing farmers' adoption decision-making. Speaking on the subject, Ervin and Ervin (1982) state that adoption decision-making behaviour is difficult and often requires a combination of income, profit, and institutional support. According to Robinson (2009), the adoption process theory is unlike most other theories of change; instead of focusing on persuading individuals to change, it sees change as being basically about the reinvention of products and behaviours so they become better fits for the needs of people.

The adoption process is further emphasized by King and Rollins (1995) who suggest that a critical element in the adoption of agricultural innovation is the education process that extension practitioners use to equip farmers with the knowledge and skills necessary to use innovation. The education of the individual plays a pivotal role in their decision-making efforts. In the views of Bonabana-Wabbi (2002), citing Waller *et al*. (1998) and Caswell *et al*. (2001), education creates a favourable mental attitude for the adoption of new technologies especially those of information-intensive and management-intensive practices.

From the foregoing, the need to study and understand farmers' adoption decision-making behaviours becomes very glaring, more so to understand them in their particular environment. This is crucial because, according to Lewin (1951), cited by Dűvel (1991), the environment of every individual carves his/ her motivations and eventual practices. In this regard, this study particularly aims at investigating the role smallholder farmers' adoption decision-making processes play in the utilization of soil management technologies in South Africa, using the case of selected irrigation schemes in the Eastern Cape. It seeks, amongst other things, to understand decision-making processes, with a view to reduced soil degradation and improve agricultural production.

1.1. Problem statement

The process of soil management decision-making is complex, and currently limits the understanding and explanation for the persistence and prevalence of soil degradation worldwide. Lategan (2007:5) refers to the process as “non-linear and recursive”.

In literature, there are strong emphases of delays in the adoption of soil conservation technologies. For example, Tiwari *et al*. (2008), reporting Paudel and Thapa (2004), maintain that in the mountains of Nepal, despite the availability of various technological options for soil conservation and management, farmers’ adoption remains low, as such soil fertility continues to decline in the area. Also, Rezvanfar, Samiee and Faham (2009) maintain that although several soil conservation technologies had been developed and promoted in past years, adoption levels have been minimal. In sub-Saharan Africa, it is reported that fodder legumes have not achieved their full potential despite 70 years of research and development (R & D) promoting legumes (Shelton, Franzel & Peters, 2005, citing Sumberg, 2002). Supporting this also, Giller, Witter, Corbeels & Tittonell (2009), citing Tittonell *et al*. (2008), posit that in sub-Saharan Africa, it is often found that options for soil management that show great potential gain little foothold in real practice.

Moreover, the study of Ajayi *et al*. (2007:307), citing Ajayi and Kwesiga (2003), in Southern Africa reveal that despite the potential of renewable soil fertility replenishment (RSFR) technologies in the region, the adoption and spread among smallholder farmers has generally lagged behind scientific and technological advances thereby reducing their impact. It is however sad to say, based on Flett *et al*. (2004) study, that many innovations such as artificial insemination (AI) with huge potential to benefit pasture-based milk production are found not always adopted by dairy farmers.

In the consideration of Lategan (2007), citing Botterill and Mazur (2004), important inconsistency is reported in relation to the utilization of natural resources, in this case, soil resources. This seems to shed light on the problem under study. It is said that there has been a bone of contention between farmers, researchers, conservation officials and agricultural leaders due to the apparent inconsistencies in the decision-making behaviour of farmers in scenarios where the utilization of natural resources are involved.

Speaking on this, Nakhumwa (2004) asserts that, in many instances, factors prevailing on smallholder farmers decision-making regarding soil conservation technology adoption have been difficult to predict policy level making, largely because of limitations of methodology. Nakhumwa (2004), citing Goezt (1992), states further that this dilemma is due to the fact that the decision-making process of smallholder farmers is still not clear.

According to literature, there abound many studies on soil conservation in the study area. Examples are artificial drainage induced erosion: the case of railway culverts on the Kwezana Ridge, near Alice, Eastern Cape (Kakembo, 2000), hydro climatic trends, sediment sources and geomorphic response in the bell river catchment, Eastern Cape Drakensberg by Dollar and Rowntree (1995), and the relationship between land use and soil erosion in the communal lands close to Peddie, using a series of aerial photographs captured between 1938 and 1988 (Kakembo and Rowtree, 2003). However, little is reported on the impact of smallholder farmers' adoption decision-making process in the application of soil conservation technologies, particularly focusing on the nature and factors which propel adoption tendencies, as stipulated in this study. This is the strength and particular relevance of this study.

1.2. Research questions

Quality soils do not only breed increased (quality and quantity) agricultural production, and thus improved food security for rural people, but also it engenders sustainable land resource base and ecosystem function. As indicated in literature, the soil is an invaluable resource to humans (Ighodaro, 2012). For example, citing FAO (1998), Pimentel (2006) posits that more than 99.7% of human food (calories) results from the land. Hence the need to protect its resources from undue depletion and adopt measures which ensure quick restoration of lost nutrients after every use cannot be overemphasized. This is especially so in sub-Saharan Africa where majority of people depend on agriculture for their livelihood (Odendo, Obare & Salasya, 2010, citing Sanchez *et al*., 1997). In support, Bishop-Sambrook (2005) maintains that agriculture remains the main feature sustaining the livelihoods of rural people in many regions of the world.

Agriculture plays significant roles in the degradation of most parts of the world. Citing Myers (1993), Pimentel *et al*. (1995) maintains that agricultural land forms the largest area of influence of wind and water erosion impact worldwide. Due to the impact of soil erosion, each year, 75 billion metric tons of soil is lost from land through the action of wind and water erosion, with most of these coming from agricultural land (Pimentel, 1995, citing Myers, 1993).

According to Dűvel (1991), problems that are normally addressed in agricultural development are ultimately that relating to non-adoption or inappropriate adoption of specific recommended practices by farmers. Therefore a proper understanding of the processes associated with smallholder farmers, who form the bulk of most rural communities, decision-making around their application of soil conservation practices should be thought worthwhile. This is because, according to Barham *et al*. (1995), new technologies play a significant role in raising the income (and agricultural productivity) of smallholder farmers.

Based on this therefore, the main research question of this study is what is the nature and factors of smallholder farmers' adoption decision-making process regarding the application of soil conservation technologies and practices for improved agricultural production in South Africa? It uses the farming situation of Qamata Irrigation Schem, Chris Hani District Municipality, Eastern Cape, South Africa. The following are the specific research questions:

1. What is smallholder farmers' perception on soil conservation practices introduced by extension officers in the study area?
2. What are smallholder farmers currently doing to conserve the soils of their farmland?
3. What factors influence smallholder farmers' adoption decision making processes regarding the use of soil conservation practices introduced by extension officers?
4. What is the level and intensity of smallholder farmers' participation in extension recommended practices for soil conservation in the study area?
5. What is the role of smallholder farmer's perception on soil conservation practices on their adoption decision-making processes in the study area
6. What influence does smallholder farmers' adoption decision-making has on the livelihood standards of farmers in the study area?

1.3. Research objectives

The main objective of this study is to determine the nature and factors at play in the adoption decision-making of smallholder farmers in their utilization of soil conservation strategies and technologies by extension officers in South Africa, using the case of selected irrigation schemes in the Eastern Cape. By nature here is meant the character, as well as the level or "to what extent" is farmers' participation in soil conservation. This is very crucial because the adoption process, with particular reference to soil conservation practices, is not straight (complex). It is not just an issue of whether a farmer accepts the use of a certain technology or not, but also relates to what level is participation in the technology in question. Alluding to this, Asafu-Adjaye (2008) emphasizes that a farmer's decision to use a particular technology is not necessarily an issue of yes or no, but also may involve two or more variable quantities (multivariate in nature). He pointed further, quoting Lynne, Shonkwiler and Rola (1988) and Dorfman (1996) that this is important because using a binary dependent variable could lead to the loss of useful economic information contained in the interdependent and simultaneous adoption decisions.

In order to achieve this, the following are the specific objectives of the study:

1. **To assess smallholder farmers' perception on soil conservation practices in the study area**. This is very important to achieving the overall objective of the study because perception as an independent variable, according to Dűvel (1991), is one of the three mediating variables immanent to farmers' adoption decision-making or behaviours. Stressing on the importance of perception, Asafu-Adjaye (2008) opines that the perceived extent of actual or potential physical erosion on a farmland, for example, may influence a farmer to choose a certain mitigating measure. Understanding farmers' perception on soil conservation practices in their area will provide an indication of how or why they have related to certain soil innovations introduced to them or will relate to any other one in future.
2. **To identify what smallholder farmers are currently doing to conserve the soils of their area**. Before the advent of improved technologies, humans have always developed local methods to address whatever problems they are faced with. This is why in modern day research (participatory research), farmers are not altogether treated like bunch of nonentities, unlike it was

before, but their traditional knowledge are cherished and improved upon concurrently with the farmers. This method has been proven to be the best way to receive a wide acceptance (or a high level of adoption) of any external interventions in rural areas. So in the study area, measuring what farmers are currently doing to conserve their soils is important because it will help to understand what level of prominence they give to their traditional approaches with respect to the incoming improved practices by extension officers or any other intervention body in the area, which helps to explain why they have related to certain soil innovations the way they may have done.

3. **To determine which factors influence the adoption of appropriate (recommended) soil conservation practices by smallholder farmers in the study area**. The focus of this objective is to measure factors which influence smallholder farmers' adoption decision-making processes with particular reference to the recommended practice introduced by extension officers suited for the soil conservation needs of the study area.
4. **To evaluate the level of smallholder farmers' participation in extension recommended practices for soil conservation in the study area**. As indicated, adoption of innovation is not merely an issue of whether or not a farmer adopts, but may also be multivariate in nature (involve two or more quantities) (Asafu-Adjaye, 2008). Hence in this objective, apart from evaluating whether the farmers adopt or not adopt the recommended soil practices introduced to them, the aim is to measure the extent or intensity of their adoption or participation.
5. **To evaluate what role smallholder farmer's perception on soil conservation practices play in their adoption decision-making processes**. The goal of this objective is to ascertain the type of effect farmers' perception has on their adoption decision-making. This is necessary because, research has it that perception of individuals has a great role of influence in their decisions regarding the adoption of innovations. This is why Asafu-Adjaye (2008), reporting Ervin and Ervin (1982) and Norris and Batie (1984), Asafu-Adjaye (2008) maintains that the relationship between perception and soil conservation adoption is a positive one.

6. **To evaluate the effect of adoption decision-making regarding the use of soil conservation practices introduced by extension officers on the livelihood standards of farmers**. It has been noted that one of the main reasons farmers are willing to try out on a new technology is the potential gain perceived in the new technology. For example, Barungi and Maonga (2011) maintain that farmers are rational consumers of new technologies, and that they will be willing to adopt a new technology if and only if they perceive the technology will boost their productivity. Thus this objective seeks to understand how such benefits by farmers impact on their livelihood standard, according to their perception.

1.4. Research hypotheses

The following are hypothesis of the research:

1. Smallholder farmers' at Qamata Irrigation Scheme have a poor perception of soil conservation practices introduced by extension officers.
2. Smallholder farmers at Qamata Irrigation Scheme have their own traditional methods for soil conservation.
3. Several factors influence the adoption of appropriate (recommended) soil conservation practices by smallholder farmers in the study area.
4. Apart from whether smallholder farmers adopt or do not adopt recommended soil practices by extension, adoption studies also require how much of the practices farmers are adopting in their farms.
5. Smallholder farmer's perception on soil conservation practices introduced by extension play a great role in the adoption decision-making processes of farmers in the study area.
6. There is not significant relationship between smallholder farmers' adoption decision-making processes regarding the use of soil conservation practices promoted by extension officers and the livelihood standards of farmers at the Qamata Irrigation Scheme.

1.5. Thesis statement

According to Hofstee (2009), the central argument of a study is the thesis, and a thesis statement names that argument. Explaining further, Hofstee (2009) said that, once a problem is identified, a stand should be taken about it, or better put, a

solution should be hypothesized for it. With respect to this study, the problem has been identified: despite the availability and inherent benefits of many improved soil management technologies or practices, farmers' adoption is low, as such many soil problems abound. Therefore taking a stand or hypothesizing a solution for this problem, this study states that an adequate understanding and definition of smallholder farmers' adoption decision-making process is very crucial to solving the problem of soil erosion/ degradation. It thus states that for a holistic understanding and analysis of why farmers behave the way they do (the adoption decision making process), the adoption decision-making process should be viewed basically at four stages. These are:

1. Farmers first forming a view on any new innovation for change (the perception stage;
2. The decision whether to accept or not accept the innovation (the adoption stage);
3. How much of the innovation should I use as a farmer (the level and extent stage)?;
4. How much is the innovation impacting on my life as a person (the impact stage)?

Although this view is well represented in literature, the coherent and spelt-out nature identified with this view is the difference. For example, the well known adoption process model of Rogers (1983) regarded the stages of adoption process as; knowledge, persuasion, decision, implementation and confirmation stages. Also, Bembridge (1991) classification of the adoption process, says that the process goes through awareness, interest, evaluation or comparison, trial and then ends with the adoption stage. As indicated in these views, there seems to be no explicit representations of perception and the impact of adoption, not just in terms of the soil, when looking at soil-related technologies, but on the farmer. Although Rogers (1995) spoke of the five perceived characteristics of innovation success, but referred to under the persuasion stage of his adoption process. By this, the undeniable role of perception is implied.

A consideration of other literature seems to concur to, at least, one two aspects of this argument. For instance, Bayard, Jolly and Shannon (2006), referring to several studies on adoption (Ervin & Ervin, 1982; Napier, 1991; Bultena & Hoiberg, 1983),

especially with regards to soil conservation, two groups of researchers were identified. The first group are those who have considered adoption of new technologies based on the use of binary choice models. Examples of such studies are those of Rahm and Huffman (1984), Lee and Stewart (1983), Anim (1999), Traore, Landry and Amara (1998). The other group are those who have evaluate farmers' behaviour, considering the adoption level by the number of practices adopted, and measuring adoption using capital expenditures made for installation. Examples of this group of authors are Ervin and Ervin (1982), Gould, Saupe and Klemme (1989), Featherstone and Goodwin (1993).

Further, Ervin and Ervin (1982) allude to the fact that every adoption of soil conservation begins with perception. Ervin and Ervin (1982) state that once the soil erosion (problem) is perceived, then the landowner decides whether or not to adopt a certain soil innovation. If this is, then also follows the likelihood of, what type? Asafu-Adjaye (2008) also maintains that the perceived extent of actual or potential erosion on a farmland is what motivates the farmer to use a control method. Arguing further, Asafu-Adjaye maintains that once a problem is well perceived, that is when the farmer then adopts a soil conservation practice(s), as the case may be. This was why in his study on factors affecting the adoption of soil conservation measures: a case study of Fijian cane farmers, the adoption decision process was considered at three levels: perception of the erosion; adopting a control measure; and the amount put in adoption stage (Asafu-Adjaye, 2008).

As indicated, the first three stages of the argument of this study are explicitly alluded to, whether directly or indirectly, by the above authors, except the last stage. But by implication, if there is 'any adoption' and 'what type', or 'how much of the adoption' phase, logically there should be the 'how is the adoption fairing (impact)' part also. This is why Mulugeta and Hundie (2012) argue that based on evidence, wheat technologies had a very strong and positive impact on farmers' food consumption. Similarly, with regards to information and communication technologies (ICTs), Martin and Abbott (2011), citing Saunders, Warford & Wellenius 1994), posit that benefits enjoyed by adopters in developing countries include increase in knowledge of market information; improvement in the coordination of transportation, especially during emergencies; and enhancement in the effectiveness of development activities. Also supporting, Godoy, Franks and Claudio (19980), citing De Franco and Godoy (1993),

say that correct adoption decisions do not only profit farmers but produces substantial equitable benefits to the broader society. Further, from a negative angle, Brown and Shrestha (2000) argue that the continuous use of crop intensification without appropriate conservation practices, as represented in conventional farming, accelerates soil erosion and nutrient degradation.

In all, much closer evidence to the stance of this study are views like that of Lewin (1951) field theory and Tolman (1967) model, which was improved upon by Dűvel (1991) model. In these views, analysis of farmers' behaviour is seen first beginning with independent factors, which are relayed through the intervening/mediating factors, where perception largely plays a role, then the adoption stage, and the result of adoption stage. The only issue here is that perception is not given the much attention it requires, considering its role in adoption decision-making process.

1.6. Assumption of the study

One assumption of this study is that smallholder farming sector in South Africa is informal in nature and operation. It is also assumed that every farmer cultivating a piece of land in the selected irrigation schemes of this study makes farm decisions. More so, it is assumed that every farmer in the irrigation scheme is a smallholder farmer.

1.7. Significance of the study

- One of the foremost significances of this study is that it aims at creating a programme to influence farmers' decision-making behaviours in the study area toward accepting appropriate soil management technologies to improve soil qualities in the area.
- A second significance is that an understanding of farmers' adoption decision-making process will assist in advising farmers in the study area on what to do to solve the soil problems of their area.
- Thirdly, the study will provide clear-cut management procedures for extension officers in the study area, not just in terms of management of soil problems only, but other farmers' problems, thus providing effective service in the area.
- It is anticipated that this study will make an original contribution to a broader and more informed understanding of this process.

- According to literatures, only about 13% of land in South Africa is arable. With increased degradation, agricultural lands are negatively impacted. Hence any adoption of suitable degradation control measures immensely increases potential lands for agricultural production.
- Improves rural livelihoods. Over 70% of population of developing nations live in rural areas and depend on agriculture for livelihoods. Hence improved land resources, which are one of the ultimate goals of a project such as this, means increased livelihoods for the rural people/ smallholder farmers.
- It will help to address food security. Improved soil quality implies improved agricultural production, which will also mean increased food supply/ security, especially for the rural people, since most people in developing countries live in rural areas
- Assist in reducing unemployment and poverty alleviation. Adopting recommended practices for soil conservation, which is one of the long-run targets of this project, will surely result in better agricultural production, and more money for farmers, which will in the long run motivate more people into farming, thus reducing unemployment and poverty.

1.8. Scope and delineation for the study

"Limitations in a human environment usually set boundaries to their activities" (Ighodaro, 2012). Based on this, the following are particular focus of this study:

a. This study shall not consider commercial farmers, but smallholder farmers in an irrigation scheme. This is so because relatively smallholder farmers are the ones with the highest level of adoption problems, due to their particulate characteristics such as poverty, inadequate education, inadequate access to credit facilities, et-cetera. Using smallholder farmers in an irrigation scheme is to serve as a bench of understanding how smallholder farmers relate to new technologies for soil conservation. In other words, if smallholder farmers in an irrigation scheme are assumed to be more organized in their farming practices, behave in a certain way, then one should be able to have an idea of what to expect amongst smallholder farmers outside an irrigation scheme, and in general.

b. Due to the problem of complexity associated with the adoption process, the term adoption in this study refers to farmers' participation in extension programmes on soil conservation in their area, or the participation in the use of a certain recommended practice by extension officer**.**

1.9. Definition of terms

Smallholder farmers: A smallholder farmer is referred to in this study as anyone who cultivates crops, rears animals or both, either for personal purpose or with some sales for profit, usually not in very large quantities.

Adoption: Adoption in this study is referred as the participation of farmers in the use of any soil conservation practice, recommended either by extension officers, other bodies, or by farmers themselves.

Adoption behaviour: This is defined as the different manners farmers demonstrate with respect to any new technology introduced to them. Sometimes they may accept or reject the use out rightly, or they may wait for a while, may be to see how it goes with others who have accepted its usage before they adopt. Also others who rejected before may later accept to use the technology, while there are those who accepted before who may later reject the use. All of this is put into consideration when the term is mentioned in this study.

Adoption decision-making process: This is the process associated with farmers' adoption of any new technology introduced to them. It starts with farmers' awareness of the innovation and ends with farmers' eventual usage and continued usage of the innovation (Bembridge, 1991).

Soil conservation: This is the protection or preservation of the quality of the soil against soil erosion and deterioration.

Soil conservation technologies/ practices: These are new and improved soil management practices to protect the soil against soil erosion and deterioration.

1.10. Chapter overview

According to the intended structure of this study, the chapters two, three, four and five deal with the literature review of basic concepts associated with the study. In this regard, while chapter two deals with a description of smallholder farmers, chapter three reviews literature on adoption decision-making and adoption models, and chapter four deals with soil conservation and soil conservation practices. Because

talking about adoption without assessing its contribution to farmers' livelihoods standards, in the view of this study, seems absurd, chapter five reviews literature on impact of farmers' adoption on the livelihood standards of smallholder farmers in. Similarly, chapter six provides a clear understanding of the various methods adopted for the study. Chapters seven and eight are both discussions of results of data analysed from the study. While the former provides insight into the descriptive results, the latter discusses the various empirical results of the study. The study ends with chapter nine, which provides a summary, conclusion and policy recommendations for the study.

1.11. Conclusion

As indicated, one main problem effort for agricultural improvement in South Africa must overcome, especially as it relates to smallholder agriculture, is soil erosion and/or degradation. Soil degradation happens to be one of the main agricultural problems in South Africa. Improved soil management technologies have been developed over the years to protect the soil from damage and improve its quality, with a view to improving production tendencies. Therefore farmers must as a matter of urgency adopt such technologies for adequate soil protection and improvement. Due to the particular character and nature of smallholder farmers, several factors influence their adoption decision-making around soil conservation practices. As a result, despite the inherent potentials of improved soil management technologies, adoption amongst smallholders and in many developing areas has been slow. This therefore is the main reason for this study. As such, in the next chapter that follows, effort is geared towards evaluating literature on smallholder farmers and some basic elements which define their existence.

CHAPTER TWO

Defining smallholder farmers

2.0. Introduction

As one of the fundamental concepts of this study, this chapter endeavours to provide an understanding on smallholder farmers, as well as some elements surrounding their operations. The chapter begins by reviewing literature on the term 'agriculture in smallholdings. It provides various definitions for the term and why the continued reoccurrence of the term in literature. It also sheds light on basic characteristics and challenges faced by smallholder farmers, and finally rounding up with a revelation of the place of smallholder farmers in South Africa.

2.1 Agriculture in smallholdings

According to the popular saying 'the journey of a thousand miles begins with a step'. In other words, it is practically impossible to achieve one thousand miles without taking, and adding all the one steps together. The same is true for every other human endeavour including agriculture especially in resource-poor environments. Due largely to inadequate capital and other factors, things are started small, before after some periods of development, they grow to big holdings and complexes.

2.1.1 Why the term 'smallholder farmers'?

A lot of people have queried the continuous reappearance of the term 'smallholder' especially in agricultural research. From all indications, the use of smallholder agriculture will continue in several decades to come due to its particular relevance in developing countries, particularly talking of the African situation. There are several reasons for this. Some of them are related to the somewhat general poverty situation of Africa as a continent, unemployment, food insecurity, and the level of population in rural areas who largely depend on agriculture for survival. For example, in sub-Saharan Africa close to 70% of people are said to reside in the rural areas, depending on agriculture for livelihoods (Loulseged & McCartney, 2000). In fact, Diao *et al*., (2007) maintain that for Africa to experience broad-based economic growth and poverty reduction, agriculture and its food subsector is said to be a major key. Supporting also, FAO (2006), as reported by Toenniessen, Adesina and De Vries (2008), maintains that almost two-third of the population in sub-Saharan Africa

live in rural areas and agriculture is their main source of livelihoods. In areas like Ethiopia, according to Dűvel, Chiche and Steyn (2003), the percentage of those who live and depend on agriculture for livelihoods in rural areas is close to 85%.

As indicated, the population of people in rural environment in Africa is close to 70%. In a rural environment especially in developing areas, there are factors which limit people to certain kinds of lives. One of them is that the rural area is closest to nature. For example, the vegetation, soil, weather conditions are still relatively very primary and un-tampered with by human activities. Other factors are the illiteracy or low level of education of majority of the population; poverty; unemployment; food insecurity; inadequate infrastructures; inadequate capital; inadequate technology and skills, needed to compete with the level required in the urban labour market. As such, the easiest job in a rural environment is farming on a small scale at least for subsistence.

Smallholder farming as it relates particularly to Africa should not be thought strange, especially due to the poverty situation of the continent, compared to other continents of the world. Livingston, Schonberger and Delaney (2011) opine that compared to other continents, Africa is poorer, and while others have been able to reduce the absolute number of poor, the number of poor in Africa has steadily increased. In the light of this, Poverties (2013), posits that decade after decade, politicians and international organizations have not been able to reduce poverty in Africa. It states further that between 1975 and 2000, which was her worst period, Africa was the only place on earth where poverty intensified. Quoting the British Prime Minister's statement in 2001, "African poverty is a scar on the conscience of the world" (Poverties, 2013).

Another basic reason why smallholding agriculture seems to be very relevant for the development and advancement of Africa as a continent is because Africa consists largely of rural people who mostly rely on agriculture for livelihood. As such, their main type of agriculture is largely smallholding. Commenting, Garrity, Dixon and Boffa (2012) emphasize that most poor in Africa live in the rural areas, and most of them depend on agriculture for livelihoods. They therefore say that based on current and widely-shared view, improving smallholder agriculture is fundamental to overcoming the difficult problem of African poverty. Drawing lessons from history, transformation of world economies has never been made possible without

agriculture, and smallholding agriculture for that matter, whether we speak of England in Europe, United States in North America, Japan and other Asian countries in Asia. Buttressing this, Byerlee, Janvry and Sadoulet (2009), citing Diao *et al*. (2005), a rich literature, consisting of theoretical and empirical, has articulated the role of agriculture as the precursor of accelerated industrial growth from England's story in the mid-18th century to Japan in the late-19th century, and then much of Asia in the late 20th century.

In the case of Africa, some persons have questioned the potency of agriculture to stimulate development of Africa as it did to some other developed countries of the world today. Byerlee, Janvry and Sadoulet (2009) emphatically say that despite the rapidly changing context of today and Africa's potential to import food, agriculture remains an effective engine for growth and development. DAFF (2012) maintains that even though the potentials are often not recognized, smallholder farmers are the engine of many economies in Africa. With the U.S. as a case study, unlike the case of today where agriculture is largely commercial, it however started small. For example, Dimitri, Effland and Conklin (2005) state that agriculture in U.S. in the early 20th century was labour-intensive (employing close to half of the U.S. workforce), took place on a number of small, diversified farms in rural areas, where more than half of the U.S. population lived. Who today would reconcile the current developed state of U.S. with this?

In South Africa, which is regarded as the most developed in the African continent, it is said by Mudhara (2010) that a large component of its population reside in the rural areas, who in one way or the other are involved in some agriculture-related practice. As indicated by Kumo, Rielander and Omilola (2014), 65% of her young people are unemployed. It was actually said that unemployment is South Africa's greatest social problem. Aliber and Mdoda (2015) maintain that around 80% of black farming households are in the former homeland areas of South Africa. In the former homeland areas of South Africa, majority of the people live in rural areas in abject poverty and unemployment. More so, they are largely dependent on agriculture or agriculture-related activity as a means of livelihoods. As such, agriculture in smallholding can easily be encouraged to fill up this gap.

2.1.2 The term "smallholder"

Defining the term 'smallholder' is problematic and could be an on-going debate. This is alluded to by various literature sources. According to the Ethical Trading Initiative (ETI, 2005), some have tried to define the term based on size of farms. Further, ETI (2005) says the fair trade movement tries to use dependence on family labour as opposed to non-family labour as basis of definition. However, although the term 'smallholder' represents farming at various levels of small-holdings, it is more often used in the literature to avoid the problem of clarification of its several categories. For example, while Baiphethi and Jacobs (2009), as well as Menong, Mabe and Oladele (2013) used the terms 'smallholders' and 'subsistence' interchangeably in their studies, which seem to indicate that both refer to same meaning, Hosu and Mushunje (2013), as well as Sepiso, Daniel and Nicola (2012) in their studies rather preferred the term 'small farms' for 'smallholders', also referring to the same meaning. More so, although the discussion paper was more focussed on agribusiness, FAO (2012) interchangeably in its discussion used the concepts 'smallholder' and 'small-scale', to mean one and the same thing.

Small farms, also known as family farms, have been defined in a variety of ways. The most common measure is farm size: many sources define small farms as those with less than 2 hectares of crop land. Others describe small farms as those depending on household members for most of the labour or those with a subsistence orientation, where the primary aim of the farm is to produce the bulk of the household's consumption of staple foods (Hazell *et al*., 2007). Yet others define small farms as those with limited resources including land, capital, skills and labour. The World Bank's Rural Development Strategy defines smallholders as those with a low asset base, operating less than 2 hectares of cropland (World Bank, 2003). An FAO study defines smallholders as farmers with limited resource endowments, relative to other farmers in the sector (Dixon *et al*., 2003). In this study, small farms have been defined as those with less than 2 hectares of land area and those depending on household members for most of the labour.

In the report of the Department of Agriculture, Forestry and Fisheries (DAFF, 2012), smallholder farmers are defined in different ways depending on the context, country and even the ecological zone in question. It however brought in some other synonyms used for smallholders. It says that the term 'smallholder' is used

interchangeably with such terms as ‘small-scale’, ’resource poor’ and sometimes ’peasant farmer’. In general therefore, smallholder only refers to a farmer’s limited resource endowment relative to other farmers in the sector (DAFF, 2012). Furthermore, smallholder farmers could as well be defined as farmers owning small-based plots of land on which they cultivate subsistence crops and one or two cash crops, relying almost totally on labour provided by family members (DAFF, 2012).

Aliber and Mdoda (2015) however differentiated between subsistence farmers and smallholder farmers but eventually categorized both as small scale farmers. In their definitions, subsistence farmers are those who farm to derive an extra or main source of food, while smallholder farmers are those who farm for the sake of deriving a main or extra source of income. But the confusion as in knowing which term applies at what time will still remain, largely because of the informal nature of small producers. Sometimes a farmer who is known to, or perhaps planned to consume his/her harvest may end up selling some to neighbours or friends, as the case may be, and vice versa. Even though the term ‘small scale’ farmers seem to be more appropriate, however, the term smallholder farmers seem to prevail in literature, perhaps due to the aforesaid confusion in use of terminologies and to avoid the often needed clarification. The suggestion therefore is that users may at each time of use have to provide an operational definition alongside every use.

According to Cousins (2011), the term ‘smallholder’ is problematic because its usage obscures several other elements associated with agricultural production on a relatively small scale. Examples are inequalities and significant class-based differences which exist within the large population of households engaged in small-scale agricultural production. Further, the term does not facilitate analysis of the dynamics of differentiation within small farmers’ population (referring to the causal processes through which inequalities surface), and thus draws attention away from, often gender-based, internal tensions within households over the use of land, labour and capital (Cousins, 2011).

According to this foregoing, even though smallholder seems to prevail in literature, there are however levels of intrinsic diversities within the term that need clarification and understanding. The definitions of Cousins (2011), Salami, Kamara and Brixiova (2010), van Averbeke and Mohamed (2006) and Torero (2011) shall be considered in the following sections.

2.1.2.1 The definition according to Cousins (2011)

In Cousins' discussion, the following summary analysis on smallholder farmers based on literature findings is given:

1. Even though other possible criteria such as the use of different types of labour (whether it is household or family labour, hired workers or cooperative labour) or source of capital for farming, are sometimes mentioned but rarely discussed, two criteria predominates in the discussion of the term smallholder. These are the size of land holding and extent of production for the market. Thus the term "smallholder" usually describes and is used in an inconsistent way, referring among other things to producers who occasionally sell products for cash as a supplement to other income sources; also to those who regularly market as surplus after their consumption requirements have been taken care of; and as well to those who are small-scale commercial farmers, with a main focus on production for the market.
2. Also it was said that even though surveys reveal that the demand for land in rural areas of South Africa is mainly for the most part for supplementary food production, evidences from literature suggest that the term smallholders should refer to farmers (even though it is a sizeable minority) who desire extra land for farming as a source of cash income (but on small farms, mostly less than five hectares).
3. More so, it was said that smallholders are often considered as comprising the 'rural poor', plus subsistence producers and landless households. From this, emphasis often centres on commonalities rather than differences in, for example, assets, income, investment and class identity.
4. It was also said that other issues not discussed at all are the dynamics of change and the underlying processes which might explain reasons some producers are more 'commercially-centred' or 'commercially-ready' than others.
5. Moreover, the need for policy frameworks which cater for a range of land challenges and scales of production is widely acknowledged, but rarely discussed are possible compromise in the location of beneficiaries and the allocation of scarce resources of the state.

6. Another problem revealed in literature is the lack of reliable large-scale survey data on small-scale agriculture in South Africa. This is a further contribution to the earlier difficulties in defining categories such as “subsistence farmers” or “semi-commercial smallholders” more precisely.

In all, Cousins (2011) proposed the following classification for farmers at various levels of smallholdings in South Africa based on what he calls class-analytic typology.

1. Supplementary food producers. These are farmers who work small plots or gardens; they do not have access to wage income; and they rely on additional forms of income such as social grant, craftwork or petty trading for their simple reproduction.
2. Allotment holding wage workers. These work on small plots or gardens but are mainly dependent on wages for their simple reproduction.
3. Work peasants. These farm on a substantial scale but are also engaged in wage labour, and combine these in their simple reproduction activities.
4. Petty commodity producers. These are able to reproduce themselves from farming alone, or with only minor additional forms of income.
5. Small-scale capitalist farmers. These rely substantially on hired labour and can begin to engage in expanded reproduction and capital accumulation.
6. Capitalists. Of these, their main income is not from farming, they farm on a small-scale but their main source of income is another business.

2.1.2.2. The definition of Salami, Kamara and Brixiova (2010)

Commenting, Salami, Kamara and Brixiova (2010) opine that African smallholder farmers are categorized in three ways:

1. On the basis of the ecological zones they operate;
2. On the basis of the type and composition of their farm portfolio and landholding; and
3. On the basis of annual revenue they generate from their farms.

According to Salami *et al*. (2010), citing Dixon *et al*. (2003), in places of high population densities, smallholder farmers cultivate less than one hectare, but increases up to 10 ha or more in low density semi-arid areas, and sometimes combining with up to 10 livestock. Smallholder farmers that are defined on the basis

of farm revenue range from those who produce crops only for home consumption to those in developed countries earning as high as USD 50,000 annually (Salami *et al.* 2010, citing Dixon *et al*. 2003).

2.1.2.3. The definition according to van Averbeke and Mohamed (2006)

According to van Averbeke and Mohamed (2006), citing the Department of Agriculture (2001), smallholders are classified into three main categories: subsistence farmers, emerging farmers, and commercial farmers.

1. **Subsistence farmers**: These are groups of farmers who grow crops and rear livestock (notwithstanding the number) for home consumption, with little or nothing to sell for cash. In other words, the main aim of production is home consumption. It is only when there is extra after consumption, which most times are never there, that there can be sales. This group of farmers make up the large majority of smallholders.
2. **Emerging (smallholder) farmers:** The emerging farmers group is a transition stage between the subsistence and the commercial farmers. As the term indicates, they are farmers who are transiting from being farmers who mainly produce for home consumption (subsistence) to farmers who produce for large sale. Citing Niewoudt (2000), van Averbeke and Mohamed (2006) argue that this group of farmers are those with a desire to increasingly commercialize their production.
3. **The commercial (smallholder) farmers**: These consist of a small minority of smallholders. They are those whose main reason for farming is for income.

2.1.2.4. The definition according to Torero (2011)

According to Torero (2011), smallholders are classified based on the markets where they compete. They were thus categorized into:

1. **Rural world 1**: smallholder farmers in this category are those who produce for international markets;
2. **Rural world 2:** These are smallholder farmers whose produce are for domestic or national markets; while
3. **Rural world 3:** These are smallholder farmers who produce mainly for self consumption.

The view of Torero (2011) looks somewhat like that of van Averbeke and Mohamed (2006), as rural world 1 could be regarded as large scale commercial farmers, rural world 2 also as emerging smallholder farmers, and rural world 3 as subsistence farmers. In fact, Torero (2011) called rural world 1 globally competitive and market oriented farmers, rural world 2 local market oriented farmers, and rural world 3 subsistence farmers.

2.1.3. Characteristics of smallholder farmers

As noted, although it is problematic trying to define smallholder using some of its characters, there is however some characteristics that could be used to identify smallholders, as indicated by the Ethical Trading Initiative (2005). Smallholders:

1. Smallholders produce small volumes, and on a relatively small piece of land.
2. They may produce an export commodity as a main livelihood activity or as part of a range of livelihood activities.
3. They are generally less well-resourced than large scale commercial farmers.
4. They are usually considered as part of the informal economy.
5. They may actually be men or women.
6. They may also depend on family labour, but may as well hire significant number of workers.
7. They are often vulnerable in supply chains.

2.1.4. Challenges faced by smallholder farmers

No matter the prospect of smallholder farming for the African continent, the sector is faced with several challenges limiting its progress. This is because, for smallholder farming to actually achieve its potential and drive the economy of Africa as it did to other continents of the world, the following challenges must be overcome, using the experience of southern Africa (Southern African Trust, 2013).

2.1.4.1. The problem of land ownership

In southern Africa for example, most smallholder farmers do not have individual right to land, land is mostly owned communally. The implication of this is that farmer's access to formal credit is limited, as land cannot be used as collateral and farmers' motivation to invest money and energy to improve the land is reduced.

2.1.4.2. Problem of access to improved agricultural inputs.

Access to improved agricultural inputs is very crucial for the success of the smallholder farmer. But the problem these days is that big corporations have commercialized and commoditized agricultural inputs, thus removing them out of reach of smallholders. For example, seed production, that was a community venture in the past, is now predominantly run by multi-national companies like Monsanto, Pioneer, Seed Co and Cargill.

2.1.4.3. Problem of access to credit

One other indisputable necessity for the success of smallholder agriculture is adequate access to credit. In southern Africa, it is said that farmers are unable to access credit like commercial farmers, which has led to their poor performance in the production of food and vulnerability in the supply chain. Unlike in Asia where agricultural financial services are adequate, in southern Africa, the case is different.

2.1.4.4. Problem of access to functioning markets

Poor infrastructures in rural areas make it difficult to transport produce from rural to urban areas. Also knowledge of potential markets and market expectations is restricted. It was stated that in most African countries, less than one-third of the domestic food eventually enters commercial market channels beyond the local area because of the distances it takes from villages to urban centres, as well as the lack of an all-weather road infrastructure. As a result, agricultural surpluses are difficult to move from areas of surplus to areas of deficit. Other market problems are the lack of economies of scale and an inability of smallholder farmers to negotiate the best prices for their produce.

2.1.4.5. Problem of lack of irrigation

The heavy reliance on rainfall by farmers in southern African region exposes them to droughts and floods which are common in the region. Lack of irrigation also makes farmers vulnerable to the negative effect of climate change. Instead of using the appropriate coping strategies to climate change, some farmers are using negative coping strategies like cutting down on the number and quality of meals they eat, as well as withdrawing their children from schools.

2.1.4.6. Problem of moving from extensification towards intensification.

One of the major challenges smallholder farmers in Africa will have to deal with is the problem of moving from extensiveness to intensive production. Due to poor technology, major ways of increasing production in Africa has been perhaps by increasing land, labour, et-cetera. Due to the problem of population increase, this process has become impossible. According to Livingston, Schonberger and Delaney (2011), smallholder farmers will need to increase their own productivity through greater capital and technology investments in order to increase production with less additional production inputs. Livingston *et al*. (2011) further say that smallholder farmers' production will depend on increased on-farm investments, such as the right seeds and fertilizers, irrigation and mechanization technologies, and reductions in postharvest losses (PHL). Livingston *et al*. further suggest that unlike the current trend of youth shying away from agriculture, youth becoming attracted to agriculture for livelihood in Africa may not happen without increased intensification, which improves returns per unit of labour and land and builds on their educational advantages.

2.1.4.7. The problem of population explosion: affecting food security, poverty and land

According to Garrity, Dixon and Boffa (2012), unlike before, in the past 50 years, Africa's population growth rates have accelerated tremendously, becoming the highest in the world, and the aggregate effects impinge upon all aspects of development, including food and land.

2.1.4.8. Land degradation problems.

The challenge of land is another major challenge smallholder farmers is dealing with to increase production. This challenge is exacerbated by a plethora of other problems like poverty, illiteracy, inadequate technology, and a lack of capital. Considering the need to increase agricultural yields in the future, the current trends of land degradation in Africa is worrisome (Garrity *et al.* 2012). Estimates are that approximately 65% of agricultural land in sub-Saharan Africa is subject to degradation (GEF, 2003, in Garrity *et al*., 2012).

2.1.4.9. Soil fertility replenishment

Allowing an exhausted cropland to fallow for several years had been the way African farmers have restored lost fertility of soils (Garrity *et al*., 2012, citing Allan, 1965). But

due to changes in society, majority of farmers are now forced to crop their fields continuously (Garrity *et al.,* 2012).

2.1.4.10. Problem of science and technology

There is low level of science and technology currently in Africa, hence the low production levels. In terms of science and technology issues in Africa, Garrity *et al*. (2012) has the following to say: practically with exception, production yield gaps in Africa are large and persistent; public research findings have declined in many countries; tsetse infestation is a major factor affecting the distribution of livestock among farming systems; understanding delivery chains for vaccines to rural communities for livestock and poultry, e.g. Newcastle Disease; little research is being conducted on socioeconomic issues.

2.1.5. Smallholder farming in South Africa

Smallholding farming has always been a practice worldwide, even before the age of industrial revolution. According to Delgado (1999), one major tool for creating employment, especially in the rural areas of sub-Saharan Africa and for human welfare and political stability is smallholder agriculture. Speaking on this, Lele and Agarwal (1989), cited by Abdu-Raheem and Worth (2011), maintain that smallholder agriculture assist in reducing rural poverty and insecurity of food supply. This is why Delgado (1999) argues that no matter how difficult smallholder agriculture may seem, African countries cannot afford to ignore its role in their economy. For example, Bryceson (1996) states that, regionally, with the exception of South Africa which is to a large extent industrial, at the beginning of the 1990's, about 85% of the population of Africa was said to be rural, and more than a quarter of the labour force was actively engaged in smallholder agricultural production. Even in South Africa, it is argued that in the former homeland areas, where this study consist, though it is dominated by commercial agricultural sector (Bembridge, 1990, cited by Wiskerke & van der Ploeg, 2004), smallholder farming is said to continue to play a part in the livelihoods strategies of large numbers of households, also involving large numbers of farmers (Cooper, 1988, cited by Wiskerke & van der Ploeg, 2004).

In South Africa, it is estimated that there are about four million people who practice smallholder agriculture for various reasons; majority is said to reside in the former homeland areas (Baiphethi & Jacobs, 2009). This estimate is about 8% of the total

population of South Africa, using mid-year 2013 figures (StatSA, 2013). However, the view of Hosu and Mushunje (2013), reporting the National Department of Agriculture (2002), seems somewhat different. According to them, although South African agriculture is regarded as sophisticated, with some levels of success, and being driven by large scale/medium farms, there are however a large percentage of its population involved in smallholding and subsistence farming for their livelihood and food security.

Generally speaking, Mhlaba and Brey (2014) emphasize the enormous potentials of the smallholder sub-sector in driving the economy of South Africa. It was said that the sector has the potential to assist in ameliorating South Africa's employment and food security challenges. The reason given for this is that smallholder producers tend to use labour-intensive rather than capital-intensive methods of production. As such, with adequate support, smallholder agriculture is likely to absorb more workers and intensively utilize land (Mhlaba & Brey, 2014).

2.2. Conclusion

According to this chapter, there is no single definition for the term 'smallholder' in the literature. However, the term represents farming at various levels of smallholdings, and it is often used in the literature to avoid the problem of clarification of its several categories. Agriculture in smallholding is indeed the aggregates that culminate into large scale commercial production. Africa as a continent faces a lot of challenges that limit its development. If smallholder agriculture is adequately encouraged, the expected industrialization and development that is typical for the known industrial world of today will soon be a dream comes true for Africa. Therefore, land being a major resource for this industrial drive, on which smallholder farmers engage in their daily business, must be readily made available to farmers and managed adequately to ensure the benefit of this generation and the generations yet unborn. As such, in the chapter that follows a review of smallholder farmers 'adoption decision-making, especially with regards to soil conservation is provided.

CHAPTER THREE

Adoption decision-making and adoption models

3.0. Introduction

Decision-making processes of individuals or group emanate from their behaviours. It therefore means that an understanding of people's behavioural tendencies is an indirect understanding of their decision-making processes. In this chapter, effort is given towards providing a clear understanding of adoption decision-making and adoption processes, some models used in explaining adoption in literature, as well as the role of human needs, perceptions and knowledge in the adoption decision-making processes of individuals.

3.1. Adoption and the adoption process

According to Bembridge (1991), adoption as a concept could be defined as the act of accepting a new idea, innovation or technology. In an earlier definition by Rogers (1983), adoption is a decision to make full usage of an innovation as the best available action. As indicated, the definition of Rogers (1983) seems to be more encompassing, in that it incorporates the element of "full use" in the definition of adoption, unlike that of Bembridge (1991). In this sense, someone who merely accepts an innovation, or uses it partly is not considered as having adopted. Further, the element of "full use" also implies the user has tried and tested the innovation, and has finally settled for a continued use of the same, at least for a considerable length of time.

From this perspective, although the problem of what time-gap should be allocated to someone who is said to be a full user of innovation still abounds, this study suggests the following as clarification for the same. A person can be said to be a full user of an innovation when he/she accepts and continues with the use of a particular new innovation, until the user discovers a generally accepted or known problem with the innovation, or if a newer and better technology comes up. This therefore means the time-gap can spread over years, and it could as well be within few hours or days. For instance, if after accepting an innovation and research discovers another better one which is presented to farmers, this adopter in question cannot be said to have faulted with the first innovation, it is just that another better one has just emerged. This is

why the adoption process, according to Bembridge (1991) could span within very short time, and also can be over a very long time.

The knowledge of the adoption process, according to Ighodaro (2012) is a fundamental knowledge-gap every extension practitioner must fill if there can be optimum extension success in their services in the rural areas. This is because, no matter the potential benefits inherent in any new technology, literature reveals that adoption has not always been an easy process as may have been predicted (Ighodaro, 2012). In fact, the findings of Toborn (2011), quoting Rogers (1995) sum it up that "many technologists believe that advantageous innovations will sell themselves, that the obvious benefits of a new idea will be widely realized by potential adopters, and that the innovation will therefore diffuse rapidly. Experience has proven that, seldom is this the case. Most innovations, in fact, diffuse at a disappointingly slow rate". This somewhat sheds some lights on the complexities associated with farmers' decision-making or the innovation adoption decision-making process. For an example, Sumberg (2002), as cited by Shelton, Franzel and Peters (2005), suggest that the potential of fodder legumes have not been realized in sub-Saharan Africa despite the 70 years of R & D promoting legumes. Similarly, Feder and Salde (1984), reported by Isabirye, Isabirye and Akol (2010) maintain that the decision to adopt any technology is a process, wherein a farmer puts into consideration several factors that benefits himself/herself against the backdrop of loses and risks connected to the adoption of such innovation.

In this regard, the rational choice theory seems to be much enlightening. According to the theory essentially, every action is 'rational' in nature (Scott, 2000). It says further that people usually calculate the likely costs and benefits of any intended action before deciding whether to take it or not (Scott, 2000). Also, Barungi and Maonga (2011) maintain that all human behaviours, whether that of farmers or non-farmers, are propelled by a possibility of making gains, and that farmers are rational consumers of new technologies; as such, they will adopt a new idea if and only if they perceive it will boost their productivity.

Based on this, the adoption process is said to be a mental process through which a person passes through from the very first time he/she hears about a new innovation to its final adoption (Ighodaro, 2012). As a matter of fact, Bembridge (1991) maintains that new agricultural practice must pass through several mental stages

before their final adoption by farmers. Furthermore, individuals pass through several learning and experimenting stages from the first time they get information about a certain problem and its potential solutions, until the time when they eventually decide to adopt or reject the proposed technology (Bembridge, 1991).

In the classification of Bembridge (1991), the adoption process is in five basic stages. The first is awareness. This is when individuals get knowledge of the existence of the new innovation but have little or no information about it. The second is interest. In this, the individual become interested in the particular idea, as such, seeks more information about it. The third is evaluation/comparison: the individual weighs the advantages against the disadvantages of using the idea. The fourth is trial. In this regard, the individual tries the idea, but on a limited scale or level, to see how it works in practice and to establish whether it works and its profitability on the farm. The final stage is adoption. In this stage, if the individual is satisfied after trial, the idea is then used on a full scale and incorporated into the farming system of the farmer for continued use.

The opinion of Rogers and Shoemaker (1971) is a bit different. In their view, the adoption process is a four-stage process, which looks exactly like that of Bembridge (1991), except for the omission of trial stage: awareness, interest, evaluation, and adoption. This was however improved upon by Rogers in 1995 to a five-stage process, looking more like the view of Bembridge (1991): knowledge, persuasion, decision, implementation and confirmation (Orr, 2003). Table 3.1 is a representation of these different comparisons. Commenting on the adoption process, Tiwari *et al*. (2008) posit that at each stage of adoption, there are various challenging and prevailing factors, such as social, economic, physical, or logistical, for different groups of farmers. According to this view, these factors are they which confront the farmer at each stage of adoption decision-making, and determine whether they will proceed to the next stage or to the final stage of eventual adoption or rejection, or if adopted, to continue adoption, or to discontinue afterwards.

Table 3.1: The adoption process according to Rogers and Shoemaker (1971), Bembridge (1991) and Rogers (1995)

Rogers and Shoemaker (1971)	Bembridge (1991)	Rogers (1995)
Awareness	Awareness	Knowledge
Interest	Interest	Persuasion
Evaluation	Evaluation/comparison	Decision
Adoption	Trial	Implementation
	Adoption	Confirmation

3.2. Models of adoption decision-making

Models are symbolic representation of realities. They are simple representations of nature. Models are created to assist human understanding of realities in nature which sometimes is complex. Several authors especially in the behavioural studies, where detailed studies of human behaviours emanated, have modelled human behaviours in such a way to allow proper understanding. As such, this section tries to do a review of some of these models. Although the list of adoption decision-making models in the literature is in-exhaustive, however for the purpose of this study, few are reviewed. Examples are Maslow hierarchy of needs (1970), Lewin (1951) field theory, Tolman (1967) model, the cognitive dissonance theory by Festinger (1957), Roger's innovation diffusion theory (1983), and the Dűvel (1991) model.

3.2.1. Abraham Maslow hierarchy of needs (Maslow 1970)

One of the most insightful theories explaining human behaviour as it relates to decision-making of historic times is that by Abraham Maslow in 1970. As such, in this section a detailed review provided by Boeree (2006), is used as basis of discussion.

According to Maslow (1970), as Boetee (2006) emphasize, human behaviours, essentially are motivated by a desire to satisfy personal needs. In his theory, Maslow classified all human needs into hierarchies of five levels, with the most alluring needs first before others as represented in the pyramid below.

According to the Figure 3.1, Maslow's theory is subdivided into two: deficit needs and being needs. Usually deficit needs or D-needs are the basic needs of humans that must be met first, with the most basic ones coming first. Being needs or B-needs are the needs associated with growth motivation.

Maslow's hierarchy of needs suggests that unmet needs provides explanation for difficult behavioural patterns. In the course of his research, Maslow observed that some needs took precedence over others. For instance, if hungry and thirsty at the same time, most people seek to satisfy thirst first before hunger, which shows that thirst is most basic or stronger than hunger even though they both occupy same level in Maslow's hierarchy. In a nutshell, Maslow's theory indicates that humans are

motivated by unsatisfied needs, where lower needs take precedence over higher ones and must be satisfied first.

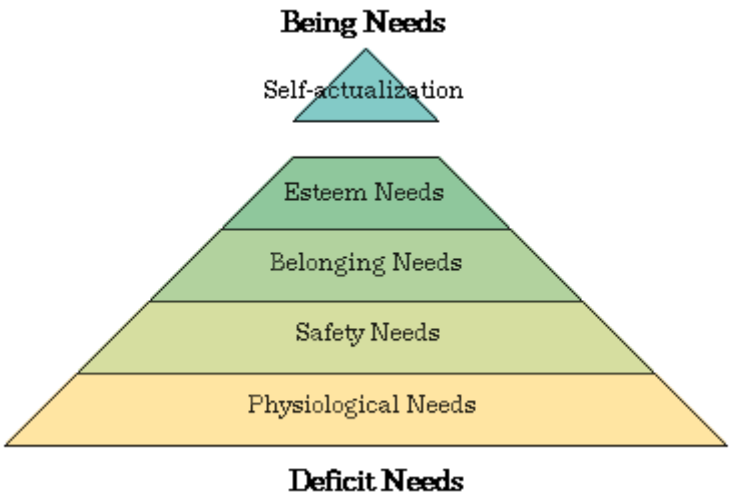

Figure 3.1: Abraham Maslow's hierarchy of needs

1). Physiological needs: these are the very basic needs such as oxygen, water, food, sleep, sex. When they are unsatisfied we may feel uncomfortable. These feelings are what motivate us to find a way to alleviate them as soon as possible, in order to reestablish equiliburium. Once they are alleviated, then we can focus on other pressing needs.

2). Safety needs: these are needs associated with our safety, security of job, family, health and property. They usually start poping up once the physiological needs are largely satisfied. When safety needs are not met, we cannot proceed to the next level of needs. For example, if one partner is abusive to the other in a relationship, the abused partner will not be able to move to his/her next level of needs, because of constant concern for safety.

3). Belonging- love needs: usually when the first two needs are largely met, we will begin to feel the need to belong, or need for friends, family, etc.

4). Esteem needs: these are needs associated with self-esteem. Maslow considers it from two perspectives: lower and higher esteem needs. The lower forms are respect from others, for status, fame, glory, recognition, attention, reputation, appreciation, dignity, even dominance. Higher forms involve the need for self-

respect, including such feelings as confidence, competence, achievement, mastery. Low self-esteem and an inferiority complex are negative versions of esteem needs.

5). Self-actualization needs: other names Maslow called this need are growth motivation, being needs or B-needs, in contrast to D-needs. This is the desire to become more and more of everything that one is capable of being. They involve the continuous desire to fulfil one's potential. Once this needs are engaged, they continue to be felt. They actually become stronger as we seek to satisfy them, unlike the deficit needs, which when satisfied ceases to motivate us.

3.2.2. Lewin (1951) field theory of behaviour

Lewin happens to be one of the early authors who commented on individual behaviours as it relates to their decision-making. One of his leading works was the one of 1951. Lewin (1951), as reported by Shaw and Constanzo (1970), says that human (farmers') behaviour is a product of individual life space or psychological environment. This environment was defined as the totality of all psychological factors influencing the individual at any particular time. Under this consideration, farmers' perspective or perception plays a great role.

According to Dűvel (1991), in order to provide an appropriate theoretical concept for the study of human behaviour, Hruschka (1969) decided to review the various theories and theoretical concepts offered by the disciplines of psychology and sociology. In all, it was identified that the field theory of Lewin (1951) is the most useful for the advisor or extension practitioner. As such, in the section that follows, based on Dűvel (1991) suggestion, a review of Lewin (1951) theory is made and the most relevant features and principles are represented.

a. The basic drive or motivation of any living organism is to maintain equilibrium.

b. A need tension is experienced whenever the equilibrium state of an individual is disturbed. As such, there is a felt need to reduce the tension. The individual therefore engages all avenues to reduce tension and to reestablish a new equilibrium under the given conditions.

c. The process of reestablishing equilibrium is what leads to movement (behaviour), which can be physical or psychological. This continues until equilibrium is reestablished.

d. According to this theory, anyting that is perceived by a person as a goal, or as a path or barrier to a goal, is understood as a force acting on the behaviour of that person. This force can actually be positive or negative.

e. Behaviour (B) is regarded as a function of the person (P) in the perceived environment (E)

$$B = f\{P, E\}$$

f. Factors of both the environment and that of the personality becomes behavioural determinants.

g. These two co-existing forces depend on each other dynamically, constituting the so-called force field which is subjective, time-specific, and which determines individual behaviours.

h. Change or the lack of change, is, in principle explained by the constellation of interacting forces.

Some consequences or advantages of the field theory of behaviour are:

1) It provides a concept in terms of which the complexity of any real-life situation can be analysed.

2) The theory is not only meant for change behaviour, but also non-change.

3) The application of the theory goes beyond an individual level.

4) The theory is easy to understand, except perhaps with the mathematical descriptions and quantifications.

5) The field theory of behaviour makes provision for all influences, and not confined only to any of the existing disciplines like sociology, psychology, economics, anthropology, etc.

However, one of the main challenges of this model is that, though it did much in terms of trying to simplify behavioural determinants into positive and negative forces, if all the variables in a total situation or life space of an individual, according to Lewin were to be considered, it will still look like the considerations before by scientists, which indeed is just inumerable.

3.2.3. Tolman (1967) model

In an attempt to lend a hand in the explanation of human behavioural processes and its determinants, in 1967, Tolman extended the theory of behaviourists by selecting the best of behaviourism and then combining it with some aspects of cognition and intention. The resulting theory was, to a large extent a mixture of behaviourism and Gestalt theory. Nevertheless, its contributions to the understanding of human behaviour are valuable. According to Dűvel (1991), the fundamental elements of the theory are stated below.

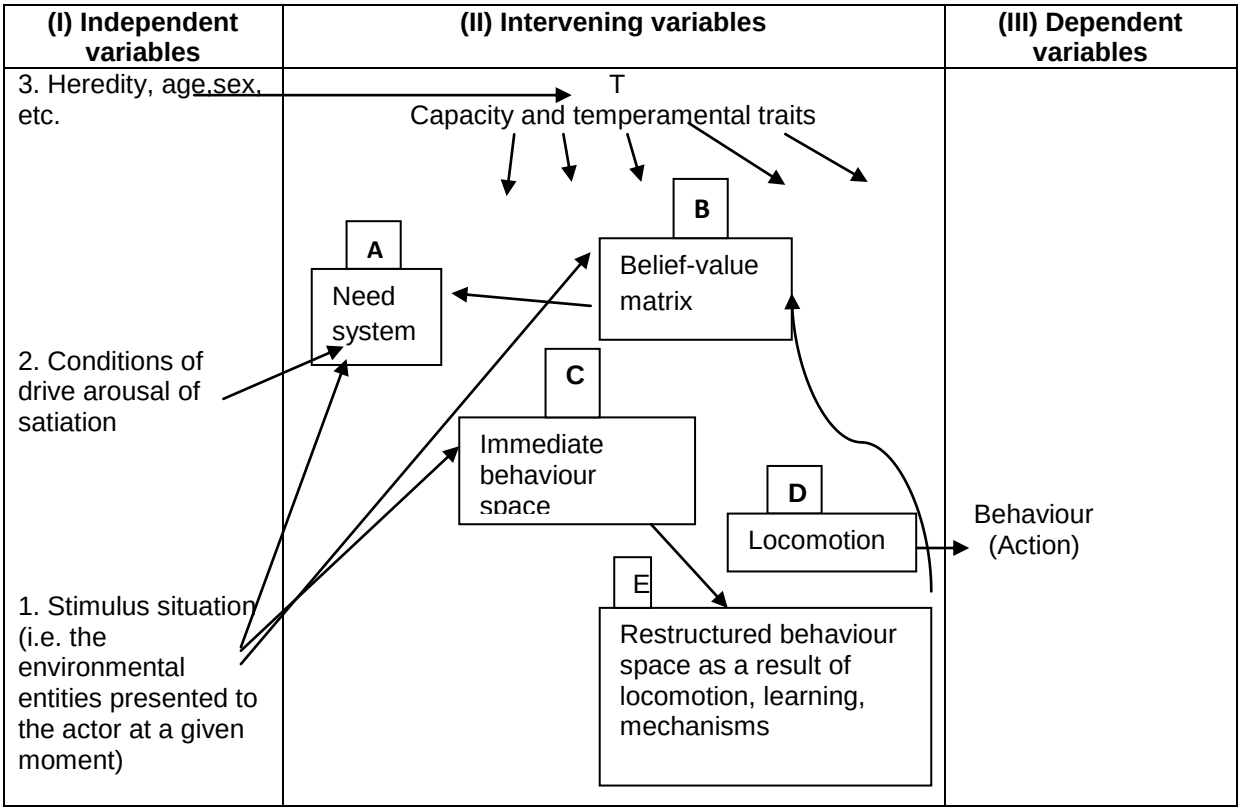

Figure 3.2: The Tolman (1967) model

1). According to Tolman (1967), behaviour is intentional. This means that behind any action, there is a reason for it.

2). Behaviour is usually guided by an expectation concerning the environment.

3). The immediate determinant of actions is the behaviour space. All actions or behaviour changes are consequently associated with a whole series of variables. According to this model, three sets of variables are differentiated: the independent, dependent and intervening variables as indicated in Figure 3.2.

From all indications, Tolman (1967) model is an improvement on Lewin's (1951) model. One of the similarities is that, for Tolman, the space where variables operate to influence behaviour is called "behaviour space", while Lewin regarded it as "psychological environment or life space". Although Tolman tried to reduce determinants of behaviour, his concept still leaves a lot of room in terms of reducing behaviour determinants to such easy manageable form.

3.2.4. The cognitive dissonance theory

Another major theory that could be of immense benefit in the explanation of adoption decision-making is the cognitive dissonance theory, propounded by Leon Festinger in 1957, cited by Zimbardo and Ebbesen (1970). According to the basic principles of this theory, humans (be they farmers or non-farmers alike) cannot withstand psychological inconsistency. In this regard, psychological inconsistency is the discomfort or inconsistency that is set in motion in an individual whenever there is a need tension. As such, whenever there is anything that causes tension, individuals move or are motivated towards the direction where such tensions can be resolved, or at the least, relieved.

Perez (n.d) however used a somewhat different terminology for the concept, that is "cognitive consistency theory", but it is in almost all respect like the cognitive dissonance theory. According to Perez, cognitive inconsistency theory is the basis for equilibrium for various people. Quoting Perez, " this theory focuses on the balance individuals create cognitively when inconsitencies create tensions and thus motivate our brains and body to respond". This theory tries to explain how behavioural motivation occurs whenever internal thoughts differ and conflict with each other, leading to the creation of tension in the individual. Perez emphasizes that, this tension is the actual driving force for changes in individual behaviour. The aim is to ease the particular tension. According to Perez, this theory operates on three principles:

1). People expect consistency. Naturally, people expect things to go as expected. When this does not happen, psychological and physical tension sets in them.

2). Inconsistencies create a state of dissonance. This principle states that frequently unexpected situations arise which sets in an inconsistency between what was expected and what actually occurs, thus a state of dissonance is set in the individual. Dissonance, according to Perez is the cognitive, emotional, psychological and behavioural state which arises when expectations do not come through.

3). Dissonance drives us to restore consistency. Because dissonance is usually against expectations and unpleasant, people will therefore engage themselves using different methods to resolve dissonance, and try to return to equilibrium. These methods are what lead to human behaviour.

For an example, if the knowledge of a certain new innovation is brought to farmers, and it disagrees with farmers' former knowledge, perception or need/aspirations, a tension is set in motion in the farmer. Farmers therefore move correspondingly according to their perception at the time, either for or against the innovation, in order to, at the least relieve tension.

3.2.5. Rogers' diffusion theory

One of the foremost authors in the study of innovation adoption and spread is Everett Rogers, and one of his outstanding works is a book titled "diffusion of innovations", written in 1983. According to Rogers (1983), the innovation-decision process is an information-seeking and information-processing activity in which an individual obtains information in order to decrease uncertainty about the innovation. Rogers' view of the adoption decision making process is conceptualized in five stages: knowledge; persuasion; decision; implementation and confirmation. As such, the discussion of this section is based on Rogers' (1983) concept of innovation diffusion and adoption decision-making process.

1. Knowledge. According to Rogers, at the knowledge stage of the adoption decision-making process, individuals or any other decision making unit is only exposed to an innovation's existence and gains some understanding of how it functions.

2. Persuasion. At the persuasion stage, individuals or any other decision making unit develops a favourable or unfavourable attitude regarding the information or new technology. Individuals here start developing a behavioural attitude that draws him/her towards the particular idea or away from the idea.

3. Decision. Rogers view this stage as the stage where individuals or any decision making unit starts engaging in activities that eventually lead to a choice to adopt or reject the innovation.

4. Implementation. Similarly, Rogers view this stage as the one individuals or any decision making unit puts the innovation into use or tries the particular idea.

5. Confirmation. Rogers (1983) view confirmation stage as the last stage of the adoption decision-making process. According to this view, at this stage, individuals or any decision making unit seeks a reinforcement of an innovation decision that has already been made. However, the particular individual may reverse this previous decision if exposed to conflicting messages about the said innovation or idea.

Following Rogers' concept, the adoption decision-making process either leads to adoption: a decision to make full use of an innovation as the best available action; or rejection: which is the decision not to use the innovation. In line with the model, anything can happen at the confirmation stage of the adoption process. An individual's decision to reject a new idea can be reversed to adoption, and a decision to adopt can be discontinued (this usually occurs when individuals become dissatisfied with an innovation, or because the innovation is replaced with an improved one).

The Figure 3.3 is a modified representation of Rogers' (1983) view of the innovation adoption and decision-making process.

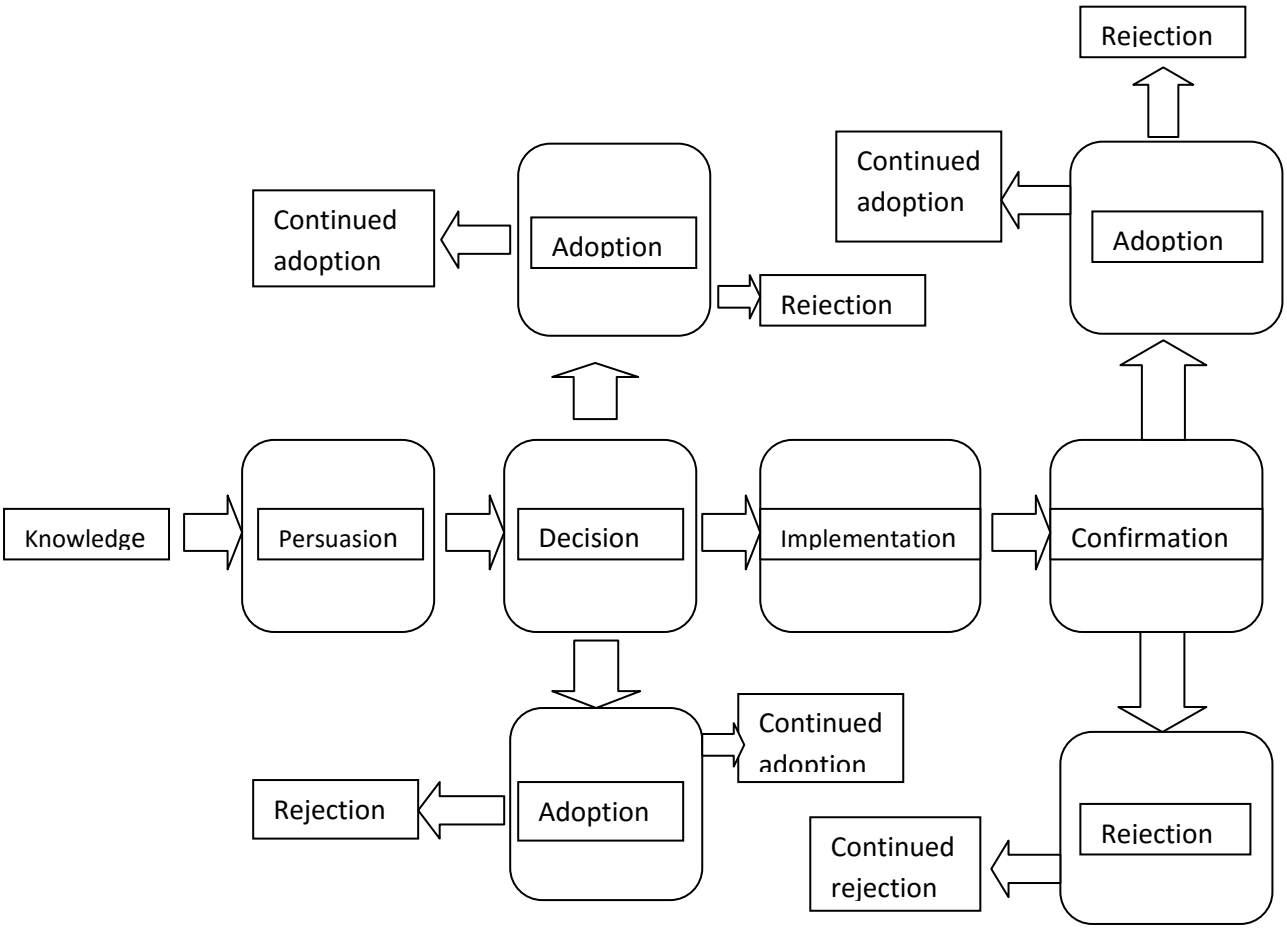

Figure 3.3: An illustration of the adoption decision making process (after Rogers 1983)

3.2.6. The Dűvel (1991) model

Farmers' adoption decision-making could be regarded as the major factor in agricultural improvement. According to Dűvel (1991) problems normally addressed in agricultural development is ultimately that of two types: (1) non-adoption or (2) inappropriate adoption of certain recommended practices. Figures 3.4 and 3.5 below are adapted models upon which the discussion of this section bases its reasoning.

Figure 3.4 gives a picture of the operation of farmers' decision making and its impact on agricultural production outcomes. According to the model, farmers' decision-making process is governed by their production environment (personal, production, institutional and environmental factors), which is transmitted through their mediating variables (needs, perception and knowledge). In this regard, farmers' adoption decision-making environment is composed of their mediating variables, which Dűvel, Chiche and Steyn (2003), classified as cognitive field factors, and their actual

production practice behaviours. Due to the particular significance of the cognitive field factors in a decision-making process, Dűvel (1991) emphasizes that these must be the main focus of extension research.

Similarly Figure 3.5 is a broad conceptual framework, an explanation and application of Figure 3.4, provided by Dűvel in 1991 for a situational analysis of farming problems. According to the model, the non-adoption of agricultural technologies by farmers is as a result of their unwillingness and their incapability (unable) (Dűvel, 1991). Farmers' incapability (unable, outside farmers' behaviour) is said to be more of an independent nature, and as such are classified broadly as personal, physical, economic, social, cultural and communication factors. On the other hand, farmers' unwillingness is the human factors which have to do with farmers' decision-making processes or behaviour, occasioned largely by the cognitive field factors of needs, perception and knowledge. In a situation analysis, according to Dűvel (1991), much effort must centre on these factors.

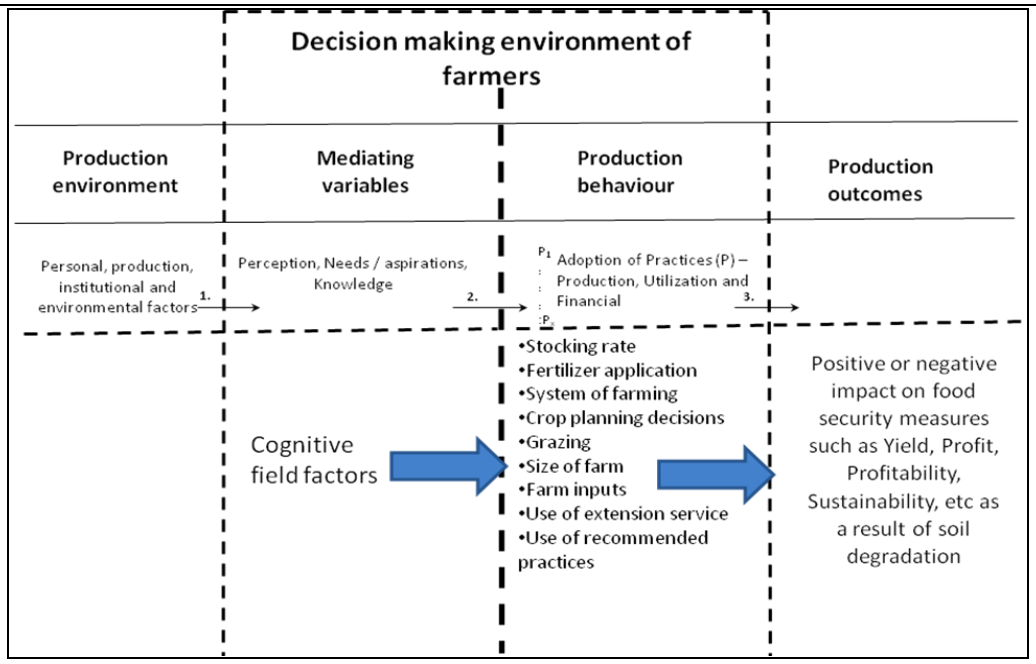

Figure 3.4: Relationship among variables of study [after Dűvel (1991) and Lategan (2007)]

According to the tenets of this model (Fig. 3.5), the obvious factors, or category of variables, responsible for decision making, on which research attention needs to be focused are the intervening or mediating variables, which are needs, perception, and knowledge (Dűvel, 1991). In other words, this model is a hierarchical breakdown of

research problems. It focuses analysis on the human aspect, which has to do with individual's behaviour, because the other aspect is independent of the farmer, hence it is called independent factors.

In terms of this study therefore, farmers' none or inappropriate adoption of soil management technologies has to do with their unwillingness, which is broken down into three aspects: (1) farmers either have no need of the innovation, or (2) they have unfavourable perception of the innovation, in terms of its prominence, its relative advantage, or the innovation is incompatible with their needs; or (3) they have no knowledge of the innovation. The farmers' lack of need is further subdivided into two: (1) either they lack aspiration, or (2) it is a case of need incompatibility. Similarly, farmers' lack of aspirations can as well be subdivided into three: (1) farmers' overrating their own efficiency; (2) being unaware of possibilities of optimum; and (3) farmers are satisfied with present or sub-optimal situation. Similarly, farmers' problem of unfavourable perception can as well be seen from three perspectives: (1) prominence; (2) relative advantages; and (3) compatibility. In the same vein, the problem of prominence can be seen from four perspectives: (1) insufficient prominence; (2) unawareness of advantages; (3) aware of disadvantages; and (4) incompatible with situational factors.

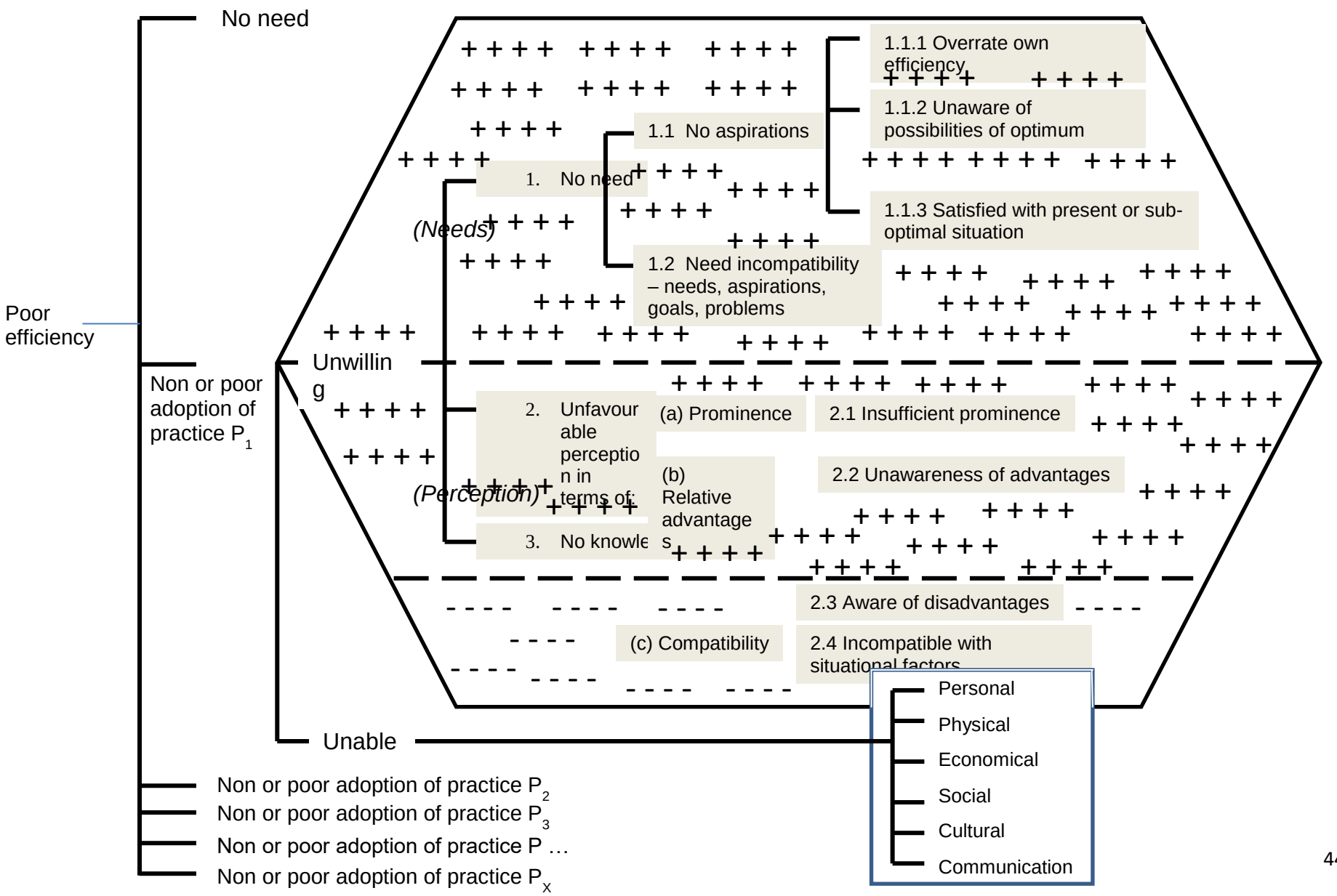

Figure 3.5: A broadly conceptualized Duvel (1991) model of farmer's adoption decision-making behaviours suitable for the information needs of the study

3.3. Factors of adoption decision-making

Food security and household food security for that matter will continue to be a huge battle for the African continent especially due to the rate of population increase, poverty and the current added impact of climate change. According to FAO (2015), although the prevalence of undernourishment in sub-Saharan Africa declined from 33% to 23% between 1990-1992 and 2014-2016, still the total number of undernourished people continues to rise with a current estimate of 220 million in 2014-2016, as compared to 175.7 million in 1990-1992. Supporting, Al-Baguri (2014) laments the unacceptable irony of the African continent, that despite the continent rich natural and human resources, it is still up to now the world poorest continent and of all regions, her people suffer the most from the problem of food insecurity. In its recommendations for food insecurity for the African continent, as stated by Majtenyi (2012), foremost amongst the suggestions by the first ever African Human Development Report 2012 is boosting the productivity of small farmers. Thus therefore, smallholder farmers' role and the adoption of recommended practices for improved agricultural productivity and for food security in Africa becomes very significant.

In the literature, there exist an in-exhaustive list of factors prevailing on farmers, which define their decision-making, especially as it relates to soil conservation and management. In the section that follows therefore, effort is geared towards analysing literature on factors responsible for soil conservation technologies and practice adoption by farmers.

3.3.1. Factors responsible for the adoption of soil conservation practices

Kabwe, Bigsby and Cullen (2009), citing Feder *et al*. (1985) and Rogers (2003) maintain that suggestions from literature indicate that successful adoption is a product of favourable convergence of technical, economic, institutional and policy factors. This seems to be the view of Rezvanfar, Samiee and Faham (2009), except that their list of factors was divided into two main groups: individual level characteristics of farmers and farm structural factors. (1) individual level characteristics of the farmer includes age of farmers, education status, years of farming, knowledge level, awareness, attitude toward conservation practices,

farmers motivation, et-cetera. (2). Farm structural factors, according to Rezvanfar, Samiee and Faham (2009), relates to the adoption of conservation practices, including farm size, income, farm profitability, tenure, et-cetera.

Speaking on this, Oyewole and Ojeleye (2015) maintain that the most important factors influencing smallholder farmers' decision to adopt improved farm practices are age, level of education and extension contact. Also commenting, Chi and Yamada (2002) provided a list of reasons why farmers adopt technologies. These are: if farmers are progressive (i.e. if farmers believe on science and technology); if they are educated (i.e. if they know how to read and write); and if farmers are young, preferably less than 40 years of age. It was further noted, based on findings from farmers that if a technology increased farmers profit, more effective income, farmers will change to adopt such a technology (Chi & Yamada, 2002).

Reporting on the review done by Feder and Zilberman (1985), Kaguongo, Ortmann, Wale, Darroch and Low (2010) posit among other things, that farmer's adoption decision-making is controlled by four main factors, which seems to agree with the view of Kabwe, Bigsby and Cullen (2009), as indicated. In their opinion, farmers' adoption decision is influenced by factors such as socioeconomic, demographic, ecological and institutional, which are dependent on the technology in question. Reporting on a study conducted in Zambia, to assess factors influencing farmers decisions to adopt improved fallows, Kabwe, Bigsby and Cullen (2009) reveal that non-farm income, method of ploughing, limited land, lack of seed and lack of interest were found to be responsible for adoption.

According to Kaguongo *et al*. (2010), studies of key determinants of innovation adoption by farmers cultivating upland rice and soybeans in Central-West Brazil (Strauss *et al*., 1991) and to evaluate the role of human capital and other factors in adoption of reduced tillage technology in corn production (Rahm & Huffman, 1984) discovered that education of farmers and experience play a crucial role in promoting adoption.

A review of adoption factors by Howley, Donoghue and Heanue (2012) seems to agree with other findings in literature regarding the adoption of technologies by farmers. According to them, there is general agreement in literature that the adoption

of agricultural technology hinges on a range of personal, social, cultural and economic factors, as well as on the characteristics of the technology in question (Pannell *et al*., 2006). According to Howley, Donoghue and Heanue (2012), cost of using a technology, potential benefit of the technology, ease of use, labour, time (of administering the technology, say artificial insemination process as compared to using a bull), age and education of farmers, presence of children (this could be that they act as potential successor), as well as farmers participation in advisory programmes were found to promote the adoption of artificial insemination (AI) among dairy farmers in Ireland.

3.3.2. Intensity of farmers' adoption decision-making process

Obuobisa-Darko (2015) defines intensity of adoption as the level of adoption of a certain innovation (for example the number of hectares planted with an improved seed or the amount of fertilizer used per hectare of farmland). In this case of soil conservation practice, it could mean the number of soil conservation practices adopted by a farmer. Another example can be the use of vetiver grass strips or any other plant to reduce soil erosion on a farm. According to Asafu-Adjaye (200), farmers are then informed of the negative effect of reduction in the farmland, but will ultimately increase production in the long-run due to soil erosion decrease, and farmers are asked, 'how many of the plant will they be willing to plant in their farm?'

According to research, evidences are that the adoption of agricultural innovations and soil technologies in particular is not just a binary issue, but multivariate. Asafu-Adjaye (2008) posits that the subject of the adoption of agricultural technologies, and soil technologies in particular, has been widely researched since the 1950s, but the problem has been, that most of those studies have treated the adoption of soil conservation only as a binary choice decision process. As a result of this, according to Asafu-Adjaye (2008), the extent and intensity of the adoption decision-making process is overlooked. Citing a seminar review on the adoption of various innovations in developing countries by Feder, Just and Zilberman (1985), Asafu-Adjaye (2008) observes that the adoption decisions of various innovations are interrelated, but lamented the dearth of information along this line.

Supporting this view, Arslan *et al*. (2013), reporting Baudron *et al*. (2007) and Umar *et al*. (2011) maintain that although most applied literature on conservation agriculture (CA) seems to describe adoption decisions as a binary outcome, it is now generally accepted that adoption decision-making process is not a binary process but tends to be partial and incremental. In the view of Kaguongo *et al*. (2010), citing Wale and Yallew (2007) modelling farmers' adoption behaviour about whether or not to adopt an innovation consists of a discrete (whether or not to accept the innovation) and continuous (the intensity of use of the innovation) decision. Speaking on this, Obuobisa-Darko (2015) argues that once a decision to adopt a technology has been taken, the farmer may then intensify its usage. It was also pointed out that the adoption and intensity of use can be made jointly or separately, and the decision to adopt may come before the decision on the intensity of use, and factors affecting each level of decision may as well be different. Reflecting on this, Xu and Wang (2012) suggest that all factors that influence decision to or not adopt an innovation could also influence the adoption share (intensity).

3.4. Modelling adoption decision-making processes of farmers

As indicated, a review of adoption literature seems, to a large extent, agree with Dűvel (1991) classification of factors responsible for farmers behaviours. The only exception is the view that includes characteristics of technology like Panell *et al*. (2006) did. However, Dűvel (1991) model, which was actually a modification of Lewin (1951) theory and Toman (1967) model, seems to a large extent be more all-encompassing. For example, while the independent variables of Dűvel (1991) model cover for almost all factors of adoption by virtually all other authors, Dűvel however included another set of variables called mediating variables, which are thought to be the immanent precursors of decision-making of farmers. According to this view, the effects of all other independent factors are actually transmitted through these mediating variables. In other words, though the mediating factors are actually influenced by the independent factors, the mediating factors are the real determinants of behaviours or decision-making. Hence, Dűvel suggested that extension research must focus on these variables. The only exception, which will call for further research in improving Dűvel (1991) model, is the view that included characteristics of the innovation as part its framework.

According to Annor-Frempong and Dűvel (2011), the intervening variables are psychological constructs; they are denoted intervening because (1) they transmit the effects of the antecedent causal factors to the variable behavioural outcomes, and (2) they have a causal effect on the behavioural outcome. Although the numbers of variables to include among the mediating variables are said to be innumerable, these Dűvel (1991) classified into three: need, perception and knowledge, which were further classified as cognitive field factors by Dűvel, Chiche and Steyn (2003) (Figure 3.6) in one of their studies in Ethiopia in 2003. Although Annor-Frempoong and Dűvel (2011) tried to provide a list of some possible factors that can be included in this category, a close look at them indicates all factors fall into the three earlier classification by Dűvel (1991) model. The list consist of need tension, compatibility, awareness, prominence, efficiency, perception, and subjective norm (Figure 3.7).

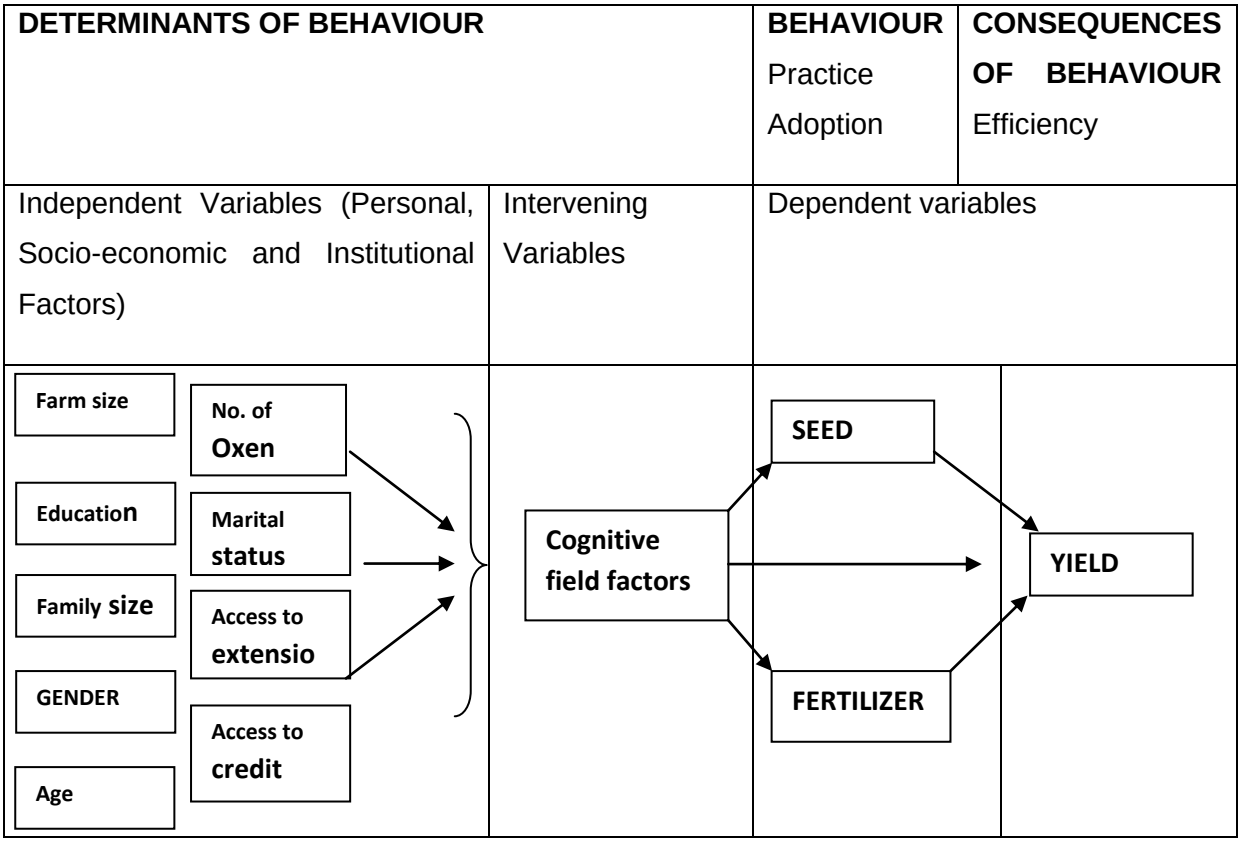

Figure 3.6: The hypothesised determinants of production efficiency of rural households in the Arsi Negele farming zone (Dűvel, Chiche and Steyn 2003)

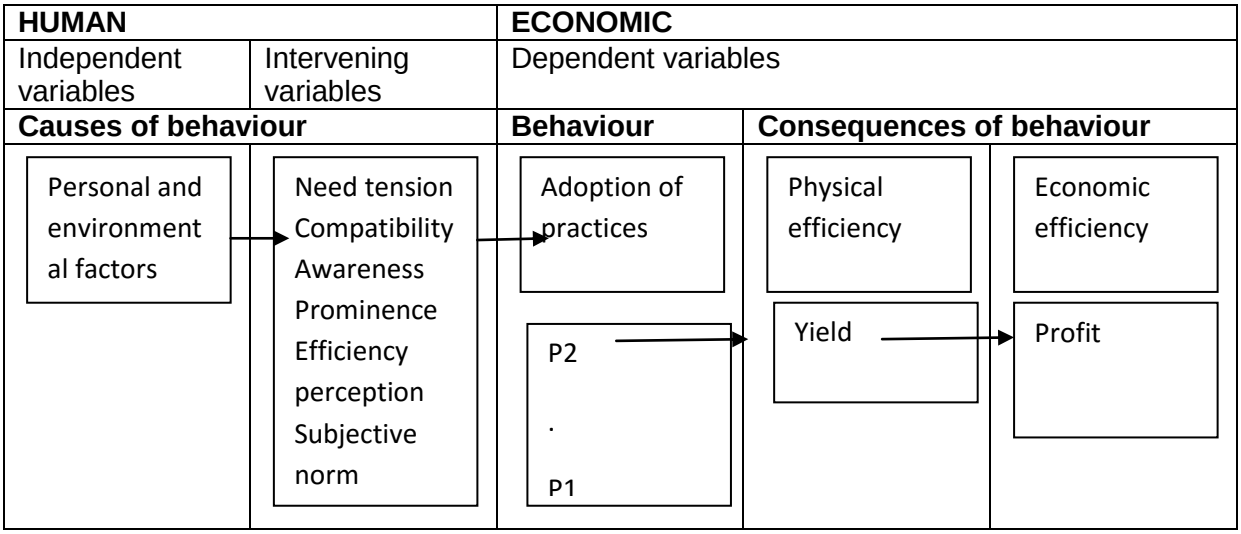

Figure 3.7: The relationship between behavior-determining and behavior-dependent variables in agricultural development (Annor-Frempong and Dűvel 2011)

3.5. The role of human needs, perception and knowledge in behavioural change or adoption decision-making

A cursory analysis of all social science research, and in fact any other researches, by implication, researches where responses are expected from individuals, the influence of human perception on results can never ruled out. Hence, the notion of mediating variables by Dűvel (1991) or cognitive field factors by Dűvel, Chiche and Steyn (2003) as main centres where research must be focussed seems to become very relevant and uncontested. In this sense, models where the cognitive field factors are included and viewed as immanent precursors of behaviours seem to be the closest measure of behaviour determinants or adoption decision-making. As such, in this section, the role of needs, perception and knowledge impact on human behaviour and decision-making is emphasized.

3.5.1. Need as a behaviour determinant

The role of need in behavioural change cannot be undermined. For instance, Maslow (1970), as cited by Boeree (2006), maintains that the underlying reason for any human behaviour or decision-making is to satisfy personal needs. For Lewin (1951), as posited by Shaw and Constanzo (1970), need is among three major things (others are goals and past events) which exist for individuals and which constitute their total situation or psychological space. Also, need is regarded as one of the major elements which constitutes the individual life space, influencing on human behaviours. Need, according to Bembridge (1991) is defined as a condition where an

individual experiences a lack of something and does everything to overcome it. From the cognitive dissonance theory by Festinger (1957), cited by Shaw and Constanzo (1970), lack produces a need tension or psychological inconsistency in an individual, which the person moves (behaviour) to eliminate or at least relieve.

In the consideration of Dűvel (1991), need is the first among three elements constituting the three mediating variables regarded as the most immanent determinants of individual's decision-making, and through which all other factors in a farmer' environment are expressed. In fact, Dűvel (1990) defines behaviour as a type of movement brought about by forces or energy due to a system in disequilibrium. The system in disequilibrium here is the condition of lack in the definition of need according to Bembridge (1991), and psychological inconsistency or tension in the cognitive dissonance theory by Festinger (1957) as reported by Shaw and Constanzo (1970), which motivates individuals to take action to resolve.

From the foregoing therefore, every individual moves or changes behaviour in the direction where his/her needs (tension situation) can be overcome. For example, if Mr A is hungry, the lack of food creates in him/her a system of disequilibrium or inconsistency. As such, if there are two points X and Y in space, wherein X has food, or is perceived as a potential supply of food for hungry people like Mr A, whereas point Y has not or is not perceived of as potentially being able to supply food, Mr A without doubt, will do everything to move to point X, because he believes or knows that his need (hunger) can be satisfied at X. In view of this study, if a farmer do perceive extension recommended practices for soil conservation being able to solve his land or farming problems, no matter how all other factors impact on the farmer in question, he/she may not accept the recommendations. This certainly is an explanation why farmers may prefer to continue with their own practices despite the potentials inherent in extension recommended practices.

3.5.2. The role of knowledge in behavioural change

Knowledge as a factor in decision-making or behavioural change cannot also be overemphasized. Lewin (1951), cited by Shaw and Constanzo (1970) maintains that the total situation or life space of individuals is characterised by things which exist for the individual. Examples of such things include individual needs, goals, and past

events. Lewin (1951) further emphasizes that individual's life space is differentiated into regions, or what is called life sphere, and the degree to which individual's life space is differentiated depends on their ages, intelligence, and experience acquired. These as is very obvious are all indicators of knowledge. In fact, Lewin (1951) reiterates that the life space or total situation of individuals become differentiated as a child grows older; in this regard, the more intelligent person has a more highly differentiated life space than the less intelligent. Intelligence and experience here are by and large products of knowledge.

According to Dűvel (1991), examples of knowledge required in behaviour change includes: knowledge of basic principles; knowledge of what is attainable; knowledge of advantages and disadvantages; and knowledge of practical implementation aspects.

Although knowledge is very important in behaviour change, knowledge alone may not significantly affect expected change in behaviour. In fact, knowledge is just the first step in Roger's adoption diffusion theory (Rogers's, 1983). Supporting, Spehr and Curnow (2011) maintain that although information may help improve people's knowledge about a problem or contribute to a change in behaviour towards it, there is a vast difference between knowing about a problem and doing something about it. It was stated further that in literature, there are decades of research which shows that information on its own is unlikely to lead to a measurable change in behaviours of individuals.

3.5.3. The role of perception in adoption decision-making

Another basic element discovered impacting strongly on individual's behaviour is individual perception. The truth is all behaviour can be traced back to individual's perception.

3.5.3.1. Tracing all human behaviours to perception

Firstly, what is perception? Berelson and Steiner(1964) define perception as the more complex process by which people select, organize and interpret sensory stimulation into a meaningful and coherent picture of the world. In this regard, no individual comes to the point of taking any decision (appropriate interpretation of information and subsequent action) without the information being selected and

organized in the individual in question. Individuals therefore make decisions on incoming information based on their mindset and the conclusion their mindset draws about the information. According to Sargent and Williamson (1966), every individual plays an active part in determining what will be allowed to stimulate them. They thus spoke about “selective exposure” and ”selective awareness”. It was said that, by “selective exposure”, for example we look at some things, others we ignore, and yet we shy away from others. Sargent and Williamson (1966) further reiterate that, the only stimuli we become aware of are those, by selective exposure, we allow to gain effective entrance into us. Based on this, which stimuli become selected by us depends on three factors:

1) the nature of the stimuli involved;

2) previous experience or learning as it affects the observer’s expectations; and

3) the motives in play at the time. That is what the observer wants or needs to see and not see.

These three factors of selection shall be illustrated here using some hypothetical examples, for the purpose of clarification. In terms of stimuli nature, take for example Mr A and Mr B, who both tune in to a television (TV) channel, and discovers a pornographic film being displayed. Mr A tunes off his TV, or better still, tunes to another channel/station while Mr B seems to be very pleased with the programme. These two men behave differently, because of individual differences with respect to the nature of the incoming stimuli. In terms of how past experience affects behavioural change, let us also consider using a hypothetical example: the reactions of farmer A and B when invited to an extension service meeting/seminar. Farmer A bluntly refused the meeting because a past meeting he/she attended did not live up to his expectation. But on the other hand farmer B welcomes the invitation, because the one he/she attended before helped him/her a great deal in his farm. The differences in behaviour of the two farmers here is their past experiences.

Motives of individuals as it affect perception can as well be understood through the following hypothetical example, of farmers A and B, who behaved differently in a farmers’ study group discussion. Farmer A is found to always object virtually every

motion raised, but farmer B on the other hand is very cooperative. A close examination of their motives of joining the discussion meeting reveals that the underlying reason farmer A joined the meeting is to be elected a group leader, but since he was not elected, he seems to look for every opportunity to destabilize the meeting. Unlike farmer A, farmer B's goal is to receive help for his farming work, and so this is his driving force.

Apart from considering perception based on its definition, another angle to consider it is through its determinants. Krech and Crutchfield (1958) assert that perception is determined by two major sets of variables: structural and functional variables. By structural variables is meant those characters inherent in the physical stimuli, which are outside the control of an individual. On the other hand, functional variables are those inherent in the individual in question. Mood as a factor can be very relevant as a determinant of a person's perception. According to Kavanagh and Bower (1985), when we are sufficiently happy or delighted, we tend to feel able to achieve our ambitions to the highest, unlike when we are feeling low. Commenting further, it was said that usually, people have lower self-esteem of themselves when they are sad than when they are happy (Kavanagh & Bower, 1985, citing Underwood, Froming & Moore, 1980; Amrhein, Salovey & Rosenhan, 1982).

From the foregoing, it is obvious that all behaviours or decision-making tendencies of individuals are traceable to individual's perception. One of the reasons is because humans naturally, by selective exposure are able to allow whatever they want to stimulate them. Also, individuals have inherent in them certain functional factors, such as moods, past experiences, et-cetera which have influence on their perception, and thus their behaviour at any particular time.

3.5.3.2. The relationship between perception and adoption decisions

Although accurate measurement for perception as a variable in a research is a bit subjective, it is however a very crucial element at play before the choice of adoption of any innovation for change. The choice to adopt or reject any particular innovation begins from the level of perception a farmer have of the problem that require adoption of a mitigating measure, as well as of the proposed measure. In fact, the impact of perception in any human-related research cannot be underestimated. According to Ighodaro (2012), a positive perception is of high importance in social

science research because it helps to explain farmers' problems as it affects them. Perception as an independent variable, according to Dűvel (1991), is one of the three mediating variables directly responsible for farmers/people's adoption decision-making. In his opinion on the role of perception, Asafu-Adjaye (2008) emphasizes that the perceived extent of actual or potential physical erosion on a farmland (or any land), is capable of influencing the farmer to use a control method. As indicated, perception could be said as a vital element that impedes or propels appropriate adoption of recommended innovations for change.

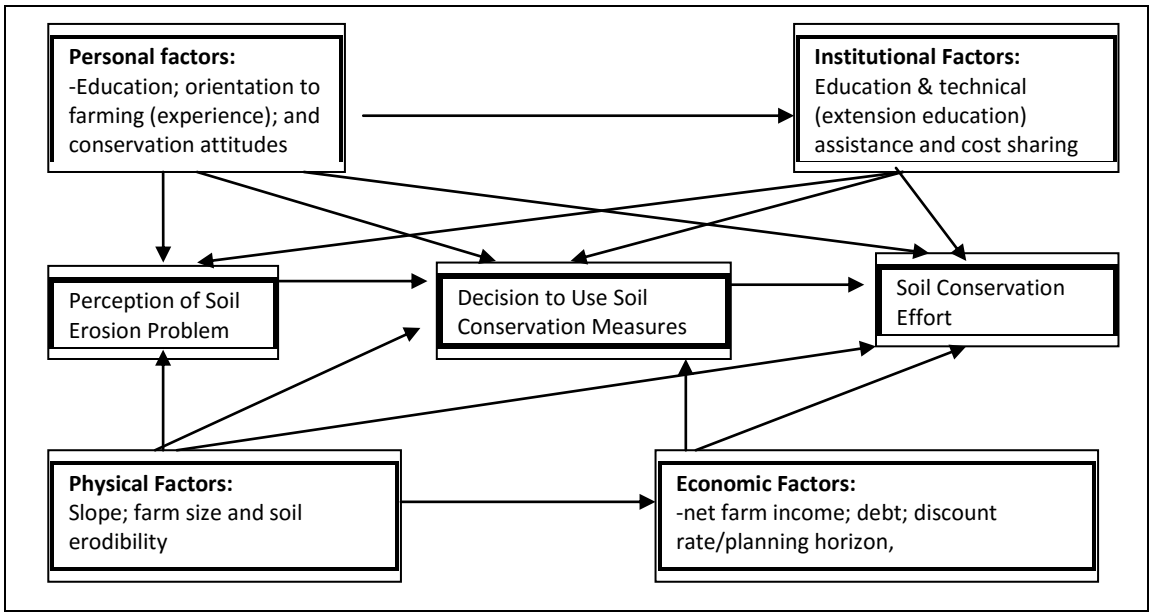

Figure 3.8: The decision to use soil conservation (Adapted from Ervin & Ervin 1982 and Asafu-Adjaye 2008)

Ervin and Ervin (1982) hypothesizes that the decision-making process of farmers to adopt soil conservation practices begins with a perception of soil erosion (degradation) (Figure 3.8). According to them, once the problem has been perceived, the farmer then adopts a soil conservation practice(s). Further, this decision is affected by a number of factors such as personal, institutional, physical and economic. The level of perception is determined by farmers' personal characteristics (such as age, education, marital status, gender, et-cetera) and the physical characteristics of the farmland (e.g. size of farm). Similarly, institutional factors such as extension participation do also play a part in the relationship in that it assists in increasing farmers' awareness of the problem, as well as economic factors such as

farm income and off-farm income, in that it provides suitable conditions for farmers' decisions.

3.5.3.3. Conceptualizing the relationship between perception and livelihood standards of the adopter

It is a well known fact that the major aim of any new technology is agricultural improvement and thus better life for farmers and the society at large. Concurring, Hailu, Abrha and Weldegiorgis (2014) in their study emphasize that the relevance of agricultural technology adoption in putting an end to poverty and food insecurity has been well research by authors like Besley and Case (1993); Doss and Morris (2001); Mendola (2007); and Becerril and Abdulai (2009). Similarly, conservation agriculture (CA) as viewed by Li *et al*. (2011), citing FAO view based on its objectives and expected outcomes, is that which aims at achieving sustainable and profitable agriculture; and subsequently aims at improving livelihoods of farmers through the application of three conservation principles.

The fact that perception has a significant relationship with livelihoods of the adopter can never be overemphasized. This is because several studies indicate a significant relationship between perception and adoption. For example, Ervin and Ervin (1982) maintain that it is only after the problem of soil (erosion) is perceived, that the farmer decides on whether or not to adopt any conservation measure. Supporting this also, Asafu-Adjaye (2008) emphasizes that farmers decide on adoption only when soil erosion problem has been well perceived.

Judging from Dűvel (1991), Annor-Frepong and Dűvel (2011), as well as Dűvel, Chiche and Steyn (2003 models of adoption analysis, in order, the consequences (impacts) of behaviour (the result of the direct impact of mediating variables) are profit and farm yield, which basically speak of farmers' livelihood standards. Amongst the mediating variables perception, according to this study, is the main variable responsible for adoption behaviours, through which all other factors reflect, which eventually ends up in the type of standards of living the farmer enjoy. This relationship is as indicated in Figure 3.9.

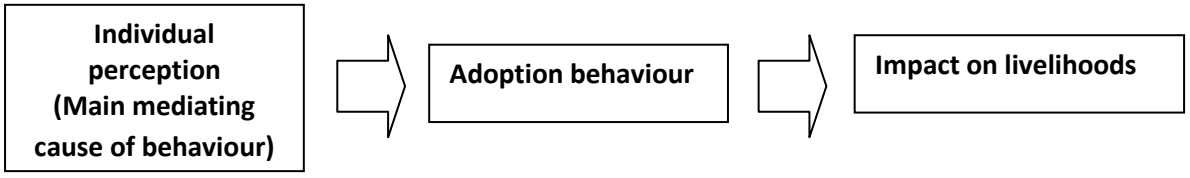

Figure 3.9: Relationship between perception and farmers' standard of living

3.6. Conclusion

According to this chapter, smallholdings and smallholder farmers will continue to thrive, especially in sub-Saharan Africa, at least for the some more decades to come. This is largely due to her level of poverty and underdevelopment. As indicated, smallholder farmers' adoption decision-making process is not straightforward, which is a function of several factors, ranging from the very independent factors such as personal and demographic factors, social, cultural, environmental, and institutional factors respectively, to the mediating factors. However, there is need for all behaviour determinants models to include and focus more research on the mediating variables of individuals if there can be a holistic analysis of determinants actually responsible for adoption decision-making.

CHAPTER FOUR

Soil conservation and soil conservation practices

3.0. Introduction

The soil is the most valuable resource ever known to humans, especially because 99.7% of human food (calories) comes from the land (Pimentel 2006, citing FAO 1998). Young (1998) maintains that changes inflicted on the soil by continuous soil degradation processes over the years are significant, and have led to the lack of productivity of many valuable lands, which eventually are abandoned. In fact, citing Myers (1993), in this regard, Pimentel *et al.* (1995) suggests that 75 billion metric tons of soil is lost from the land because of wind and water erosion each year, with most of them coming from agricultural land. It therefore becomes very imperative that farmers, who are the most users of land, develop and adopt appropriate soil-friendly practices that will limit to the barest minimum damages inflicted on land through agricultural activities. As such, in this chapter efforts are made to review soil conservation as a concept in agricultural science and the various soil technologies that have been developed for its conservation.

4.1. What is soil conservation?

To many lay people, the idea of soil conservation is synonymous with soil erosion control. The reason for this misconception may not be farfetched. This is because, soil erosion happens to be the most conspicuous form of soil degradation. But over and beyond, there are several other aspects of soil degradation apart from soil erosion. This is why in his book “soil conservation and sustainability’’, Young (1990) maintains that soil conservation is interpreted in a broader sense to include control of erosion and maintenance of fertility. According to Young (1990), this idea emanated from two premises. The first is that soil conservation was formerly equated to the control of erosion. But this has changed, as it is now being recognized that the principal adverse effect of erosion is lowering of fertility, through the removal of organic matter and nutrients in sediments being eroded (Young 1990). The other reason is the fact that other forms of soil degradation apart from soil erosion are being increasingly recognized today, such as physical, chemical and biological degradation which sometimes are classified as soil fertility decline (Young 1990). But the question remains, what is soil conservation?

Young (1990) opines that soil conservation is equal to maintenance of soil fertility, and this entails several other measures such as control of erosion; maintenance of organic matter; maintenance of soil physical properties; maintenance of nutrients; and avoidance of toxicities. In its definition, the Johnston County Government (JCG, 2015) suggests that soil conservation could be defined as a combination of practices that help to safeguard the soil from being degraded (Johnston County Government, 2015). Using a simple analogy, JCG (2015) states that:

> "Soil conservation can be compared to preventive maintenance on a car. Changing the oil and filter, and checking the hoses and spark plugs regularly will prevent major repairs or engine failure later. Similarly, practicing conservation now will preserve the quality of the soil for continued use."

From this analogy, it is very obvious that the ultimate goal of soil conservation is soil/resource sustainability. This entails a situation where the soil and its resources are used to meet the immediate needs, but doing so in the most soil-friendly way, so the soil do not lose its ability to meet future needs or that of generations hereafter. In another sense, if a farmer wants the quality of land to remain for long, then there must, in the process of cultivating the land, be precautionary measures, otherwise the soil will degenerate in quality or become degraded. Examples of such degradation processes are soil erosion, soil compaction, soil fertility decline, soil acidification and alkalinity. As such, productivity will eventually decline, or in worse situations, the land is abandoned. According to Young (1998), the effect of soil erosion as a degradation process over the years is indeed remarkable and has led to some valuable lands becoming unproductive, which often are eventually abandoned. In this regard, Pimentel (2006), citing Lal (1994), reports that since farming began, an approximate amount of 2 billion ha of arable land has been abandoned. Hence it is worthwhile to understand some of the soil degradation (worldwide) processes that demands prevention or mitigation measures.

4.1.1. Soil erosion

According to literature, soil erosion is the most conspicuous perhaps the most devastating form of soil degradation. Soil erosion is one of the world's and South Africa's most critical environmental issues (Le Roux *et al*. 2007). Adediji (2000)

defines it as a process through which soil materials are detached, as well as its transportation by water, wind and ice. In Marsh and Grossa (2005) terminology, erosion is the dislodgement of particles from the soil. Citing Morgan (1995), Le Roux *et al*. (2007) and (2008) define soil erosion as the process through which soil materials are first detached and transported by wind or water. In other words, soil erosion goes through three stages of development. These stages are detachment (weathering), transportation and deposition. Soil erosion can be either geologic or accelerated (Toy, Foster & Renard (2002). Geologic erosion is a natural and very slow process through which the soil is removed by various denudation agents like water, wind, ice and waves (Strahler 1973). On the other hand, accelerated erosion occurs as a result of human activities, especially that related to the removal of vegetation (Adediji 2000).

Ighodaro (2012) summarized agents responsible for soil erosion into five, which includes water, wind, ice, gravity and animals (humans and other animals). Several factors are said to be responsible for soil erosion. These are nature of soil, nature of the land surface, climate, vegetations, and human or anthropogenic activities (Ighodaro 2012). Amongst all others, soil erosion causes a reduction of the productivity of terrestrial ecosystems (Pimentel 2006).

4.1.2. Soil compaction

Soil compaction is said to occur when soil particles are pressed together, which thus reduces the pore spaces between such particles (DeJong-Hughes *et al*., 2015). Supporting also, the Colorado State University Extension (2014) maintains that soil compaction reduces total pore space of any particular soil, and more importantly it reduces the amount of large pore space, restricting the movement of air and water into and through the soil. It was said further that low soil oxygen levels in soils by reason of soil compaction are the primary factor that limits growth of plants in landscape soils (Colorado State University Extension, 2014). Defining the term also, Wolkowski and Lowery (2008), posit that compaction can be viewed as the physical consolidation of the soil by an applied force which destroys soil structure, reduces porosity, limits air and water infiltration, increases resistance to root penetration, and often leading to a reduced crop yield. Like soil erosion, most farmers know about compaction problems, but the relevance is often underestimated (Wolkowski &

Lowery, 2008). In fact, the effect of compaction can be very significant. It was stated further that compacted soils can cut crop yields by as much as 50% due to reduced aeration, increased resistance to root penetration, poor internal drainage, and limited availability of plant nutrients (Wolkowski & Lowery, 2008).

4.1.3. Soil fertility decline

Soil fertility decline is said to occur when the amount of nutrients removed from the soil in harvested products exceed the amount of nutrients being applied (Queensland Government, 2013). A basic contributory factor to soil fertility decline includes growing crops, soil erosion, and leaching, although it is said that nitrogen can also be lost from the soil in the form of a gas through the process of denitrification (Queensland Government, 2013).

4.1.4. Soil acidification

Soil acidification is a process where the pH of the soil decreases over a period of time (Queensland Government, 2013). It states further that this process can be accelerated by agricultural production. According to the Queensland Government (2013), some of the factors causing soil acidification are 1) when high levels of ammonium-based nitrogen fertilizers are applied to soils that are naturally acidic; 2) when nitrate nitrogen, originally applied as ammonium-based fertilizers are leached from the soil; and 3) when plant materials are harvested from the soil. It was stated that plant materials are usually alkaline, but when it is removed from the soil, the soil is more acidic than when the plant material is returned to the soil. Some of the problems that evolve when the soil becomes acidic are: helpful soil micro-organisms may be hindered from nutrient recycling; phosphorus in the soil may become less available to plants; the ability of plants to use moisture in subsoil may be limited (Queensland Government, 2013). Possible control measures can include using less acidifying farming practices; and the applications of agricultural lime.

4.1.5. Soil alkalinity

Soil alkalinity can as well be called salinity. It is known as a condition resulting from the accumulation of soluble salt in the soil (Day & Ludeke, 1993). In defining the term also, Oosterbaan (2003) says that alkaline soils are soils, which are mostly clay soils, having a high pH (> 9) and a poor soil structure and a low infiltration capacity.

According to Day and Ludeke (1993), most of the alkaline soils are found in the desert areas of the world. They further say that although saline soils do occur in humid regions in areas that are affected by sea water, regions mostly having extensive occurrences of saline soils are those usually found in low-lying areas where evaporation concentrates the salt received from more elevated locations in surface water, ground water, or irrigation water. The problem with alkaline soils is that it becomes difficult for agricultural production; rainwater will become stagnant on the soil easily and, in dry periods, irrigation almost becomes impossible. If there will be agricultural production in such soils, it must be limited to crops which are tolerant to surface water logging.

4.2. The link between soil conservation and conservation agriculture (CA)

A discussion on soil conservation is indirectly a discussion on sustainable and conservation agriculture. This is because just as all principles of soil conservation aim at improving the quality of the soil, as well as protecting it from undue degradation, likewise all principles of CA. For example, four principles were proposed by the JCG (2015), for conserving the soil.

1. Preserving the soil life and organic matter content of the soil. According to them, this starts first by the soil user learning to treat the soil as a living ecosystem, and recognizing also that all organisms living in the soil play important roles in producing a fertile and healthy environment. For example, living organisms in the soil assist in breaking down organic matter, releasing nutrients, and opening up adequate pore spaces for proper circulation of air and water in soils. This is the reason why, the principle of soil conservation entails that organic matter must be returned to the soil from time to time, because these living organisms depend on dead plant and animal matter for their survival.
2. The principle of managing surface runoffs. This is also very crucial because, if not properly managed, surface runoffs could lead to soil erosion, which in many parts of the world, is the most grievous form of soil degradation.
3. The principle of protecting bare exposed soil surfaces and highly susceptible sites, such as steep slopes. Bare exposed soil surfaces and highly susceptible sites need protection because; such soils are very vulnerable to

degradation factors such as wind and water erosion, as well as soil compaction.

4. The principle of protection of downstream watercourses from sedimentation and pollution. This also is very necessary because, runoffs usually in its course transport various eroded particles such as soil particles, nutrients, fertilizers and pesticides. These become deposited downstream, which either blocks the river drainage, or pollutes the river life, which could be very harmful to organisms living in such water bodies.

Similarly, CA as viewed by Li *et al*. (2011), citing FAO view CA based on its objectives and expected outcomes as that which aims at achieving sustainable and profitable agriculture; and subsequently aims at improving livelihoods of farmers through the application of three conservation principles. These principles are minimum soil disturbance, permanent soil cover and crop rotations, which also are basic beliefs of soil conservation. In fact, Li *et al*. (2011) summed up CA as a system approach to sustainable agriculture.

According to the JCG (2015), soil conservation is an ongoing process, whereby the user is expected to maintain commitment, otherwise success may be compromised. Therefore, several steps were advocated for maximum success by any user. One of them is to obtain a good basic and working knowledge of the land resource. This means you have to know where the soil is most permeable and susceptible to groundwater contamination from excess pesticides, or where the land is most susceptible to water erosion because of the nature of the soil. This knowledge is needed to plan a most appropriate conservation strategy. Other steps suggested are: identifying or predicting areas of problems, choosing and implementing soil conservation methods, maintaining control structures, and continuous monitoring of the effectiveness of the plan and making adjustments where necessary.

4.3. Conservation agriculture as a concept

In the literature, there seems to be no straight definition for conservation agriculture. Most definitions available are often defined in terms of its principles or objectives, which are reduced soil disturbance, permanent soil cover and crop rotation. According to Hobbs, Sayre and Gupta (2008), the term is a recent system of agricultural management that is beginning to gain popularity in many parts of the

world. For example, Hobbs, Sayre and Gupta (2008), citing FAO define CA as minimal soil disturbance (no-till, NT) and keeping the soil permanently covered (mulch) in combination with crop rotation. According to Friedrich and Kienzle (n.d.), CA is defined as a resource-saving process of agricultural crop production which strives to attain acceptable profits, high and sustained production levels while simultaneously conserving the environment. This position seems to be also that of Sims, Friedrich, Kassam and Kienzle (2009). Quoting FAO, Hobbs (2007) maintains that “CA aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs. It contributes to environmental conservation as well as to enhance and sustained agricultural production. It can also be referred to as resource efficient or resource effective agriculture.”

Furthermore, Hobbs, Sayre and Gupta (2008) say that FAO characterized CA as an agricultural practice which maintains permanent or semi-permanent organic soil cover. It was said that this can be a growing crop or dead mulch, which is meant primarily to protect the soil physically from the sun, rain and wind and to feed the soil biota.

a. Minimum soil disturbance
b. Permanent soil cover
c. Crop rotation

4.3.1. Minimum soil disturbance

Since the soil is never tilled under these principles, soil structure changes. Another advantage is that a system of continuous macro pores is established, facilitating water infiltration and aeration of the soil as well as penetration of roots into deeper areas of the soil. Also, soil tillage mixes air into the soil, leading to mineralization (oxidation) of soil organic matter, which is reduced due to absence of tillage. But because roots and residues are added in CA, soil organic matter contents increases with higher values closer the surface, declining as you go downwards, thus macro and micro fauna and flora is re-established in the soil, leading to quality soil fertility and nutrients.

4.3.2. Permanent soil cover

Permanent soil cover through crops, mulch or green manure cover crops complements the zero tillage effects by supplying substrate for the build up of soil organic matter and for soil life, which is enhanced by not disturbing the soil. Also, protection of the soil surface reduces evaporation and crusting, as well as suppressing the growth of weeds. On the other hand, the use of zero tillage and direct seeding technology enhances management of residues which are often regarded as a problem in conventional systems. In very dry areas, incomplete soil cover is practiced due to lack of adequate water. Even with this CA is still very valid, provided sufficient organic matter is made available to the system to build up soil organic matter and for increased productivity.

4.3.3. Crop rotation

Although crop rotation serves different purposes in CA system, it is however linked with the other two principles. Apart from the phytosanitary and weed management goals, crop rotation serves to open different soil horizons with different roots. Also, applying a diversified rotation of crops increases the eventual productivity of the crops and as such also the long term profitability, compared to monocropping of economically attractive cash crops which in the long run always proves unsustainable. More so, since one of the objectives of CA is to keep the soil always covered under a live crop or dead residue mulch, crop rotation at the same time, becomes part of the soil and residue management strategy.

According to the JCG (2015), soil conservation is an ongoing process, whereby the user is expected to maintain commitment, otherwise success may be compromised. Therefore, several steps were advocated for maximum success by any user. One of them is to obtain a good basic and working knowledge of the land resource. This means you have to know where the soil is most permeable and susceptible to groundwater contamination from excess pesticides, or where the land is most susceptible to water erosion because of the nature of the soil. This knowledge is needed to plan a most appropriate conservation strategy. Other steps suggested are: identifying or predicting areas of problems, choosing and implementing soil conservation methods, maintaining control structures, and continuous monitoring of the effectiveness of the plan and making adjustments where necessary.

4.4. Importance of soil conservation

Although there are several reasons why soils, especially for agricultural purposes must be conserved, Johnston County Government (2015) however highlighted ten.

1. It helps maintain adequate amount of organic matter and biological life in the soil. In fact, it is argued that organic matter and biological life of the soil account for 90-95% of the total productivity of the soil.
2. It ensures a secure food supply at reasonable prices. Soil conservation has been proved to increase both quality and quantity of crop yields in the long run. This is because through the process, the topsoil is kept in its place, and the long term productivity of the soil is preserved.
3. It helps to grow enough food for all, especially in areas where there are food shortages like in poor countries of the world.
4. It assists in saving farmers' money. For example, erosion is said to currently costs farmers over $90 million annually in terms of lost income due to lower crop yields and nutrients loss from the soil.
5. Apart from farmers, it saves citizens money. According to recent research reported by the Johnston County Government (2015), soil erosion costs the government an extra $9.1 million each year.
6. It improves quality of water. All living creatures need clean water for survival. But soil erosion, which is a main problem of improper soil management, is the major source of sediments and contamination of water supplies.
7. It improves habitat of wildlife. It is said that soil conservation practices such as providing buffer strips and windbreaks, or replacing of soil organic matter, in great measure enhance environmental quality for wildlife conservation.
8. Aesthetic reasons. Soil conservation helps to provide more attractive and picturesque scenery of the environment.
9. It also helps to create an environment that is free of pollution suitable for humans.
10. For soil sustainability. Soil conservation helps protect the soil from unnecessary wastage during use today, so the future generations can have to support their lives.

4.5. Soil conservation practices

According to the definition of soil conservation, several practices are combined with a view to conserving the quality of the soil. As such, depending on its user, provided the goal of a user, which is to protect and conserve the soil quality is achieved, several variables of soil conservation practices are in the literature. For example, the Minnesota Department of Agriculture (2014), gave a list of about 55 different types of conservation practices. A cursory look at the list will reveal that some of the practices have very little difference per se. Hence for simplicity, the Johnston County Government (2015) classified these different practices into about fifteen types based on how close they are in operation. One special note about their view is that a distinction is drawn between soil conservation practices and wildlife habitat preservation. But due to the fact that soil conservation principles and that of wildlife habitat preservation overlaps or coincides, the latter is also discussed under the former. In this regard, below are the different classes of soil conservation practices according to the Johnston County Government (2015).

4.5.1. Conservation tillage

Conservation tillage is soil conservation practice which requires several other practices used to reduce wind and water erosion. The main principles are to keep bare soils protected throughout the year, either with living vegetation with residues from previous crops, and to reduce to a minimum the number of times a field is tilled. In conservation tillage, about 20-30% of the soil surface is covered with the crop residue from previous year after planting. This serves a lot of purpose. It reduces wind velocity, breaks the impact of raindrops, root systems hold the soil in place, and if practiced across slope, it slows down runoffs. One main type of conservation tillage is no-till farming. It consists of planting seeds into the residue of previous crop, with no tillage in between harvest. This thus leaves up to 60-70% of the field covered with crop residue. Another very important issue in the practice of conservation tillage is the choice of machinery used. Chisel ploughs for example, which leave 30-50% of the soil surface covered with residue, can be used instead of the traditional mouldboard plough which overturns and throw the soil leaving it bare to erosion impact.

Other advantages of conservation tillage are: increased water infiltration and organic matter into the soil; it saves fuel and time for the farmer; and it enhances wildlife habitat for soil organisms, birds and other small animals like mice and snakes.

4.5.2. Contour farming

Contour farming is a soil conservation practice most suited for sloppy environments. It actually involves tilling and planting crops along contours, rather than planting up and down a slope. The furrows and rows of plants act as dams which slow down running water down the slope thus reduce soil erosion in such area.

4.5.3. Strip cropping

Another very potent practice most effective in the control of erosion in sloppy environments when it is used along the contour of the land, is strip cropping. If the aim is to control wind erosion, the practice works best if the strips are at right angles to the direction of the prevailing wind.

Strip cropping therefore is a soil conservation practice which involves alternating strips of small grain (e.g. rye) or forage crops (e.g. clover) with row crops such as corn.

4.5.4. Windbreaks

Windbreaks or shelterbelts are vegetation barriers designed to reduce or eliminate wind speed and thus reduce erosion by wind. Although they are the same, a distinction can be made between windbreaks and shelter belts. While windbreaks consist of one to five rows of trees or shrubs, shelter belts are six or more rows wide. Both windbreaks and shelter belts help to check erosion. But above this, crop quality and livestock performance are improved because of less abrasion from blowing soil. A major advantage of windbreaks is their ability to enhance wildlife habitat.

4.5.5. Crop rotation

Crop rotation is a system of agriculture where the main crop planted in a farm is rotated, preferably with cereal crops such as winter wheat or forages like clover and alfalfa. One of its advantages is that the practice reduces the risk of insect and disease, as such limiting pesticide dependency.

4.5.6. Forage crops or legumes.

Forage crops or leguminous plants such as clover and alfalfa are often planted as green fertilizers or what is called plow-down crops. This means that they are cultivated and later mixed in with the soil as a natural form of fertilizer and soil builder. Legumes have the natural ability to fix atmospheric nitrogen and make it usable for plants. Also their deep roots create tunnels which allow air and water in the soil.

4.5.7. Cover crops

Cover crops are planted mostly in areas susceptible to erosion, like steep slopes, stream and river banks, and grassed waterways or around wells to protect contamination in ground water supplies. Examples of cover crops can be sweet clover, alfalfa, rye, and winter wheat.

These crops are planted to decrease the effect of wind and water on bare soils. They usually absorb the impact of rain, decrease the speed of runoff, hold soils in their place, and they encourage more infiltration, thus runoff is reduced.

4.5.8. Intercropping

This is the practice of mixing crops in a field. Examples can be cultivating leguminous crops between rows of corn or soybean. The practice may be recommended for poor farmers who may not be able to afford to take his/her entire crops of corn out of production.

4.5.9. Buffer strips

Buffer strips are areas of land adjacent to a water course vegetated with grasses or bushes. The plant cover helps to filter sediments out of runoffs; they hold soils in their place and prevent washout, slumping, and decrease in water quality because of siltation.

4.5.10. Grassed waterways

A grassed waterway is a permanently vegetated saucer-shaped channel designed to convey surface runoff across the land without allowing erosion of the soil. It is commonly practiced where there is gully or rill erosion taking place as a result of concentrated flow of water on the land.

4.5.11. Terrace

A terrace is designed to intercept runoffs on slopes, and reduce their erosive power on the soil down slope. It is actually a constructed earthen ridge with a water channel along its upper side. There are many design options, but normally the ridge and channel are permanently grassed.

4.5.12. Drop inlets and rock chutes

A drop inlet is made up of a vertical intake pipe and a horizontal underground pipe. Water enters the vertical pipe at the ground surface, and falls under where it is directed safely through a large pipe (concrete metal or plastic) into a stream or ditch. On the other hand, a rock chute is a pile of rocks designed to transport concentrated water flows over steep slopes. Both devices are often used to step down water where there are rapid changes in elevation, and thereby guiding against soil erosion.

4.5.13. Natural fertilizers

Natural fertilizers, like chemical fertilizers replenish the soil with basic nutrients such as nitrogen, phosphorus and potassium. But still, they have the extra benefit of providing soils with organic matter.

Examples of natural fertilizers are livestock manure, mulch, municipal sludge and leguminous plants like alfalfa or clover. Manure and sludge are used by spreading them over the land and then working it into the soil. However, it is advised that strict guidelines have to be taken in timing the applications, since sludge and manure can cause major water contamination if not well handled. Leguminous plants such as clover or alfalfa are grown and then tilled into soils as ‘green fertilizer’.

4.5.14. Bank stabilization

At the banks of rivers or streams, waves, stream current, ice and surface runoff can scour away soils. So bank stabilization is any measure taken to hold soils in place on the bank or a watercourse. Its benefit is that it reduces soil erosion, better water quality and an increased aesthetic environment.

4.5.15. Organic ecological growing

Organic ecological growing is a form of soil conservation practice consisting of minimizing or eliminating the use of synthetic fertilizers and pesticides, but nurturing a process of rich, long term balanced soil fertility through methods such as crop

rotation, conservation tillage and adding compost and manure to the soil to improve its quality.

4.5.16. Sediment control

Sediment control is a list of practices aimed at controlling the amount of soils carried away by water or wind especially in a construction site. This is because soil erosion is an inevitable consequence in a construction site.

4.5.16.1. A silt fence

A silt fence is a device used to contain silt on any property being developed. It filters runoff, and trap sediments behind a filter cloth. As in water erosion control, this device also works in wind erosion control.

4.5.16.2. A sediment trap

A sediment trap is of several forms, but the one now preferred is made up of a filter cloth and crushed stone barrier which is placed over an inlet to the storm sewer system. The stone prevents the movement of large particles while slowing down the speed; and also the cloth prevents the finer particles from entering the storm sewer.

4.5.16.3. A sedimentation pond

A sedimentation pond is most important in a construction site if large areas of land must stay exposed for long period. The pond consists of a large depression which allows sediments laden runoffs to be temporarily detained. This lowers the velocity of the runoff and allows soil particles to settle at the bottom of the pond. The water is then directed to an appropriate outlet, while the soil is removed and stabilized.

4.5.17. Integrated pest management (IPM)

IPM as a conservation practice uses a variety of techniques intended to reduce the use of chemical pesticides, and thus reduce environmental risks. The underlying principle of IPM is crop rotation. Through a yearly rotation of crops, pests are starved out and less likely to establish themselves in damaging proportions. Also, IPM uses pest resistant crops, and biological controls such as the release of pest predators or parasites for the purpose of controlling pest populations.

4.6. Conclusion

Soil conservation is a combination of practices which help to protect the soil from undue degradation. Although the list of soil conservation practices in the literature is

almost endless, the ultimate goal of all soil conservation practices is to protect the soil from undue damage and improve soil quality. So, any combination of practices aiming at the aforesaid objective is to be embraced. Farmers must adopt these practices, because a lack of adequate soil conservation is the reason why several agricultural lands have being abandoned till date. Due to the fact that adoption decision-making regarding the use of conservation practices begins with appropriate perception of the soil conservation technologies and the need for conservation, the next chapter that follows provides an explicit discussion of the methodology and research design for this study.

CHAPTER FIVE

Research methodology

5.0. Introduction

Research methodology is the “how” of data collection, as well as the processes through which the data is analysed within the framework of the research process (Brynard & Hanekom, 2006). Put in a different language, research methodology is the method of collecting data for a research, and the way the data is analysed and interpreted to give meaning (Ighodaro, 2012). In this section, basic aspects of discussion shall be a description of study area, research design, data sources, method of data collection, population for the study and population sample, sampling technique, and processes of data analysis.

5.1. Study area

The study area chosen for this study is the Qamata Irrigation Scheme, Intsika-Yethu Local Municipality, Chris Hani District Municipality, in the Eastern Cape of South Africa.

5.1.1. Selection of irrigation scheme

Prior to data collection, the researcher made some visits to some irrigation schemes in the Eastern Cape, in 2014 before finally settling on one. During the visits, it was discovered that some of them were not suited for the project, either due to non-functionality of the scheme or other reasons. For example, at one irrigation scheme at Whittlesea, Chris Hani District Municipality, the researcher found out that due to historical problems, the scheme currently is not functioning properly. The scheme is divided into two sections: crops and livestock. The livestock was better off than the crops. One reason was, because most of the members were now old, and no longer into active farming. This usually is the current trend of many agricultural development projects in most developing communities especially in sub-Saharan Africa, where agricultural decisions are now in the hands of old people, either due to the problem of rural-urban migration of youth, or the lack of interest of most youth in agriculture.

However some of the old farmers in that irrigation scheme do employ younger people to farm for them, but still this does not change the fact that farming decisions are in the hands of old people. According to part of the ethics of research,

respondents have the right to discontinue in an interview, or even not to participate, if they so wish to. As such, the study was therefore based on Qamata Irrigation Scheme only, which seems to be more organized, have been functioning for quite some time, and cooperation of many of the farmers also was far more encouraging.

5.1.2. Why smallholders in irrigation scheme?

Generally speaking, smallholder farming is regarded as informal and unorganized. Therefore conducting a study which seeks, amongst other things, how smallholder farmers adopt soil conservation practices would be better off, if conducted in a more organized environment. This is because this study assumes that farming in an irrigation scheme is more formal and organized, and there is supposedly a better adherence to recommendations for farming. The study also assumes, that amongst smallholders farmers, those in an irrigation scheme should be first to adopt soil conservation innovations, because their farming conditions are better off than their counterpart outside irrigation projects. For example, they have a standby extension officer who works with them from day to day, they are better funded, they have access to better marketing conditions, and they have full access to all benefits of cooperative farming. This is one main reason Qamata Irrigation Scheme, Eastern Cape was chosen as the study area.

5.1.3. Qamata Irrigation Scheme

Qamata Irrigation Scheme as a scheme started in the 1960s, but became operational in 1972. Due to low rainfall in the area, the area had experienced some periods of droughts. As such, a decision was reached to establish an irrigation scheme in order to combat hunger and food insecurity prevailing in the area. A total of four thousand hectares (4000ha) was allocated for the project. Land under cultivation varies according to seasons and available funds for crop production. But currently, land under cultivation is about two thousand hectares (2000ha), utilized in a four year cycle for different crops. The project is made up of six sections, representing different villages. The total beneficiaries making up the scheme is one thousand seven hundred and thirty-one (1731) beneficiaries, but farmers actively involved in farming in the scheme are 875 farmers. The scheme cuts across 12 smaller villages, run by 24 dams, with some of the dams, precisely dams 4, 5, 6, 7,

15 and 17 used to water garden plots in the area. The map of Qamata Irrigation Scheme is as presented in the Plate 1.

5.1.3.1. The location of Qamata Irrigation Scheme

Some of the villages that make up the scheme are Taleni in the north, Qamata Basin, Tatsi and Camama in the east, Nduluni in the southeast area, Mkhonjane and Xabisaweni in the west and Luxeni and Rwantsana in the northwest (Gidi, 2013).

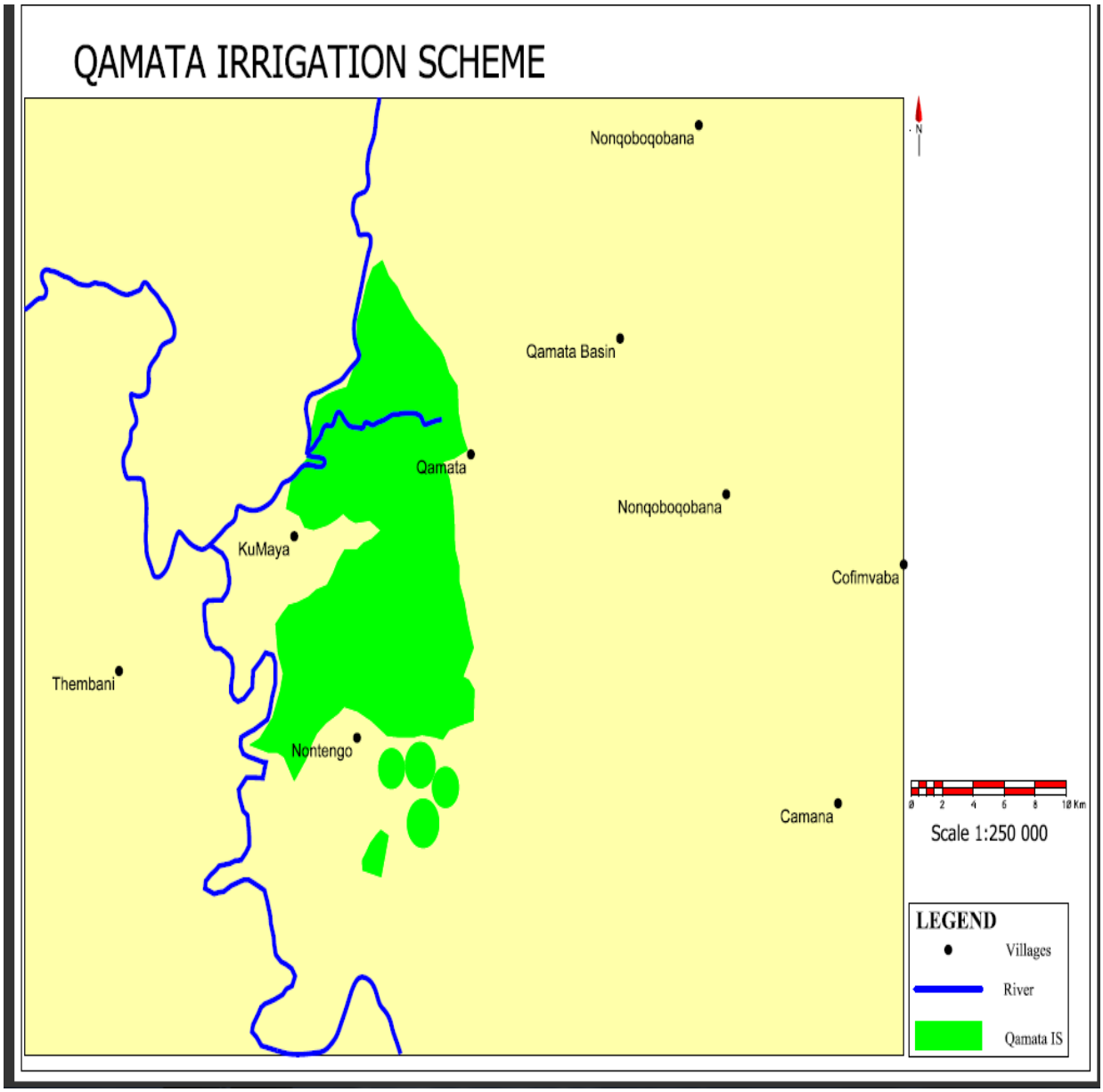

Plate 5.1: Map of Qamata Irrigation Scheme

5.1.3.2. The physical environment of Qamata

The physical environment represents the natural factors that make up any area. Some aspects of the physical environment are the nature of the soil, the weather

conditions, type of vegetation, et-cetera. The rural people engages and modify aspects of their physical environment like water and soil through the use of technology in order to increase agricultural production and address the challenges of poverty and deprivation. In the following section, various aspects of the physical environment of Qamata Irrigation Scheme are addressed.

5.1.3.2.1. Climatic conditions in Qamata

According to Manona (2005), cited by Gidi (2013) rainfall and temperature are the two main aspects of climate needed for crop production. Qamata community experiences a cool continental type of climate because of its special location (Gidi, 2013, reporting the Republic of Transkei 1991). It receives an annual rainfall average of 500mm, and it is highly unreliable in amount and distribution (Gidi, 2013, citing ARDRI, 1996). The impact of rainfall is said to be reduced in the area due to high run-off and high summer temperature; and recurrent droughts are said to be common, as such total crop failure in the dry-land farming areas is also said to be common (Gidi, 2013). The climate thus at Qamata determines the amount of surface run-off available for irrigation, the types and variety of crops grown and the types and frequency of most natural disasters (Gidi, 2013).

Summer temperature in the area varies from 24^0C in September to 29^0C between December and February, and winter is said to be cold: lowest temperatures are recorded in June and July when the mercury levels drop to about 12^0C on the average (Gidi, 2013). Further, the area is said to experience winds of low to moderate speed and variable direction, and wind is said to affect the cultivation of crops like tobacco, cotton and citrus (ARDRI, 1996, cited by Gidi, 2013).

5.1.3.2.2. Vegetation of the study area

According to the Republic of Transkei (1999), there is currently a false kind of bushveld due to the invasion of the dry Cymbopogon-Themeda veld in Qamata by thorn bushes. Also, due to overgrazing, annual grasses and weeds dominate the landscape of Qamata, and the problem of sheet erosion in the area makes it difficult to re-establish grass on the bare land (Gidi, 2013). Citing Bembridge (1984), Gidi (2013) opines that the veld nutritional level is favourable for livestock production.

More so, it is said that the light forests occurring along river valleys in the area are exploited to provide fuel needs by people in the area (Gidi, 2013).

5.1.3.2.3. Soils and soil erosion

According to ARDRI (1996), cited by Gidi (2013) the topsoil of Qamata consists majorly of sandy loam (alluvium), and of the total land in the basin initially earmarked for irrigation, only 47% is said to be suitable for surface irrigation due to the less permeable state of the subsoil. As such, citing Maitin (1990), Gidi (2013) states that by late 1980s, 390ha of irrigated land was either saline or waterlogged. Generally though, owing to the low rainfall and low temperatures experienced in Qamata, the soils are less leached and more fertile than those developed under moist conditions and cooler temperatures (Gidi, 2013, reporting Republic of Transkei, 1991).

5.1.3.3. General operation, management and performance of the scheme

The project is managed by what is called 'Producers Assembly'. The Producers' Assembly consist of two members from each location (section). In terms of daily and weekly operations, the scheme has the Producers' Assembly. Depending on which decision that needs to be taken, decisions are made. If it is decision relating to issues outside the project, the

Producers Assembly takes the lead, but if it relates to micro decisions, sections or even land owners are responsible for such decisions.

Focus of the scheme: Major crops planted by beneficiaries are maize (yellow and green), cabbage, lurcene, butternut, potatoes, spinach, carrot, beetroot, lurcene and green pepper (but in small quantities). Amongst all the crops, lurcene contributes a great deal to the economy and social wellbeing of the farmers. They are sold to other farmers outside the scheme, and also used to feed their livestock. The project is not focussed on livestock production, even though farmers do rear livestock outside the scheme. The development of wool and red meat by Farmers Association is gradually being considered for the scheme.

The irrigation system of the scheme: The project operates majorly the flood irrigation system, which primarily is a system of irrigation where water is allowed to flood an area of land planted with crops. In the scheme, only section 6, Ntshingeni village utilizes central pivot irrigation.

Soil conservation practices: The basic methods introduced by extension officers for land management to farmers in the scheme are crop rotation, reduced run-off water and limited mechanical operation such as use of heavy disc instead of the plough, which limits soil disintegration or breakdown. In the project, most of the farmers are full time farmers, which seem to be a positive factor in terms of the objective of this study, because full time farmers are hypothesized to be more willing to adopt soil conservation practices than part time farmers. This is because of several reasons like the fact that farming to the former is regarded as their main occupation, they are always there to spot easily any farm problem that requires quick mitigation, and they have better chances to receive advices from extension officers who are always there with them.

Land use: Among all land use in the area, the two most important uses of land is for crop farming, as in the irrigation scheme, and livestock grazing. They usually graze their livestock in-between plantings, especially in areas that are usually planted with crops.

Source of water: The Qamata Irrigation Scheme receives water from the Lubisi Dam, which is then channelled to the scheme through canals to feed the dams, and then the farrows, to water the farms.

Marketing of agricultural produce: Crops are mostly marketed at farm gates. They are transported with bakkies or transported to town when they have a temporary contract with shops, or even sold along the R61 road.

Leasing of land: There seem to be a strong institution guiding the leasing of land at the irrigation scheme. An agreement between the leasee and the leasor is signed in the presence of the sectional chairperson. Payment is made in monetary form or in the form of bags of maize at the end of the planting season.

Infrastructures at the scheme: Generally, the scheme owns all the infrastructures within it, which are managed by the Producers Assembly. The scheme has 16 tractors with implements. Two of those tractors are specifically for the production of Lurcene. Nine of the tractors are also managed by government officials, which provide services according to government programmes in the scheme.

Funding: In terms of funding, some of the farmers are independent, while there are those who require assistance from time to time. Also farmers themselves engage in some contributions to assist their operations. According to the interviewed extension agent, she (in conjunction with some others) in the management of the scheme, have been there for 10 years, which also could be regarded as a positive factor in relation to the objective of this study, especially in terms of the credibility of needed information.

Level of improvements: There are some improvements in the quantity of farm yield in the scheme, as well as increase in the number of hectares used for cultivation. Although the scheme at some stage was closed down, with some of its structures destroyed, it however was later revived through farmers commitment, government contributions, rehabilitation programmes (aiming at fixing the infrastructures like dams, valves and canals and mechanical equipment such as tractors and implements) which have assisted in the growth of the project.

General performance of the scheme: Generally speaking, the overall performance of scheme, general farming and farmers' level of adherence to extension officers' advices and recommendations, are said to be on average.

5.2. Research design

A research design is the overall approach a researcher has taken to test his/her thesis statement; also, it is the particular way or technique the researcher has designed in order to arrive at a reliable, well-argued conclusion (Hofstee 2009). There are several research designs in the literature, depending on the field of study some are most frequent. One of the yardsticks for a good research is the ability of the researcher to name which type of design path is chosen for the particular study. As such, the research design chosen for this study is the case study research design.

5.2.1. What is a case study research design?

According to Zucker (2001 & 2009), various definitions and understandings abound for the case study research design. However, citing Bromley (1990), case study is defined as a systematic inquiry into events or sets of associated events, aiming to describe and explain the phenomenon of interest. In the views of Yin (1994), the

case study is an empirical inquiry that studies a contemporary phenomenon within the context of its real-life, especially when the boundaries existing between events and context are obscure. Yin (1994) further maintains that every case study design must have five components. These are the research questions, its proposals, its units of analysis, a determination of how the data links up with the propositions and criteria to interpret the findings.

Stake (1995) recognizes five types of case studies depending on the purpose of an inquiry: instrumental; intrinsic; collective; the teaching and the biographic case studies. For the instrumental case study for example, it is used to provide insight into an issue of concern. Also the intrinsic case study is carried out to gain a deeper understanding of a case; why the collective case study is an investigation of a number of cases in order to inquire into a phenomenon of interest.

Just as there is nothing in life with advantages that do not have disadvantages. Similarly, some have raised certain concerns or criticisms against the case study method of research. Yin (1994) in his book, tries to allay some of the concerns. One of the concerns sometimes is, whether the case study can be used for researches requiring quantity data and reporting also is in quantity. According to Yin (1994), the contrast between quantitative and qualitative evidence does not distinguish the different research approaches. Further, there are some experimental and survey researches that rely on qualitative (descriptive), and not quantitative evidence, and likewise, there are some historical researches that include enormous amounts of quantitative evidence (Yin, 1994). His general advice is that, the case study strategy should not be confused with ‘qualitative research’, per se. The point that needs proper clarification is that case studies can be based on any mix of quantitative and qualitative evidences and approaches (Yin 1994). Based on this, this study uses a mix of quantitative and qualitative data as would be realized in the analysis, presentation and discussion chapters.

5.2.2. Why a case study research design?

In the opinion of Mouton (2009), as a design is a blueprint in the building of a house, in like manner is a research design to a research study. A research design actually is the road map for any study. Based on this, Mouton (2009) thus suggests that what

should determine a research design are the intentions of the researcher, as well as the envisaged results. Although Patton (2002) acknowledges the crucial role of research goal in determining the research design and the analysis that should follow, he however agrees to the fact that there is no perfect research design. Due to this factor, necessary compromise then has to be made based on real life limitations such as the time needed to complete the study in question.

Due to a lack of an appropriate design name, this study adopts the case study design as its research design for some reasons. One is that, though the study reasoning is not altogether that of a case study, but because it seems closer to the case study, hence the design name. This is because the goal of the research is trying to understand how smallholder farmers in South Africa responds to soil conservation practices, using the farming situation of Qamata Irrigation Scheme in the Eastern Cape as a case study. If the study was focusing on the irrigation scheme as an individual entity, the case study design name would have been very fitting. But it is rather focusing on smallholder farmers in the scheme, which in a way makes it look like a survey. For in actual sense, a case study focuses on one or few phenomena to study in-depth. In this case, the focus of study is on certain people farming in an irrigation scheme.

According to estimate, there are about four million smallholder farmers in South Africa, who practice smallholder agriculture for various reasons; and majority is said to reside in the former homeland areas (Baiphethi & Jacobs, 2009). Some of the characteristics of these set of producers in South Africa, according to literature, include inadequate capital, inadequate education and technical know-how, lack of market information, small volumes or subsistence production, and so forth. The assumption regarding smallholder farmers is that there is no formal way of farming like you would have in the commercial large scale sector. In other words, proper order in daily operations and strict adherence to recommended practices is often lacking among smallholder farmers due to the aforementioned. Therefore, choosing an irrigation scheme was based on the premise that smallholder farmers in an irrigation scheme, where there seems to be a more orderly way of farming, would be an easy benchmark of understanding for the study.

The expectation is that, research results on smallholder farmers from an irrigation scheme should be more informative and provide a better understanding of how much smallholder farmers in South Africa are deciding on soil conservation practices in the country.

5.3. Unit of analysis

Units of analysis are specific objects (animate or inanimate) that information for researches is focused on. Babbie (2010) posits that units of analysis are things examined in a research, and on which findings and conclusions are based. On this, Rosenburg (1968) maintains that there are individual, group, organizational, institutional, spatial, cultural and societal units of analysis. In this regard, the units of analysis for this study are smallholder farmers (male and female) farming at the Qamata Irrigation Scheme, Eastern Cape Province.

5.4. Method of data collection

According to this study, method of data collection is defined as all the various processes followed in the bid to obtain data for the research. This begins with sources of data: primary and secondary data sources, population and population sample, as well as the sampling procedure utilized in the selecting samples for the study.

5.4.1. Sources of data

Based on the foregoing, data for this study were carefully selected to meet up with the desired objectives. Durosaro (n.d) defines data as statistics. He also said that data are numerical measures of phenomena and they are used in the course of scientific decision making. Blankenship (2013) comments that the actual research study begins with data collection; and that data collection is a critical step in providing the information needed to answer the research question. In other words, getting the right information is of primary importance in the research process. In this study, the primary data source therefore includes field observation, interviews and questionnaire administration.

5.4.1.1. Primary data sources:

According to California State University (2012), primary data sources are first hand evidence observed by observers at the time of an event. Some of the examples

offered are: autobiographies, memoirs, diaries, emails, oral histories, letters, correspondences, eyewitnesses' accounts, first-hand newspaper and magazine accounts of events, and legal cases. Others include treaties, statistics, surveys, opinion polls, scientific data, transcripts, records of organizations and government agencies, original works of literature, art or music, cartoons, postcards, posters, map, photographs, films, objects and artefacts that reflect the time period in which they were created. One crucial importance of primary data source is that it is a first-hand testimony regarding a subject under study (California State University, 2012).

According to the design of this study, the following procedures were taken to acquire primary data for the study:

1. **Ethical clearance**: The researcher had to first of all ensure an ethical clearance from the University of Fort Hare (Appendix 2), as part of the policy requirements for data collection by all researchers in the institution. This was formally approved in 2014
2. **Reconnaissance survey**: Sequel to the ethical clearance, the researcher had to make some first visits to the irrigation scheme of interest through the assistance of the Extension Department covering the particular area of the scheme. From the Extension Departments, the researcher was then directed to the particular Extension Officer in charge of the scheme as a manager. As such, a formal introduction and familiarization was made.
3. **A sample survey:** Through the extension officer working at the scheme, a sample of some possible soil conservation technologies were taken. This was needed so that the study can have an idea of some recommended soil conservation practices already introduced in the area.
4. **Questionnaire administration and interview**: In view of the above, primary data was collected with the aid of questionnaires (from smallholder farmers in the study area) and oral interviews and questionnaire (from the extension officer in the scheme).

5.4.1.2. Literature review information

In this study, real secondary data is differentiated from secondary information. Real secondary data are data such as farm records, and the likes which are first hand record of events. These were not used in this study. Unlike real secondary data, secondary information is information from published or unpublished literatures that

were utilized for the literature review process. According to the California State University (2012), secondary data sources are materials or resources that digest, analyze, evaluate and interpret information from primary sources or other secondary sources of information. Stated differently, they are information obtained from sources/ persons that are not direct observers or participants of the events under study. Examples of such sources are: books, such as biographies, textbooks, encyclopaedias, dictionaries, handbooks, articles, such as literature reviews, commentaries, research articles in all subject disciplines, criticisms of works of literature, art and music (California State University, 2012).

5.4.2. Population for the study

A population distribution refers to the entire object, subjects, events, phenomena, activities or cases which the researcher wishes to investigate in order to establish new knowledge (Brynard & Hanekom, 2006). Based on this, the focus population for this study was all smallholder farmers belonging to the Qamata Irrigation Scheme Project, Cofivamba, Intsika-Yethu Local Municipality, in Chris Hani District Municipality, Eastern Cape.

5.4.3. Population sample

Due to some peculiar reasons in a research, it is usually almost an impossible thing focussing on a whole population, except when the population is few in number. As such, a representation of the population is usually sought. This is why Field (2005) defines a sample as a smaller, but hopefully representative, collection of units from a population used to ascertain truths about the said population. In this light, two reasons were offered for sampling:

1. Due to the problem of inadequate resources (e.g. money and time) and workload.
2. Samples give results with known accuracy that can be calculated mathematically.

Based on this, a population sample representation of a rounded figure of 8% (since this is close to the 10% sample recommendation) of total active farmers (875), farming on crops at Qamata Irrigation Scheme, Cofivamba, were selected using a focus group interview section with farmers. This made a total of 70 smallholder farmers (sample representation is as calculated in the Box 5.1, using the formula

suggested by Statistics Canada 2013). In this process, an interview meeting was scheduled through the assistance of the extension officer managing the scheme. On the said meeting, the researcher first of all introduced the study, and explained to the understanding of farmers what the survey was all about. Opportunities were also provided for farmers to ask questions if there is any area that is not understood. Thereafter, with the help of three survey assistants (enumerators), who also understand the language (Xhosa) of farmers, farmers were interviewed right there through a one-on-one collection process, with the aid of a semi-structured questionnaire.

One main challenge associated with data collection of this nature is the problem of farmers' unwillingness to open up for discussion during interviews (conservatism), especially when the researcher does not understand the native language of farmers. One way this was overcome was that enumerators were first trained to employ specific protocol to establish good rapport and to encourage farmers to cooperate fine and provide honest and unbiased answers (Mukarumbwa 2009). Also, an introductory process was first provided by the researcher to explain research and its goals, in conjunction with an interpreter who interpreted in the dialect of farmers. Further, survey assistants employed were all Xhosa speaking. This not only assisted in overcoming the above problem, but also helped in providing consistency and reliability of information obtained.

Box 5.1: Calculation for sample representation (after Statistics Canada 2013)

Sample representation**=** (**n** ÷ **N**) x 100%

n= Number of samples

N= Total number of population

Therefore, study sample representation= (70 ⁺ 875) * 100%

= 8%

5.4.4. Sampling technique

It is not always feasible to study a whole population, except the situation where the population is few; this is the reason for sampling (Ighodaro 2012). The National Audit Office, Statistical and Technical Team 1992), maintains that sampling is important

because it provides a way of gaining information about the character of a certain population without the need of examining the whole population.

In view of sampling, three potential pitfalls that should be kept in view by researchers according to the National Audit Office, Statistical and Technical Team (1992), are:

1. Although sampling is said to be capable of providing a valid, defensible methodology, however it is always important to match the type of sample needed for a study with the type of analysis required.

2. A second caution is that, the user of a sampling technique must take care to check the quality of the information from which the sample is to be drawn.

3. Finally, the user of samples must know that if the quality of the sample in question is poor, sampling may not be justified.

Based on this, smallholder farmers at the Qamata Irrigation Scheme were selected using the availability sampling process and the extension officer managing the scheme was chosen based on purpose. The availability sampling process is the process whereby respondents who are available at the time of interviews are the only ones selected for interview. Although this process do have its flaws, it was however considered for this study to overcome problems like the type encountered in Zanyokwe Irrigation Scheme (a scheme that was earlier proposed in association with Qamata Irrigation Scheme), where certain farmers, due to reasons best known to them, become uninterested with the surveys. This usually happens especially when farmers realize there is no immediate benefit associated with the survey, and also due to farmers' complaints that many researchers do come to them time and time again, and they offer responses, but they as farmers never receive reports regarding findings of such surveys. Another reason is the problem of misconception of such survey meetings with political meetings. Most politicians make empty promises to rural people which are never kept. As such, all other meetings with visitors are judged the same way. More so is the problem of rural poverty. Due to the poverty situation of most communities especially in the Eastern Cape, any meeting with an outside visitor is perceived as an occasion for financial benefits, and when this is not the case, they sometimes become uninterested.

Other reasons for the adoption of the availability sampling technique are due to the ease of its use, both in operation and in relation to time, and the cost-effective nature associated with its use, especially because the study right from its inception to finishing was totally the self-effort of the researcher.

5.5. Limitations to the study

Without any doubt, a study like this is associated with several limitations. As such, some of the key challenges encountered in the entire period of this study are outlined below.

1. Financial challenge: One of the main challenges that limited the extent of the quality of this study was inadequate fund. The fact there was no funding for the study limited the study in a number of ways. For example, a study like this would be better of if larger numbers of irrigation schemes or smallholder farmers in the entire local municipality of the Eastern Cape Province, and even in the whole of South Africa are interviewed.
2. Problem of time. Time is usually a major constraint in a project like this. This is because most soil degradation factors such as soil erosion takes a long time to develop. Apart from measuring the adoption of soil conservation practices, there are other aspects of soil conservation studies that add some level of robustness to a study like this. For example, adequate time is needed to measure and study the rate of soil erosion, as well as the rate of soil fertility decline, which is most times inadequate in a study like this. Although the aforementioned are not the focus of this study, incorporating such aspects into the study surely would have enhanced its outcome in an immeasurable way, if not the problem of time.
3. Another major challenge is the unwillingness of some farmers to participate in the interview sessions. Since it is an organized scheme, one would have expected 100 percent cooperation from farmers. But the reverse is the case. Some meetings were called, where some farmers refused turning up, and even sometimes, among those who turn up, some will deliberately be uninterested in participating in the interviews, especially when they realize there are no financial gains on their part attached to the survey.

4. Problem of data collection. This is largely due to the problem of a lack of fund. Since the researcher do not speak the local dialect of the people, there was therefore a dare need to employ survey assistants.
5. Another challenge was that, originally the study anticipated a situation where there is one or two soil conservation technologies already known and introduced to farmers. But this was not the case, as most of them do not even know the meaning of soil conservation, even though there were some traditional and introduced soil conservation practices being used for soil management.

5.6. A conceptual framework for the study

The underlying principle behind the use of problem conceptualization is the understanding and belief that “a problem well put, is also a problem half solved” (Dűvel, 1991). Thus, a conceptual framework can be defined as a theoretical map that provides an appropriate guidance for a research endeavour (Sinclair, 2007). Just like the human skeleton, a conceptual framework assist in providing a mental reasoning in the process of resolving a research problem. Dűvel (1991) thus defined a conceptual framework as a mental construct which provides for the researcher a scientific basis for a purposeful and systematic probing into factors responsible for a problem, and it also offers a frame of reference where problems in extension are investigated. Based on this, the Figure 5.1 is a conceptual framework of reasoning around the problem of this study, and it provides a basis for the information needs of the study.

Based on the logical reasoning or central argument of this study, every holistic understanding and analysis of the adoption decision-making process must view the adoption process in four basic stages: the perception stage; the adoption decision stage; the level and extent of adoption stage; and the impact of adoption stage. According to the Figure 5.1, although it is argued that several other factors (personal, institutional, economic and environmental) prevail on the perception of individuals, perception happens to be the variable through which all other variables reflect, including the other mediating (cognitive) variables like needs and knowledge. Although there are literature supports, in part or whole, aspects of this argument, the closest views are those that include the intermediate stage in-between the

independent and dependent variables; views such as that of Tolman (1967) and Dűvel (1991). Using this concept, basic aspects that were interrogated by this research include the following, as reflected in the Table 5.1.

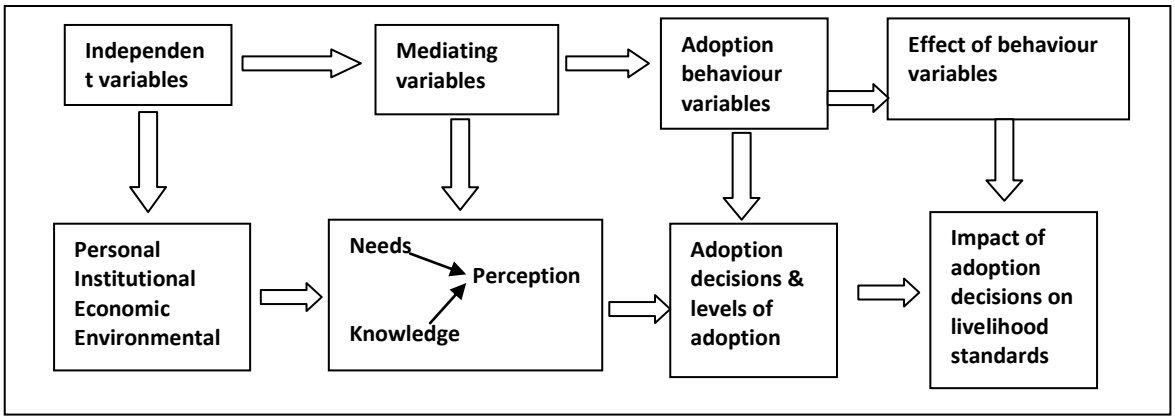

Figure 5.1: A simple conceptual framework for the study

Table 5.1: A simple conceptualization for the information needs of the study

Independent factors	Intermediate factors	Adoption factors	Impact of adoption factors
Personal: Age, education levels, gender, household size, farm type, length of time of continuously farming on one spot,	How is farmers' perception for soil conservation practices affected by personal characters of the farmer?	How do farmers' personal factors affect their adoption decisions and the level of their adoption decisions?	How has the adoption of soil conservation practices by farmers affected their educational capacity, household size, and their type of farming?
Institutional: Participation in extension	How is farmers' perception for soil conservation practices affected by farmers' participation in extension activities?	How does farmers' participation in extension programmes affect their adoption decisions and the level of their adoption decisions?	How has the adoption of soil conservation practices by farmers affected their extension participation?
Economic: Incomes, level of crop and livestock production	How is farmers' perception for soil conservation practices affected by economic variables of the farmer?	How do farmers' economic factors affect their adoption decisions and level of their adoption decisions?	How has the adoption of soil conservation by farmers affected their incomes, level of crop and livestock production?
Physical: Size of farm	How is farmers' perception for soil conservation practices affected by the size of their farms?	How do farmers' farm size affect their adoption decisions and level of their adoption decisions?	How has the adoption of soil conservation practices by farmers affected their size of farm?

5.7. Data analysis and interpretation

The primary data for this study were coded, captured and analysed using the Statistical Package for the Social Sciences (SPSS) version 23. Reporting was with the aid of basic descriptive statistical measures such as frequencies, percentages, means, pie and bar charts, while empirical analysis was with binary logistics regression, multinomial logistic regression, as well as the multiple regression analysis.

Speaking on this, Annor-Frempong and Dűvel (2009) suggest that descriptive statistics such as frequencies, percentages, means, bar and pie charts are first steps, required to determine the distribution of variables and to provide a summary for large amounts of information. However to test for relationships (such as the understanding of the effect of independent variables, predictors, on the dependent, outcome, variables) which exist between variables, other higher statistical tests are required (Annor-Frempong and Dűvel, 2009). In this regard, in the Table 5.2, a list of the study objectives, as well as measures adopted for their measurements are provided.

Table 5. 2: Research objectives and measures of analysis

Research objectives	Proposed measure of analysis
To assess smallholder farmers' perception on soil conservation practices in the study area	Descriptive statistics
To identify what smallholder farmers are currently doing to conserve the soils of their area	Descriptive statistics
To determine factors which influence smallholder farmers' adoption decision making processes in decision making around soil conservation practices in the study area	Binary logistics
To evaluate the level and intensity of smallholder farmers' participation in extension recommended practices for soil conservation in the study area	Multinomial regression analysis
To evaluate what impact smallholder farmer's perception on soil conservation practices has on their adoption decision-making processes.	Multiple regression analysis
To evaluate how adoption decision-making by farmers impacts on farmers livelihoods in the study area	Multiple regression analysis

5.7.1. Model specification

As indicated (Table 5.2), the binary logistic regression was used for the analysis of objective three; the multinomial regression analysis was used for objective four; while the multiple regression analysis was used for objectives five and six, respectively. These are specified variously as follows:

5.7.1.1. The binary logistic regression analysis

The binary logistic regression analysis was used in this study to analyse objective three since it deals with issues of whether or not farmers are adopting soil conservation practices (dichotomous variables).

In the study area, primary data was gathered using a pretested structured questionnaire. The questionnaire was used to capture data on farmers' demographic and personal characteristics, farmers' adoption decision-making regarding soil conservation practices, factors influencing farmers' adoption of soil conservation technologies in the study area, as well as the impact of farmers' adoption decision-making on their livelihoods.

The binary logistic regression analysis was used to investigate the manipulative power of adoption decision-making processes based on factors that may influence smallholder farmers to adopt soil conservation technologies among soil conservation technologies' participants and non-participants, to which smallholder farmers adoption decision-making processes is taken as the dependent variable. According to Tranmer and Elliot (2008), in scenarios where the response variable is dichotomous or 0/1 as in this study, the most common analytic technique is to use the binary logistic regression model.

Using a randomly sampled data based on farmers' adoption decision-making processes; two homogenous mutually exclusive strata was created for independent variables' analysis. The SPSS statistical software package version 23.0 was used for the econometric analysis. The dependent variable was dichotomized with a value of '0' or 'yes' if a farmer preferred their own soil conservation practice (Non-SCP adopter) and '1' or 'no' if they preferred extension recommendations (SCP adopter). In other words, the question for dependent variable was constructed thus: 'do you prefer your own soil conservation practice to extension recommended practices? Seventeen input or predictor independent variables, based on farmer perceptions and soil conservation practice factors, were regressed against the binary outcome variable of soil conservation adoption decision-making status of smallholder farmers. Farmers participating in soil conservation practices are based on an assumption that each attains household food security through increased productivity from participating in soil conservation practices for production.

According to this theory, households are hypothesized to participate more in soil conservation practices, if the utility resulting from participation exceeds that of non-participation. The binary logistic model as indicated in equation (1), according to Tranmer and Elliot (2008) and Gujarati (1992), was used to predict the manipulative power of farmers' adoption based factors that may influence smallholder farmers to participate in the use of soil conservation technologies introduced by extension officers.

$$\ln\left\{\frac{\left(p(Y=\frac{1}{X})\right)}{\left(1-P(Y=\frac{1}{X})\right)}\right\} = \alpha + \beta 1X1 + \cdots + \beta nXn \quad \text{..... (1)}$$

Where p= the predicted probability of farmers' adoption making processes; 1-p= the predicted probability of non adoption/ participants; α= the constant of the equation; β= the coefficient of predictor variables; X= the predictor variables. Incorporating all variables into the model, the model could be presented as follows:

$$\ln \frac{\left(p(Y=\frac{1}{X})\right)}{\left(1-P(Y=\frac{1}{X})\right)} = \alpha + \beta 1AGE + \beta 2EDU + \beta 3MAR + \beta 4GEND + \beta 5EXP + \beta 6FARMSIZE + \beta 7LANDOWN + \beta 8SOURLAND + \beta 9FARMINC + \beta 10OFFFINC + \beta 11TOTALINC + \beta 12HHSIZE + \beta 13FARMAWAR + \beta 14PARTEXT + 15FARMTYPE + 16LENTFARM + 17CROPPROD + Btimecont \text{.....(2)}$$

The following advantages and assumptions were put forth by Laerd Statistics (2013).

5.7.1.1.1. Advantages of the binary logistic regression analysis

1. One such advantage of using the binary logistic regression analysis over other models is that there is no assumption of normal distribution needed to run the model.
2. Secondly, the binary logistic regression does not produce negative prediction probabilities.
3. More so, all probability values under the binary logistic regression are positive and range from 0 to 1
4. Another advantage is that you can use the binary logistic regression in any measurement scale.
5. Finally, the binary logistic regression can be used for dependent variables that have a nonlinear relationship.

5.7.1.1.2. Assumptions of the binary logistic regression

1. The first assumption to consider is that your dependent variable should be measured on a dichotomous scale.
2. Your data should be composed of one or more independent variables, which are either continuous (i.e. an interval or ratio variable) or categorical (i.e. an ordinal or nominal scale) variable.
3. Your data process should consist of independent observations and the dependent variable should have mutually and exhaustive categories.
4. The fourth assumption is that there has to be a linear relationship between any continuous independent variables and the logit transformation of the dependent variable.

5.7.1.2. The multinomial regression analysis

According to Laerd Statistics (2013), the multinomial logistic regression, often known as 'multinomial regression' is used when predicting a nominal dependent variable given one or more independent variables. Further, it was said that sometimes, the multinomial regression is considered an extension of the binary logistic regression to provide a dependent variable with more than two categories. In support, Sikwela (2013) suggests that the multinomial logistic regression, also called a logit model, is used when there are more than two outcomes for the dependent variable. Like other types of multinomial regression, the multinomial regression can have nominal and/or continuous independent variables and can have interactions between the various independent variables to predict the dependent variable (Laerd Statistics 2013).

In this study, the multinomial regression model was used to model the relationship which exist between the level of farmers' participation in extension recommended soil conservation practices in the study area and various independent variables such as age, gender, marital status, household head, education levels, size of farms, time of continuous farming on one plot, non-farm income, total income, farming experience, awareness of soil conservation practice by extension officers, and extension participation. These were modelled as in equation (1), as adapted from Verbeek (2004).

y_i= 0, if participation in soil conservation practices by extension officers is low;

y_i= 1, if participation in soil conservation practices by extension is moderate;

y_i = 2, if participation in extension recommended practices is high.

$$P\{yi = j\} = \frac{\exp\{xi\beta j\}}{1+\exp\{xi\beta 2\}+\cdots+\exp\{xi\beta M\}} \quad \text{.....(3)}$$

For j= 1,2,3...M

For each group that the smallholder farmer belongs to provides a set of parameters estimates using log-odds ratio (relative probabilities):

$$\log\left[\frac{P\{yi=j\}}{P\{yi=1\}}\right] = xi\beta j \text{ and } \log\left[\frac{P\{yi=j\}}{P\{yi=k\}}\right] = xi(\beta j - \beta k) \quad \text{.....(4)}$$

Marginal effects:

$$\frac{\partial pj}{\partial xi} = pj(\beta i - \beta) with\ \beta = \sum_{k-1}^{j} pk\beta k \quad \text{.....(5)}$$

5.7.1.2.1. Assumptions of the multinomial logistic regression

When the choice is made for data analysis using the multinomial regression, care must be taken to ensure data 'passes' six assumptions prescribed for the model to achieve a valid result (Laerd Statistics, 2013). However, it was stated that, unlike textbook prescriptions, often prescribed when all things goes well, in applying the model to real-world data, there should not be any surprise when one or more of the assumptions are violated. The following assumptions are as prescribed by Laerd Statistics (2013).

Assumption 1: The dependent variable should be a nominal variable. If the dependent variable is ordinal, then the fitting model should be ordinal logistic regression.

Assumption 2: The proposed data for use should be one or more independent variables that are continuous, ordinal or nominal. When ordinal variables are used, they must be treated as continuous or categorical variables.

Assumption 3: The data should have independence of observations, and the dependent variable should have mutually exclusive and exhaustive categories.

Assumption 4: There should be no multicollinearity of variables. This do occur when two or more independent variables are highly correlated with each other, which often leads to the problem of not being able to understand which variable contributes to

explaining the dependent variable. Determining for multicollinearity is therefore a major step in running multinomial regression.

Assumption 5: There also has to be a linear relationship between any of the continuous independent variables and the logit transformation of the dependent variable.

Assumption 6: Finally, there should be outliers, high leverage values or highly influential points in the model.

5.7.1.3. Description and units of variables used in the binary and multinomial logistic models

The binary and multinomial regression models were used to measure factors of adoption and the intensity of adoption in the study area. The Table 5.3 therefore is a description of the various independent variables (seventeen in all) inputted into the two models, as well as their units of measurement.

Table 5.3: Description and units of variables used in the binary and multinomial regressions

Variables		Description	Unit of measurement
	Dependent variables:		
Y_i	FARMPREF	Do you prefer your own soil practices to the recommended practices by extension?	0= Yes or 1= No
Y_i	EXTMREC	Level of farmer's participation in conservation practices introduced to them	1= Crop rotation; 2= Conservation tillage; 3= Others
	Independent variables:		
X_1	AGE	Age of farmer	Years
X_2	EDUCATE	Education of farmer	Years
X_3	MARRIAGE	Marital status of farmer	1=Married; 2= Single; 3= Divorced; 4= Widow/widower
X_4	GENDER	Gender of farmer	0= Male; or 1= female
X_5	EXP	Farm experience of farmer	Years
X_6	FARMSIZE	Size of farm	Hectares
X_7	LANDOWN	Land ownership	0= Yes or 1= No
X_8	SOURLAND	Sources of land	1= Government; 2= Rented; 3= Inheritance; 4= Purchase; 5= Community; & 6= Others
X_9	FARMINC	Income from crops	Rand
X_{10}	OFFFINC	Off farm income	Rand
X_{11}	TOTALINC	Total income of farmer	Rand
X_{12}	HHSIZE	Household size	Numbers
X_{13}	FARMAWAR	Farmer's awareness of soil conservation practice	0= Yes; or 1= No
X_{14}	PARTEXT	Is the farmer attending extension programmes?	0= Yes; or 1= No
X_{15}	FARMTYPE	Farming type of farmer	1= Smallholder; 2= Commercial;3= Others
X_{16}	LENTFARM	Time of continuous farming on same piece of land	Years
X_{17}	CROPPROD	Level of crop yield	1= Insufficient for own consumption; 2= Just enough for own consumption; 3= Just enough for own consumption & ceremony; 4= Sufficient excess for limited sale; 5= Sufficient excess for expanded sale

5.7.1.4. The multiple regression analysis

Multiple regression, according to Gujarati (1992), cited by Melusi (2012) is defined as a technique of statistics that allows the user the occasion of being able to predict the

result of a dependent variable based on the scores of various other variables, called the independent or input variables. Laerd Statistics (2013) also posits that multiple regression analysis is used when there is the need to predict the value of a variable (called the dependent variable or criterion variable) based on the value of two or more other variables (called the independent variables or explanatory or regressor variables). The multiple regression analysis models take the form indicated below:

$$y = \alpha + \beta x + \varepsilon \quad \text{..... (3)}$$

Where y= (1) Smallholder farmers' perception regarding the soil conservation practices introduced by extension; and

(2) Smallholder farmers' adoption decision-making process of study area.

x= Exogenous input data of adoption decision-making processes (independent variables)

α = Intercept of y, and

β= Partial regression coefficient (Parameters to be estimated)

Ɛ = The stochastic error term

Based on this study, the regression model for smallholder farmers' adoption decision-making process of study area shall be modelled as follows:

$$A = \alpha + \beta x + \varepsilon \quad \text{..... (4)}$$

Where A= Dependent variable (Farmers adoption decision-making process)

According to this study, the main variables compared are: smallholder farmers' adoption decision-making process and factors influencing smallholder farmers' adoption decision-making process. The equation was specified as follows:

A= β1EDUCATE+ β2MARRIAGE+ β3FARMSIZE+ β4LANDOWN+ 5BSOURLAND+ β6FARMINC+ β7OFFFINC+ β8TOTALINC+ β9PARTEXT+ β10FARMTYPE+ 11Blentfarm+ 12CROPPROD+ 13LIVEPROD.

5.7.1.4.1. Assumptions of the multiple regression analysis

When a researcher chooses to use the multiple regression analysis for analysis, as in the use of multinomial regression, the following eight assumptions, according to Laerd Statistics (2013), will have to be ensured for the model to achieve a valid result. It was also noted that there should not be any surprise if while using the model for analysis, one or more of the assumptions is violated. The reason this is likely to occur is due to the fact that there is usually a difference between textbook examples, which reflect a situation where all things are equal, and a real-world data.

Assumption 1: The dependent variable must be measured on a continuous scale, that is either an interval or ratio variable. If the dependent variable is measured on an ordinal scale, then the most appropriate regression model will be an ordinal regression.

Assumption 2: There has to be a two or more independent variables, which may be either continuous or categorical (an ordinal or nominal variable).

Assumption 3: There has to be independence of observations. That is independence of residuals, which can easily be checked using the Durbin-Watson statistics.

Assumption 4: There also has to be a linear relationship between the dependent variable and each of the independent variables, as well as the dependent variable and the independent variable collectively. To check for linearity, creating a scatterplots and partial regression plots using SPSS Statistics, and visually inspecting these plots, are suggested ways of checking for linearity.

Assumption 5: Data must show homoscedasticity. This is where the variances along the line of best fit remain similar as one move along the line. As such, when analysis is done, there has to be the need to plot the studentized residuals against the unstandardized predicted values.

Assumption 6: There also must not be multicollinearity in data. This is a situation where two or more independent variables utilized are highly correlated with each other. This usually leads to the problems of understanding which independent

variable actually contributes to the variance explained in the dependent variable, as well as technical issue in calculating a multiple regression model.

Assumption 7: Moreover, there should be no significant outliers, high leverage points or highly influential points. These points are unusual points which reflect the different impact they have on the regression line. Another thing is that these points can have effect on the regression equation and reduce the predictive accuracy of results as well as the statistical significance.

Assumption 8: A final assumption that needs to be ensured is that the residuals (errors) are approximately normally distributed. Two ways to do this are: a histogram (with a superimposed normal curve) and a Normal P-P Plot; or a Normal Q-Q Plot of the studentized residuals.

5.7.1.5. Description and units of variables used in the multiple regression model

Table 5.4: Description and units of variables used in the multiple regression model

Variables		Description	Unit of measurement
	Dependent variables:		
Y	VIEWREC	Farmer's views (perception) on recommended soil practice	1= Good; 2= Effective; 3= Very effective; 4= I can recommend and train others to use it; 5= It preserves our land; 6= Others
Y	BENADOPT	Benefit of adoption	1= Good production; 2= Improves livelihoods standard; 3= Soil stability; 4= Crops grow faster; 5= Others (e.g. entrepreneurial skills)
	Independent variables:		
X_1	EDU	Education of farmer	Years
X_2	MAR	Marital status of farmer	1=Married; 2= Single; 3= Divorced; 4= Widow/widower
X_3	FARMSIZE	Size of farm	Hectares
X_4	LANDOWN	Land ownership	0= Yes or 1= No
X_5	SOURLAND	Sources of land	1= Government; 2= Rented; 3= Inheritance; 4= Purchase; 5= Community; & 6= Others
X_6	TOTALINC	Total income of farmer	Rand
X_7	PARTEXT	Is the farmer attending extension programmes?	0= Yes; or 1= No
X_8	OFFFAINC	Off-farm income	Rand
X_9	FARMTYPE	Farming type of farmer	1= Smallholder; 2= Commercial;3= Others
X_{10}	TIMECONT	Time of continuous farming on same piece of land	Years
X_{11}	FARMINC	Agricultural income	Rand
X_{12}	LIVEPROD	Livestock production	1= Insufficient for own consumption; 2= Just enough for own consumption; 3= Enough for own consumption and for ceremonies; 4= Sufficient excess for limited sale; 5= Sufficient excess expanded sale
X_{13}	CROPPROD	Crop production	1= Insufficient for own consumption; 2= Just enough for own consumption; 3= Enough for own consumption and for ceremonies; 4= Sufficient excess for limited sale; 5= Sufficient excess expanded sale

Similarly, the multiple regression analysis was used to measure the influence of perception on adoption decision-making of farmers, as well as the influence of

adoption decision-making of farmers on their livelihood standards. Thirteen independent variables were chosen for the analysis. The Table 5.4 is therefore a description of various independent variables, as well as their units of measurement.

5.7.2. Description of independent variables

Independent variables are as well referred to as input or predictor variables because they help to provide explanations for the value of the dependent (outcome) variables. As used in this study, the following provides a clear description for all the independent variables adopted for this study.

5.7.2.1. Age of farmers

Age as an independent variable in a research is expected to impact negatively or positively. This is because the younger a person is the more prone he/she is in taking risk. In this case, age can be seen to positively impact on adoption decision-making process. On the other hand, old people are more conservative and closed to change. As such, age could be said to negatively impact on adoption decision making processes. Speaking on this, Asafu-Adjaye (2008) argued that the empirical evidence concerning the impact of age on adoption decisions is a mixed one. It was stated that earlier studies by Gould, Saupe and Klemme (1989), and Polson and Spencer (1991) have report that age has a positive impact on adoption decisions. However, it was also stated that evidence from more recent studies by Baidu-Forson (1999) and Bekele and Drake (2003) show that age has no statistically significant impact on adoption decisions. Asafu-Adjaye concluded that the effect of age in adoption cannot be determined a priori.

5.7.2.2. Education levels of farmers

Similarly education is expected to impact positively on adoption decision-making process in the study area. According to Bonabana-Wabbi (2002), citing Waller *et al*. (1998) and Caswell *et al*. (2001), education create a favourable mental attitude for the adoption of new technologies especially of information-intensive and management-intensive practices. Moreover, more educated farmers are said to have greater access to information on soil conservation measures (Asafu-Adjaye, 2008).

5.7.2.3. Marital status of farmers

Marital status of farmers in the study area with respect to the adoption of appropriate soil management technologies is expected to impact positively, because according

to Wood *et al*. (2007), a rapidly growing literature suggests that marriage may have a wide range of benefits, which includes improvements in individuals' economic well-being, mental and physical health, and the well-being of their children.

5.7.2.4. Gender of farmers

Gender difference is not expected to impact significantly on adoption of soil technologies, because the main determining factors in an innovation is the benefit that individual farmers will gain from adopting them. In fact, it is expected to be positive or negative. According to Bonabana-Wabbi (2002), it might be expected that the relative roles men and women play in adoption are similar, suggesting therefore that males and females adopt practices on equal basis.

5.7.2.5. Farm experience

In the same vein, farm experience is expected to impact positively on adoption decision-making process of farmers because as said by Asafu-Adjaye (2008), more experienced farmers are more knowledgeable about soil erosion and its effects, (and even of its control).

5.7.2.6. Farm size

The size of farm is hypothesized to affect both perception and conservation effort positively. Farmers with small farms may consider the long term investment in conservation too exorbitant, especially that, large incomes are not expected from such farms. This is unlike big farms, where the farmer is more interested in profit, as such he/ she will be willing to fight by all means anything that is a potential hindrance to that goal. According to Asafu-Adjaye (2008), farmers with smaller farms are less likely to engage in conservation efforts than farmers with larger sized farms. A reason indicated is that, small plot farmers may consider the future economic benefit of conservation too insignificant to offset the decline in production caused by conservation structures.

5.7.2.7. Land ownership and sources of land

Land ownership is expected to impact on adoption of soil conservation positively. This is because, according to general knowledge there is a great difference between the way humans handle what is theirs and what is not theirs. There is generally no sense in investing in what you know you could loose ownership anytime. Supporting this, Asafu-Adjaye (2008) maintained that, findings from previous studies indicate

that farmers who own their land seem to be more willing to adopt soil conservation measure and they also spend more effort in soil conservation than those who do not own their land.

5.7.2.8. Farm income (crops and livestock)

Farm income is expected to be positively related with adoption decision-making in the study area because poverty is one of the major reasons why most farmers shy away from adopting soil conservation practices. This is because most of the practices require adequate capital. As emphasized by Asafu-Adjaye (2008), farmers with higher net income are more predisposed to adopt soil conservation practices.

5.7.2.9. Off-farm income

Off-farm income is the income that is not directly from the farm. It could be that the farmer engages in other economic activities, apart from the farm business for income, or perhaps receives money from any other source that is not directly linked with the farm. According to Odendo, Obare and Salasya (2010), the effect of off-farm income is difficult to determine a priori, because although it can assist in providing ready cash for farm business, however farmers earning off-farm income may decide to invest their financial resources in other more profitable off-farm enterprises rather than investing in soil conservation.

5.7.2.10. Total income

Total income is the accumulation of all incomes to the farmer. This includes both incomes from the farm (i.e. income from crops and livestock) and off-farm, as it were. It is expected to positive in this study, because except from income from off-farm, which sometimes is difficult to measure a priori, all incomes is supposedly expected to raise the livelihood standard of the farmer, thus propelling the adoption tendencies of farmers for soil conservation practices.

5.7.2.11. Household size

In this study, household size is expected to be positive because the larger the a household the more labour the farmer has for farm work, and vice versa.

5.7.2.12. Farmers' awareness of soil conservation practice

According to Bembridge (1991), awareness (knowledge) is the first stage of the adoption process, and was defined as the stage when individuals receive knowledge about the existence of a new technology but have very little or no information about

it. In Tiwari *et al*. (2008) perspective, individuals pass through various learning and experimental stages beginning from when they get awareness about a problem and its potential solutions and finally deciding whether to adopt or reject the idea in question. Although knowledge is crucial in behaviour change, knowledge alone may not significantly affect expected change of behaviour. This is why, Spehr and Curnow (2011) maintain that although information may help improve people's knowledge about a problem or assist in changing behaviour towards it, there is a wide difference between knowing about a problem and something that will change it. However, in this study this factor is expected to be positively related with adoption decision-making of farmers regarding soil conservation practices because the more right information a person gets about an innovation, the more the likelihood of adopting it.

5.7.2.13. Participation in extension programmes

Farmers who participate in extension programmes are hypothesized to be more likely to adopt conservation practices, because they would have been more educated on issues of soil erosion, and be willing to take measures of conservation. Reporting Kebede, Gunjal and Coffin (1990), and Baidu-Forson (1999), Asafu-Adjaye (2008) emphasized that lessons from innovation diffusion theory indicate that farmers who participate in extension programmes are more knowledgeable on soil erosion impacts, and perceive soil problem more, and therefore would be more willing to adopt measures of soil conservation.

5.7.2.14. Farming type

Farming type is a measure indicating whether the farmer is a smallholder farmer, a commercial farmer, or any way in-between. The type of farm holdings of the farmer could either motivate the farmer to adopt or reject the adoption of soil conservation practices. For example, farmers with very small holdings may see investment on soil conservation technologies as a wasteful expenditure because their production focus is basically subsistence, and thus blinds them from the long-term gains usually associated with soil conservation. This is unlike the commercial farmer whose main interest is for business, and would be ready to do anything in fighting whatever is perceived as a potential hindrance to increased production and profit.

5.7.2.15. Time of continuous farming on same plot

This variable measures the length of time the farmer has spent in farming on same piece of land, especially in these days of increased population, where the number of those wanting to use land outweighs available land. This has resulted to great pressure on land in many parts of the world. In this study, this factor is expected to be positively related with adoption decision-making of farmers regarding the use of soil *conservation* practices by extension officers because, the more time a farmer spends in a place, the more he/she may realize the need for soil conservation practices due to fertility decline as a result of over use of land.

5.7.2.16. Farm yield (crops and livestock)

Anticipated high farm yields and income thereof may increase the probability of the adoption of improve soil management technologies (Melusi, 2012), because more farm yields mean more food reliance and income for the farmer. As such, the farmer is thought to be more open to extension advice and as well have enough money to buy better technologies in the case when the farmer has to pay. In other words, farm yield is expected to be positively related with adoption decision-making of farmers.

5.7.3. Description of dependent variables

For a proper analysis of this study, four dependent variables were chosen. These are:

1. Does the farmer prefer their own soil conservation practices to extension recommended practices?
2. What is farmer's level of participation in the soil conservation practices introduced by extension?
3. What is the role of farmer's perception on the adoption decision-making farmers regarding their use of soil conservation practices introduced by extension? and
4. What is the effect of farmer's adoption decisions on the livelihood standards of farmers in the study area? Effect of adoption decisions was measured in terms of benefits of adopting the recommended practices, as perceived by farmers.

The adoption of innovations by farmers is not all about whether farmers adopt a technology or not, but also to what extent is the farmer participating in the innovation.

This is why most adoption studies premise on two phases. They look first and foremost on whether farmers have adopted the innovation introduced to them or not, and then they also look at, to what extent has farmers adopted the innovation. With regards to the former, farmers who are soil conservation adopters (i.e. preferred extension recommended practices instead of their own practices) were ascribed the number “1”, while those not participating or those who preferred their own practices instead of the recommended “0”. In other words, farmers were divided into two groups. In relation to the level of participation in soil conservation practices, farmers were divided in respect to the type of conservation practice(s) they are adopting in their farms.

Following the central argument of the study, and for the purpose of robustness, this study added two other distinct areas: the role of farmers’ perception and the impact of farmers’ benefits from adoption on their livelihood standards. In terms of the former, literature indications are that perception plays a crucial role in determining the behaviour or decision-making of individuals. This is why it is regarded by Dűvel (1991) as one of the three immanent factors determining decision-making, through which other independent variables are expressed. In this regard, Asafu-Adjaye (2008) maintains that perception of soil erosion problem is the crucial first step in the farmers’ decision-making process to adopt soil conservation. Furthermore, it was reiterated that the perceived extent of actual or potential physical erosion on the farm land could serve as a motivator to a farmer’s choice of any particular conservation measure. Reporting Ervin and Ervin (1982) and Norris and Batie (1984), Asafu-Adjaye (2008) posits that the relationship between perception and soil conservation adoption and effort is a positive one. In the light of this, farmers’ perception was measured in the study as in: ‘how do farmers view the recommended soil conservation practices introduced by extension officers?’ Similarly, adoption impact was measures as in: ‘how has the farmer benefitted from the adoption of extension recommended practices for soil conservation?’

5.8. Conclusion

Farmers’ adoption decision-making process is not straight-forward, consisting of several factors at play, which could range from internal to external factors of the individual farmer in question. Another issue is that farmers’ decision-making process

is situation-specific. A careful understanding and analysis is thus required to be able to motivate the farmer towards appropriate adoption, as in this case the adoption of soil conservation technologies. In all, this study aims at creating an appropriate framework of understanding and analysis of smallholder farmers' adoption decision-making, not just in relation to soil conservation technologies, but other agricultural practices, thus well equipped to motivate them towards appropriate adoption. In this regard, the study did not only adopt two research questions which only required descriptive measure of nalaysis, it also provided four other probing questions, which required other more sophisticated techniques of analysis. As such, in two chapters that follow, the various analytic techniques are spelt out, and a discussion is provided based on findings.

CHAPTER SIX

Descriptive results and discussions

6.0. Introduction

According to Annor-Frempong and Dűvel (2009), descriptive statistics are first stages, required in determining the distribution of variables, and also provides a summary of large quantities of information. In this chapter therefore, emphasis is directed at providing an overview of findings based on descriptive statistics. Examples of such statistics are frequencies, percentages and mean. As such, this chapter is subdivided into six sections: basic personal and demographic characteristics of farmers; farmers' perception on soil conservation practices in the study area; current soil conservation practices used in the farm; and extension most recommended practices for soil conservation in the study area.

6.1. Basic personal and demographic characteristics of farmers in the study area

Personal and demographic characters of individuals cannot and should not be overlooked in any research study. This is because they are independent and indirect factors of behavioural change and decision-making. Examples of such variables, according to Bradmore (2004), are age, gender, income level, marital status, educational level. In the opinion of Shaw and Constanzo (1970), they are very important because they assist in showing patterns of individual behaviours. Also supporting, Lategan and van Niekerk (2007) state that analysing such patterns may provide a vehicle of understanding the decision-making processes of any population being studied and their resultant production manners. This is why this section is very relevant.

According to the Table 6.1, the study area consists of the Qamata Irrigation Scheme in Intsika-Yethu Local Municipality, Eastern Cape. Employing the case study research design, in all, 70 farmers were sampled from the scheme.

Table 6.1: Personal and demographic characters of farmers in the study area

Name of irrigation scheme		**Marital status**	
Qamata Irrigation Scheme,		Married	74%
		Single	16%
Age (years)		Divorced	4%
18-35	1%	Widowed/widower	6%
36-55	39%	**Gender**	
56-65	33%	Male	60%
>65	27%	Female	40%
Education		**Household size**	
None	20%	2	4%
Grade 1-6	37%	3	34%
Grade 7-10	20%	4	29%
Grade 11-12	20%	5	23%
Diploma	3%	6	6%
Incomes		7	4%
Crops (farm income)		**Participation in extension recommendation**	
<R1000	6%	No	11%
R1000-R5000	20%	Yes	89%
R5001-R10000	58%		
R10001-R20000	10%		
>R20000	6%		
Off-farm (plus livestock)			
<R10000	7%		
R10000-R20000	26%		
>R20000	67%		
Income total			
<R10000	3%		
R10000-R20000	13%		
R20001-R30000	50%		
R30001-R40000	21%		
>R40000	13%		

Source: Survey research, 2014

Gender as a basic characteristic of farmers is said by Espinosa and Garett (1987) to be very important in the development and spread of agricultural innovations. As well known, development and spread of agricultural innovation is a primary assignment of extension (Ighodaro, 2012). As findings reveal, the study area consists of more males (60%) than females (40%), which indicate a gender bias. This does not seem to reflect the global advocacy for gender equality, in which South Africa is a main proponent. Also, it does not reflect the overall population character of the Eastern Cape, in which females are slightly more in number than the males. Further, it seems to deviate from what is generally known in the literature about rural areas. Most rural areas in sub-Saharan Africa are made up of more women, who also constitute the larger percentage of agricultural production in those areas, as most of the able-bodied men have migrated to the cities for greener pastures. As it is said, in many parts of the world, women are the major farmers, even though their relevance remains greatly unrecognized (Raidimi, 2014). The reason why there is more males

in this study could be the fact that some soil conservation practices require man-power to operate, which most women lack.

Table 6.2: Farmers' farm characteristics in the study area

Farm characteristics of farmers			
Farm experience		**Farming type**	
<18	50%	Smallholder	89%
18-35	26%	Commercial	8%
36-55	14%	Others	3%
56-65	10%	**Time of continuous farming on one spot**	
Farm size		<5yrs	17%
<1ha	17%	5-10yrs	21%
1-2ha	53%	11-20yrs	32%
3-5ha	20%	21-40yrs	23%
6-10ha	9%	>40yrs	7%
>10ha	1%	**Crop production**	
Land ownership		Insufficient for own consumption	10%
Yes	90%	Just enough for own consumption	14%
No	10%	Enough for own consumption & ceremony	20%
Sources of land for farming		Sufficient excess for limited sale	40%
Government	10%	Sufficient excess for expanded sale	16%
Rented/lease	4%	**Livestock production**	
Inheritance	21%	Insufficient for own consumption	13%
Purchased	13%	Just enough for own consumption	23%
Others	52%	Enough for own consumption & ceremony	30%
		Sufficient excess for limited sale	26%
		Sufficient excess for expanded sale	8%

Source: Survey research, 2014

Age in a survey is also very important because it indicates the level of experience as well as the reliability of farmers' perceptions (Ighodaro, 2012). According to Mayhew (2004), age structure is a situation where a nation is composed into age groups. Arguing further, Mayhew (2004) maintains that age structure has a great influence on the future of any nation. This is because, as an example, Europe with more than 15% of its population over 60 years is suffering from "age dependency", while South Asia, with 45-55% under 16 years, is preoccupied with limiting growth in population (Mayhew, 2004). However, Asafu-Adjaye (2008) argues that the effect of age in adoption decision-making cannot be determined a priori. For example, while young people may be willing to take risks, as such more prone to adoption participation, older people are more conserved, as such less willing to participate in adoption. Further, Asafu-Adjaye (2008), citing two opposing studies, states that earlier studies by Gould, Saupe and Klemme (1989), and Polson and Spencer (1991) report that age has a positive effect on adoption decision-making. But on the other hand, it was also stated that evidence from more recent studies by Baidu-Forson (1999) and

Bekele and Drake (2003) reveal that age do not have any statistical significant effect on adoption decision-making. In the study area, findings (Table 6.1) reveal that the farming population consist of older people (60%). This is a precarious situation for farming in the area because farming decisions are left for old people, who are very conservative, more resistant to change, afraid of risks, majorly social grant dependents as main means of livelihood, which are unfavourable environments for sound adoption decision-making regarding farming and soil conservation practices.

In terms of marriage, Dűvel (1991) says that marriage is one of the independent but indirect variables responsible for individual behaviours. Arguing based on findings of research, Frank (1998), citing Berkman and Syme (1979) posits that married people have lower death rates than single and unmarried people. Ighodaro (2012) maintains that whether psychologically, socially and economically, marriage life offer some advantages to the married, which impacts on their decision-making processes. Explaining possible reasons for this, Frank (1998), reporting Goldman (1993a, 1993b) and Kisker and Goldman (1987), Frank (1998) suggests that the presumed reasons for this differential involve the integrative and protective effects of marriage life and the obligations the marriage role entails for individuals on one hand, and the possible contribution of health selection into marriage, on the other. Supporting, Wood *et al*. (2007), state that suggestions from a rapidly growing literature indicate that marriage may have a broad range of advantages, including improvements in people's economic well-being, mental and physical health, as well as that of their children. According to the Table 6.1, 74% of the population are married. This should impact positively on adoption of recommended soil conservation practices by extension officers, and thus increase in agricultural production in the study area.

The role of education in decision-making regarding soil conservation or any agricultural innovation cannot be overemphasized. Goel (2007) argues that the quality of human resource in a nation is judged by how many literate individuals live in it. It was further claimed that this is the reason rich and developed nations are composed of very high number of literate and productive human resource. In the Table 6.1, findings reveal only 3% of farmers' population exceeded grade 12, and 20% had no formal education. This is quite significant, especially in terms of decision-making, because research has shown that education relates positively to

adoption of innovations. According to Pender and Hazell (2000), poor education and poverty are said to be two main factors for poor farming decisions in rural areas. Supporting, Bonabana-Wabbi (2002), reporting Waller *et al*. (1998) and Caswell *et al*. (2001), posits that education provides a favourable mental attitude for, especially information-intensive and management-intensive technologies, to be adopted. To further support, Asafu-Adjaye (2008) argues that farmers with more education have greater access to information on soil conservation practices.

Another demographic variable investigated by the study is the size of farm. Size of farm of farmers is expected to be positively related to soil conservation practice adoption. Asafu-Adjaye (2008) posits that farmers with smaller farms are less likely to embrace conservation efforts than those with larger sized farms. One reason for this, according to Asafu-Adjaye (2008) is that, farmers with small plots may consider the future economic returns of conservation too small to offset the decline in production caused by conservation structures. In their study, Diao, Hazell, Resnick and Thurlow (2007) emphasize that one parameter for grouping farms into family farms and commercial agriculture is the size of the farm in question. It was stated that an average family farm should be about 5-10 hectares, while that of a commercial farm may be above 100 hectares. According to findings of the study (Table 6.2), majority (90%) of farmers in the study area had farms not more than 5 hectares. This is quite significant, and according to Asafu-Adjaye (2008), whether directly or indirectly, efforts for soil conservation practice participation by farmers will be lesser. This is well supported by the paragraph that follows.

According to this study (Table 6.2), farming is seen from two major angles: commercial (8%) and farming in small scale (89%). Although there are varieties of farming on a small scale in the literature, this study prefers the use of the “smallholder” farming for simplicity and to avoid unnecessary clarification of terms. The primary goal of smallholding farming is production of food to feed the family, and if there is any left over, they can be sold for cash. On the other hand, commercial agriculture is primarily aimed at production for profit. The type of farm production practiced by a farmer has a direct effect on efforts for soil conservation. That is why Asafu-Adjaye (2008) maintains that farmers with smaller farms are less likely to embrace conservation efforts than those with larger sized farms.

Land ownership is expected to be positively related to adoption decision-making by farmers in the study area. This is because there is really no sense in investing in a property you know you could lose anytime. This is why Asafu-Adjaye (2008) reports that farmers who own their land are more willing to adopt soil conservation measure and they also spend more effort in soil conservation than those who do not own land. According to findings (Table 6.2), 90% of farmers own their land, which seems to indicate a favourable environment for adoption in the study area. In terms of sources of land for farming, apart from 'other' sources where many get land, majority of the farmers (21%) get their land by inheritance. Only very few (4%) get their land through rent or lease. With improper soil management, every land being used continuously for farming will deteriorate in quality with time. Hence, time of continuous farming on a piece of land is expected to be positively related to adoption. This is because, if a land starts losing its quality and yield, farming will certainly come to a hold. This is why a farmer hypothesized will seek for ways of improving its quality, thus using one or more conservation practices.

Time as a factor in the adoption of innovation for change is a measure of, not just farmer's experience only, but also a measure of the reliability and credibility of responses, farming efficiency, reasons for some farming decisions, as well as the adoption or rejection of certain agricultural innovations. Commenting on the relevance of experience for any business success, Bean (2010) maintains that "experience plays a significant role in the business world". Based on findings (Table 6.2), half (50%) of farmers have been in farming for over 18 years, which is reasonably enough experience for farmers in the study area. , this should impact positively on the adoption of soil conservation in the study area.

6.2. Farmers' perception on soil conservation practices in the study area

According to Ighodaro (2012), a right perception is very important in social science research because it assist in explaining farmers' challenges as it affects them in their context. Perception, in Dűvel (1991) view, is one of the three mediating factors responsible for adoption decision-making. Speaking on this, Asafu-Adjaye (2008) maintains that the perceived extent of actual or potential erosion on a farm or any land is capable of motivating the farmer or user of land to use a control method. From this foregoing therefore, perception could be regarded as a vital element that

either impedes or propels appropriate adoption of recommended innovations for change. As such, in this section, farmers' perception was tested in terms of the various soil conservation practices available in their area, and the level of importance farmers attach to extension recommendations on soil conservation in their food security strategy.

A first variable to understand farmers' perception on soil conservation practices in the study area is in terms of their awareness concerning extension recommendation for soil conservation. According to Bembridge (1991), awareness is the first stage of the adoption process: a time when individuals receive knowledge about the existence of a new idea but do not have enough information about it. So understanding how many farmers are aware of the recommended soil practice is somewhat a pointer to how many people will eventually decided for the innovation. In the study (Table 6.3), 86% population of farmers said they are aware of the recommended soil practice by extension workers. This seems to indicate a situation of more adopters/ participants in the study area.

Table 6.3: Farmers' perception on soil conservation practices in the study area

Awareness of recommended soil practice	
Yes	86%
No	14%
Use of recommended soil practice	
Yes	89%
No	11%
View on recommended soil practice	
Good	48%
Effective	17%
Very effective	1%
I can recommend and train others to use it	11%
It preserves our land	10%
Others	11%
Preference for own soil practice	
Yes	41%
No	59%
View on own soil practice	
Effective/ efficient	36%
Promising because of extension help	11%
Sometimes it fails	14%
It's old model	26%
Others	13%
Advantages of recommended practice	
It improves soil quality and produce	29%
Prevents soil erosion and conserves the soil	33%
Crop rotation eliminates pest and diseases	10%
Cost effective and easy	14%
Others	14%

Source: Survey research, 2014

Similarly, farmers in the study area were also required to provide information on their personal opinion about the recommended soil practice[1] introduced to them by extension officers. As such, an open-ended question was provided, after which responses were classified as in the Table 6.3. According to the table, close to 66% of respondents said, that the recommended soil conservation practice is good and effective in assisting the improvement of their soils. Farmers were as well tested on their perception on their own soil practices. Table 6.3 reveals 47% of farmers said their own practice is effective as against the recommended practice by extension officers.

Farmers were also tested on their preference for own practice as against the recommended practices by extension officers. Based on findings (Table 6.3), 41% population of farmers in the study area seem to prefer their own soil management practices than the recommended ones by extension officers (59%). Speaking on this, Dűvel (1991) maintains that farmers' preference for own practice as against a new innovation being introduced by extension officers could be as a result of four reasons. One is that, may be farmers' perception of the new innovation is insufficient compared to their traditional practices. A second reason could be the problem of farmers' being unaware of the advantages of the recommended practices by extension officers as against their own practices. Thirdly, Dűvel (1991) says that, farmers may as well be aware of some disadvantages of using the recommended practice. As it is generally known, anything that has advantages also has a disadvantage. Finally, it could as well be caused by the problem of the new innovation by extension officers being incompatible with their situational factors. However, a larger percentage (59%) preferred extension recommendation for soil conservation instead of their own practices. This is remarkable, and it is in agreement with earlier findings of the study that there are more males (60%) in the study area, which could also be the reason there are more adopters of extension recommended practices in the study area. This is because most soil conservation practices require more labour, which men are more favoured at providing than females.

[1] The two main recommended soil practice by extension are soil rotation and conservation tillage

For rural people in most developing countries, especially in sub-Saharan Africa, farming is one of their main food security strategies. For examples, FAO (2001) and Nnadi *et al* (2013), both argue that globally, the level of rural dependence on agriculture for livelihood is 85% and 94%. So, an understanding of farmers' perceived advantages of extension recommendations on soil conservation will go a long way in explaining their adoption behaviours regarding such recommendations. Based on this, farmers were tested using an open-ended question, which was later classified, as indicated in the Table 6.3. According to findings, except with very minor percentage, all farmers' responses agree with literature on advantages of using soil conservation practices. As examples, 29% said it improves soil quality and produce, while 33% said it prevents soil erosion and conserves the soil. If this was anything to go by, it seems to indicate that farmers in the study area have a positive perception on the introduced soil innovation, which indicates some level of acceptance by them.

Farmers gave reasons why they chose to adopt recommended practices for soil conservation (Table 6.4). According to them, 38% said the practices help improve soil quality and crop yield, while 23% perceive it prevents soil erosion, as basic reasons for adoption of soil conservation practices.

Table 6.4: Major reasons for adoption

	Frequency	Percent
For improved soil quality and better crop yield	27	38
For better income	7	10
For reduced cost of production	11	16
To prevent soil erosion	16	23
To conserve the soil	6	9
Others	3	4

Source: Survey research, 2014

The foregoing sets a good tone why perception of farmers is very important in the spread of agricultural innovations. Asafu-Adjaye (2008) emphasizes that the extent of actual or potential physical erosion on a farmland perceived by a farmer, is capable of motivating the farmer to use a control method. Perception therefore is a key variable if there can be true success for the extension officers in their work.

Hence, amongst the three variables in Dűvel (1991) model where extension research is advised to focus on, perception seems to be foremost.

6.3. Farmers' current soil conservation practices in the study area

From time immemorial, rural people do have their own ways or ideas on how to deal with their problems. These also have over time become practices of the people, which also do not look different in the study area. According to Emeagwali and Dei (2014), every society has its own cultural knowledge system, including the African society. The United Nations Environment Programme (UNEP, undated), maintains that indigenous knowledge is unique to every culture and society, and it is rooted in the practices, institutions, relationships and rituals of the particular community. In support, Workineh, Garfield and Boudreau (2010) maintain that farmers followed the traditional farming practices inherited from their parents and grandparents in optimizing their harvest, as well as preparing their land or growing their crops. In this regard, farmers were tested on practices utilized for soil management outside of extension recommendations. According to findings (Table 6.5), the two main practices used by farmers are crop rotation (24%) and use of fertilizer or manure (16%).

According to the focus of this study, even though there might be farmers who use more than one practice, only one option was required for this study. In other words, even if a farmer provides multiple variables, the study only picked one variable per farmer for analysis. This was adopted to simplify the analysis process.

Table 6.5: General soil conservation practices in study area

General practices	Frequency	Percent
Crop rotation	17	24
Mixed cropping	3	4
Contour ploughing	6	9
Plant cover	3	4
Use of fertilizer/ manure	11	16
Avoid overgrazing	5	7
Fallowing	4	6
Conservation tillage	3	4
Others	18	26

Source: Survey research, 2014

6.4. Extension most recommended soil conservation practices

Although there were some other practices recommended by extension, according to farmers, the two most recommended practices for soil conservation in the study area are crop rotation (36%) and conservation tillage (20%). This is as presented in Table 6.6.

Table 6.6: Extension most recommended soil conservation practice

	Frequency	Percent
Crop rotation	25	36
Conservation tillage	14	20
Others	31	44

Source: Survey research, 2014

6.5. Conclusion

According to Annor-Frempong and Dűvel (2009), descriptive statistics such as frequencies, percentages, means, bar and pie charts are first steps, needed to determine the distribution of variables and to give a summary of large amounts of information. However to test for relationships (such as the understanding of the effect of independent variables, predictors, on the dependent, outcome, variables) which exist between variables, other higher statistical test are needed like the multiple regression model (Annor-Frempong and Dűvel, 2009). Based on findings, the study area consists of more males (60%), which seem to favour adoption of soil conservation practices, because due to the labour requirements of most soil conservation practices, more men adopt more than women. The study area also consists of older people, who also are less educated, as only 3% population exceeded grade 12, which do not indicate a favourable environment for adoption. More so, a large percentage (90%) own farmland which is less than 5ha, indicating also the subsistence nature of farmers in the area. While 86% of farmers said they are aware of the soil conservation practices introduced by extension, 89% said they participate in using them. This seems to agree with finding that a larger proportion of farmers admitted they preferred extension recommendations for soil conservation in the study area as against their own practices. Hence, in the next chapter, emphasis is on demonstrating the empirical results of the study based on the use of specific models such as the binary logistic and the multiple regression analysis.

CHAPTER SEVEN

Empirical results and discussion

7.0. Introduction

Apart from a general description and overview of data for a study, engaged primarily to determine the distribution of variables and to summarize the bulk of information collected in the study area, this chapter focuses on actual relationships existing among variables of the study. Thus the need for more sophisticated models such as the probit and logit regressions, the binary and multinomial logistic regression models, as well as the multiple regression model. In view of the central argument of the study, upon which a conceptual framework was also designed (refer to Figure 5.1), any holistic understanding and analysis of the adoption process must be premised on the view that adoption decision-making process basically is a four stage process: the perception stage; the adoption stage; the level of adoption stage; and the impact of adoption stage. As such, this chapter discusses the results of all listed models, and how they help to achieve study objectives. It begins with the results of two multiple regression analyses, which focus on the role smallholder farmers' perception on soil conservation practices play on adoption decision-making processes, as well as on the livelihoods of farmers. Secondly, it focuses on factors prevailing on smallholder farmers' adoption decision-making regarding soil conservation practices, which was run using the binary logistic regression model. The third aspect focuses on the levels and intensity of adoption decision-making of farmers, while the interest of fourth is on the contribution of adoption decision-making impact of smallholder farmers on the livelihoods of farmers in the study.

7.1. The effect of farmers' perception on soil conservation practices on the adoption of soil conservation practices

Checking for multicollinearity amongst independent variables is one main assumption needed in running a regression analysis. As such, a correlation matrix of independent variables was conducted, as represented in the Table 7.1. As expected, age (AGE) has a fairly high negative correlation (r= -0.530) with education (EDU), indicating that older farmers tend also to be less educated. This is supported by Asafu-Adjaye (2008), where his correlation coefficient (r= -0.50) for the relationship between age and education was also similar to that of this study. Off-farm income

(OFF) has a high positive correlation (r= 0.701) with total income (TOT), indicating also that farmers with high off-farm income have high total income, and vice versa. Also, off-farm income (OFF) was positively correlated with age (AGE) and size of farm (SIZ) at r= .321 and .307, respectively, but negatively corrected (r= -.330) with education (EDU) of farmers. The indication is that incomes from off-farming activities increase with age and size of farm, but decrease with education, which seem seem congruent with the descriptive statistics of this study. 60% of farmers were above 55 years of age and only 3% farmer population exceeded grade 12.

More so, level of crop produced (CRO) had a low positive correlation (r= .304) with level of livestock produced (LIV). The suggestion is that the more farmers' crops do well, the more they engage in livestock production, which was an activity practiced by farmers outside the Qamata Irrigation Scheme project. Furthermore, farmers' overall income (TOT) had a low positive correlate with level of crops produce (CRO) and crop income (INCR), with correlation coefficients of r= .240 and .738, respectively. The suggestion is that the more crop yield farmers have, which also a measure of increase in crop income, the more their overall incomes increase.

Apart from the aforesaid, the correlation coefficient of the remaining cases are low, with absolute values of the majority (almost 75%) falling below 0.2, thus suggesting that the problem of multicollinearity is not serious among independent variables of this model.

Table 7.1: Correlation matrix of various independent variables used in the study

	AGE	MAR	EDU	SIZ	TYP	HHS	LIV	CRO	INCR	OFF	TOT	EXP	AWA	EXT
AGE	1													
MAR	.024	1												
EDU	-.530**	.062	1											
SIZ	.028	.216	.069	1										
TYP	.017	.159	.004	-.016	1									
HHS	-.185	.041	.173	.045	.017	1								
LIV	-.023	-.186	-.123	-.140	-.012	.171	1							
CRO	-.018	-.099	-.018	.050	.233	.153	.304*	1						
INCR	-.047	.030	.118	.038	.045	.046	.120	.217	1					
OFF	.321**	-.109	-.330**	.307**	.073	.205	.097	.099	.096	1				
TOT	.217	-.054	-.130	.198	.083	.177	.152	.240*	.738**	.701**	1			
EXP	.092	-.059	.158	.107	.052	-.116	.029	-.105	.035	-.031	-.015	1		
AWA	.126	-.093	-.227	-.072	-.055	-.230	.015	-.112	-.213	.045	-.117	.220	1	
EXT	.100	-.038	-.208	-.104	.121	-.180	-.057	-.189	.158	.022	.127	.211	.367**	1

NOTE: AGE= Age; MAR= Marital status; EDU= Education levels; SIZ= Size of farm; TYP= Type of farming system; HHS= Household size; LIV= Level of livestock produce; CRO= Level of crop produce; INCR= Crop income; OFF= Off-farm income; TOT= Total income; EXP= Years in farming; AWA= Awareness of soil conservation practices by extension; EXT= Extension participation

Although, as it were, perceptual measurement is fairly inaccurate, it however plays a vital role in the decision making processes of individuals. Hence, just like Dűvel (1991) model, this study proposed an additional stage, the perception stage, to the five stages of the adoption process by Rogers (1983). This is because, after the knowledge or awareness stage of the adoption process, depending on the information, the source of the information and how the information was presented to the individual in question, a perception is built in the mind of the individual, which eventually leads to the persuasion stage of Rogers' adoption process. This is why, the first step of clearly understanding the adoption process of farmers in the study area, is to measure how their perception on the various soil conservation practices introduced to them by the extension officers interact with their decision to adopt such practices. As such, eighteen (18) independent variables (x) chosen for this study were passed through the multiple regression analysis model, using SPSS version 23, where y stands for the dependent variable, as represented below:

$$y = \alpha + \beta x + \varepsilon$$

Where y= Smallholder farmers' perception on soil conservation practices introduced to them[2]

x= Exogenous input data of adoption decision-making processes (independent variables)

α = Intercept of y, and

β= Partial regression coefficient= Parameters to be estimated

ε = The stochastic error term.

After a backward elimination process was conducted on the variables, the result of the analysis is as presented in the Table 7.2. As indicated, the adjusted R^2 is about 0.5, which do not indicate a high level of multicollinearity of variables. Also, the overall significance of the model indicates a level of 0.017 ($p<5\%$), indicating the fitness of the model in terms of study variables.

[2] Y was measured as: 'farmers' views regarding the soil conservation practices by extension officers

Based on results (Table 7.2), age (AGE), marital status (MARRIAGE) and education (EDUCATE) of farmers were found significantly positive in impacting on farmers' perception on soil conservation practices in the study area. Also significantly impacting are the level of livestock production (LIVEPROD), income from agricultural crops (INCOMAGC), off-farm income (OFFINCOM) and the overall income of farmers (TOTALINC). Similarly significant were farmers' years of experience (FARMYRS), awareness of soil conservation practices (AWARESCP), as well as use of soil conservation practices (participation in extension recommendations for soil conservation) (PARTEXT).

Table 7.2: Empirical results for role of farmers' perception on adoption decisions

	Unstandardized Coefficients				Collinearity Statistics	
Variables	**B**	**Std. Error**	**t**	**Sig.**	**Tolerance**	**VIF**
Constant	-3.967	3.293	-1.205	.246		
AGE	.944	.445	2.124	.050**	.412	2.427
MARRIAGE	1.114	.486	2.293	.036**	.437	2.287
EDUCATE	1.013	.295	3.430	.003***	.440	2.275
SIZEFARM	.422	.369	1.146	.269	.550	1.817
FARMTYP	-1.397	1.375	-1.016	.325	.431	2.321
HHSIZE	.410	.249	1.644	.120	.499	2.002
LIVEPROD	-.628	.274	-2.297	.035**	.709	1.410
CROPPROD	-.360	.280	-1.287	.216	.726	1.377
INCOMAGC	.000	.000	2.666	.017**	.094	10.628
OFFINCOM	.000	.000	2.266	.038**	.089	11.293
TOTALINC	.000	.000	-2.875	.011**	.042	23.654
FARMYRS	-.590	.315	-1.872	.080*	.488	2.050
AWARESCP	2.127	.783	2.717	.015**	.593	1.687
PARTEXT	1.833	.826	2.220	.041**	.533	1.876
R	.854					
R^2	.730					
Adjusted R^2	.493					
Overall sig.	.017					

NOTE: Significance levels: *= p< 10%; **= p< 5%; ***= p< 1%

According to results (Table 7.2), age, marriage and education of farmers were positively significant in the analysis, indicating that the older the farmers, the more educated and married (compared to the unmarried), the more likely they would have a right perception of soil conservation practices introduced by extension officers. These also are well supported in literature. For example, Asafu-Adjaye (2008) discovered in his studies on factors affecting the adoption of soil conservation measures: a case study of Fijian cane farmers, that age and education were

positively related with perception of soil erosion in the area. According to this finding, older farmers are more likely to perceive the soil erosion problem in the area. Supporting, Ervin and Ervin (1982) found that education was significantly and positively influential at p<1% on the perception of the degree of soil erosion problem, as well as subsequent adoption of soil conservation practices at the Monroe County, Missouri.

Also, marital status of farmers was found to be positively related with farmers' perception on soil conservation practices introduced by extension officers (Table 7.2). This is as expected. Wood *et al*. (2007), suggest that a rapidly growing literature indicate that marriage as a factor may have a broad range of benefits, including improvements in an individual's economic well-being, mental and physical health, and the well-being of their children, which thus impact on appropriate decision-making. Similarly, education level of farmers was significantly positive in association with farmers' perception on soil conservation practices. This also was as expected, because the kind of knowledge a person have has a lot on impact on appropriate decision-making. Hence, Bonabana-Wabbi (2002), citing Waller *et al*. (1998) and Caswell *et al*. (2001), maintain that education creates a favourable mental attitude for the adoption of new technologies especially of information-intensive and management-intensive practices. Moreover, more educated farmers are said to have greater access to information on soil conservation measures (Asafu-Adjaye, 2008).

In the study, the level of livestock production was negatively related with farmers' perception on soil conservation practices introduced by extension officers. The indication of this is that, increase in the level of production of livestock owned by farmers, the lower their perception on extension recommended practices, and the more their perception favour their own practices for soil conservation. This is unexpected, because as expected, the better the level of livestock production, the better the level of income, and ultimately the socio-economically more favoured a farmer is toward any new innovation by change agents. Another reason is that, livestock, to farmers in the Eastern Cape, is very crucial with respect to their agricultural and food security strategies. For example, the livestock estimate statistics, province by province of the National Department of Agriculture, Republic of South Africa (2007), suggests that the Eastern Cape is the premier province and

home to more livestock (cattle, sheep and goat) than any other province in the whole of South Africa. A reason for the negative coefficient of this variable in the study could be because the variable was actually calculated as an off-farm income. This was because; even though the farmers on their own engage in livestock production, it is however not part of the activities undertaken by the irrigation schemes where data for this study was collected.

Also positively significant in influencing farmers' perception on soil conservation practices introduced by extension, are incomes from agricultural crops (INCOMAGC) and off-farm (OFFINCOM), as well as the overall income of the farmer (TOTALINC) at 5% levels of significance. This is as expected, because the income, from whatever source, means farmers' empowerment over poverty, and enhanced purchasing power, even of the technologies needed on-farm. However, the magnitude of the coefficients of the three income sources was very small, indicating that they all exerts relatively very small impact on farmers' perception on soil conservation practices by extension officers. This agrees with literature. For example, Asafu-Adjaye (2008) posits that due to the fact the coefficient for net farm income was very small; it suggests that the variable exerts a relatively small influence on perception of soil erosion among the Fujian cane farmers.

Moreover, farmers' years involved in farming, which is a measure for farmers' experience (FARMYRS) in the study was negatively significant in its influence on farmers' perception on soil conservation practices by extension practitioners at a low significance level of 10%. This is unexpected because the expectation is that the more experience a farmer is, the more likely he is disposed to perceive and adopt soil conservation practices by extension. Although a factor that may have impacted in this result is because farmers were required at some stage to compare their own practices with extension introduced ones. Perhaps, through experience they have proven their own practices, unlike that of extension. Also other factors like insufficient information regarding extension introduction may also have impacted on the relationship. However, result of this study is almost similar to findings by Asafu-Adjaye (2008) on how farmers' experience impact on their perception toward adoption. The difference may only be in their correlation coefficients. For Asafu-Adjaye (2008), the correlation coefficient was positive but not statistically significant

for impact of farmers' experience on perception. However, for this study though the correlation coefficient is statistically significant, but it is negative.

Finally, results of this study also reveal that awareness of soil conservation practices by extension officers (AWARESCP) and participation in extension programmes on soil conservation (PARTEXT) were both statistically significant in their influence on farmers' perception on soil conservation practices by extension agents. These were as expected. In this model, farmers' awareness was coded as a binary response variable, where awareness was coded yes '1', while non-awareness was coded zero. As findings indicate, the sign of coefficient of the regression was positive, indicating that more of the farmers who claimed awareness of the soil conservation practices introduced by extension also have more and better perception of the soil conservation practices, which also is congruent with literature. Supporting this, Rezvanfar, Samiee and Faham (2009), in their study on analysis of factors affecting adoption of sustainable soil conservation practices among wheat growers, discovered that level of farmers' awareness on effects of conservation practices correlated positively and significantly with their eventual adoption.

7.2. Factors influencing smallholder farmers' adoption decision-making regarding soil conservation practices in the study area

According to literature, several factors prevail on the adoption decision-making processes of farmers, which ultimately influence their decisions regarding soil conservation. Examples of such factors are perception of risks (Lategan, 2007), household socio-economic factors, resource availability, physical characteristics of the land and institutional support (Tiwari *et al,* 2008, citing Garcia, 2001). Citing Cruz (1978), Chi and Yamada (2002), provide a long list of factors that affect farmers' adoption of technologies. Examples are characteristics or attributes of the technology, the adopter, the change agent, and the socio-economic, biological and physical environment in which the technology is transferred. Others are the age of the farmer, education level, income, family size, tenure status, credit use, values and belief system, the personal characteristics of the extension workers such as credibility, good relationship with farmers, intelligence, emphatic ability, sincerity, resourcefulness, persuasiveness, ability to communicate with farmers, and development orientation. As indicated, although there are several factors influencing

farmers' adoption decision-making in the literature, this study chose eighteen deemed fit to assist in provide answers for the objectives.

In order to check for multicollinearity, a correlation matrix of independent variables was conducted, as represented in the Table 7.3. Apart from the correlation coefficients for age and education, which was fairly negatively high (r= -0.530), and that of off-farm income and total income, which also positively high (r= 0.701), the correlation coefficient of the remaining cases are low, with absolute values of majority (almost 75%) falling below 0.2. This thus suggests that the problem of multicollinearity is not serious among variables.

Table 7.3: Correlation matrix of independent variables of the study

	AGE	GEN	MAR	EDU	SIZ	HHS	LAN	SOU	LEN	CRO	OFF	TOT	AWA
AGE	1												
GEN	-.315	1											
MAR	.024	.335	1										
EDU	-.530	.327	.062	1									
SIZ	.028	-.026	.216	.069	1								
HHS	-.185	.045	.041	.173	.045	1							
LAN	.171	-.214	-.180	.017	.091	-.070	1						
SOU	.108	-.061	-.207	-.117	.067	0.000	.166	1					
LEN	.396	-.119	.006	.036	-.135	-.234	.231	.136	1				
CRO	-.018	-.034	-.099	-.018	.050	.153	.223	050	.022	1			
OFF	.321	-.164	-.109	-.330	.307	.205	.044	.155	.027	.099	1		
TOT	.217	-.164	-.054	-.130	.198	.177	.169	.049	.024	.240	.701	1	
AWA	.126	-.167	-.093	-.227	-.072	-.230	0.000	.057	.040	-.112	.045	-.117	1

Further effort to ensure reliability of results and for better analysis of study objective, this study adopted three models of analysis: the probit and logit regression models, as well as the binary logistic model, to ascertain factors influencing farmers' adoption decisions regarding soil conservation practices introduced by extension. The goal for this was to provide a measure for comparisons of results. Results are as presented in the Table 7.4.

According to results (Table 7.4), except for household size (HHSIZE), crop production (CROPPROD) and total income (TOTALINC), where results of the probit and logit regressions vary from the binary logistic regression, values of all the other five significant factors are the same across all three models, thus indicating, to a large extent reliability of results. From the binary logistic analysis, household size was a fairly significant ($p<10\%$) factor contributing to farmers' adoption decision-

making, but insignificant in the probit and logit regression analysis, though its coefficient was negative throughout all three models. The indication of this is that, any one increase in household size reduces the chance of farmers adopting their own practices as compared to extension recommendations, which partial is as expected. Authors are not in agreement as per the contribution of household to adoption decision-making. This is because, on one side, large sized household implies more mouth to feed, and thus a reduction of money that would have been meant for agriculture. On the other hand, large household implies more family labour for smallholder agriculture. For example, Odendo, Obare and Salasya (2009) hypothesized that the proportion of household population available for labour on-farm has a positive influence on the adoption of all integrated soil nutrient management (INM) in Kenya, although, according to them, this innovation is labour-intensive. In this regard, Asrat, Belay and Hamito (2004) hypothesized family size to have a positive influence on adoption. Supporting, Pender and Kerr (1998) and Shiferaw and Holden (1998), both agree that because of labour market imperfections, large households may invest more in conservation. According to them, soil conservation structures for example, are labour intensive to build and maintain, thus households with large human capital may invest more in conservation (Asrat, Belay & Hamito, 2004).

Table 7.4: Regression estimates for factors of adoption decision-making

Variables	**Binary logistic**		**Probit**		**Logit**	
	B	**Sig.**	**Dy/dx**	**P>/Z/**	**Dy/dx**	**P>/Z/**
AGE	2.470	0.099*	.1949689	0.086*	.1942641	0.088*
GENDER	4.383	0.031**	.4352119	0.000***	.4214774	0.000***
MARRIAGE	-4.522	0.025**	-.4017135	0.001***	-.399953	0.002***
EDUCATE	1.171	0.206	.0536222	0.414	.0503182	0.452
SIZEFARM	-1.532	0.198	.0499528	0.598	-.0505581	0.587
HHSIZE	-1.712	0.091*	-.0779686	0.177	-.0789872	0.159
LANDOWN	2.622	0.218	.1167045	0.581	.1204231	0.559
SOURLAND	-1.347	0.063*	-.0765876	0.097*	-.0770962	0.101*
LENTFARM	-2.980	0.013**	-.2603467	0.000***	-.264658	0.000***
CROPPROD	-0.947	0.103	-.1463721	0.002***	-.1512637	0.003***
OFFINCOM	0.000	0.147	-2.42e-06	0.837	-5.28e-01	0.967
TOTALINC	0.000	0.081*				
AWARESC	-6.345	0.169				
CONSTANT	23.006	0.033**	5.702022	0.069*		
Contingency table			**Prob. > x^2**	0.0185	**Prob. > x^2**	0.0199
Observed	Yes= 6		**Pseudo R^2**	0.3712	**Pseudo R^2**	0.3675
Expected	No= 5.899		**Log likelihood**	-19.360	**Log likelihood**	-19.474
Overall %	80%					

NOTE: Significance levels- *= p< 10%, **= p< 5% and ***= p< 1%

In terms of the level of crop production (CROPPROD), results of the probit and logit regressions indicate a negatively significant relationship with farmers' adoption decision-making, suggesting that every increase in the level of production of farmers' crops reduces the chance of adopting farmers' own practices, thus accepting extension recommendations. This is as expected, because increase in crop yield implies more income for the farmer, which eventually is ploughed back into farming. Ighodaro, Lategan and Mupindu (2016) discovered in their study in the Upper and Lower Areas of Didimana, Eastern Cape that farm yield of farmers was positively significant in propelling the adoption of soil erosion control measures.

In the results of the binary logistic model, total income of farmers (TOTALINC) was positively fairly significant ($p<10\%$) in propelling adoption decision-making of farmers. The suggestion here is that every unit increase in farmers' overall income increases farmers' endencies to use their own practices as against extension recommendations. This is unexpected because income as it were, means higher social stability and purchasing power for the farmer, which supposedly should encourage adoption of extension recommended practices for soil conservation. Due to the informal nature of rural environments in developing countries, situations of reality may be somewhat very unpredictable. Some may sometimes prefer to marry a new wife when income increases, as the case may be, instead of investing it for the improvements of their farms. This also may not be surprising, especially in most rural part of the former homeland areas of South Africa, where people depend more on government social grants than on farming or any other income generating source. For example, this case was true in Sheshegu community and the Upper and Lower Areas of Didimana, Eastern Cape, as most farmers though still involved in agricultural production, actually obtain most part of their incomes from government social grants. However, Rezvanfar, Samiee and Faham (2009), citing Mbaga-Semgalawe and Folmer (2000), seem to support the above, when discussing on the impact of off-farm income (an element of total income) on adoption of soil conservation practices. According to them, the impact is indeterminate.

7.2.1. Socioeconomic factors and soil conservation practices in study area

Based on the three models adopted for this objective, results for impact of age (AGE), gender (GENDER), marital status (MARRIAGE), sources of land

(SOURLAND), and length of time of continuously farming on one spot (LENTFARM) seem to agree across all models, apart from differences existing in their coefficients.

Age (AGE) as a factor in adoption decision-making could be dual in impact. There are areas where research has found age to be negatively related with adoption decision-making process, while it was positive in others. Hence, result for age is said to be unpredictable a priori. For example, Bonabana-Wabbi (2002) maintains that age was positively influential in the adoption of sorghum in Burkina Faso. However, in the same study, it was also mentioned that age has been found to negatively impact on adoption decision-making, or not significant in farmers' adoption decision-making process. In this study, age was fairly positively ($p< 10\%$) related with farmers adoption decision-making process regarding soil conservation practices introduced by extension agents. The indication is that older people will prefer their own practices as against extension practices. This is as expected, because older people generally are very traditional and very conservative to change. According to Ighodaro, Lategan and Mupindu (2016), the problem of soil erosion was on the rise in the Upper and Lower Areas of Didimana, Eastern Cape, because the area consists more of older people, and very few of them were willing to accept extension advices regarding soil erosion control. This was also supported by Bembridge (1991). It was stated that older people are often very conservative in behaviour and tend towards avoidance of risks.

According to the descriptive statistics of this study, there were more males (60%) in the study area than females (40%). Males were ascribed the code '0' while females were coded '1' respectively (refer to Table 5.3). Based on results, gender (GENDER) was positively significant in influencing farmers' adoption decision-making process regarding extension recommended practices for soil conservation, implying that women are more likely to adopt their own practices as compared to extension recommended practices, which is congruent with literature. Most conservation practices are highly labour-intensive, thus making it difficult for women, except the ones who have the financial means to buy man-power. Supporting this, Bayard, Jolly and Shannon (2006) maintain that male farmers are most likely to invest in certain conservation practices like rock walls than their female counterparts. It was also indicated however regarding women, that female farmers who have the financial

means to hire labour, have been noted able to adopt rock walls on their farms in Haiti (Bayard, Jolly and Shannon 2006).

Marital status (MARRIAGE) as a factor in adoption decision-making, according to Dűvel (1991), is one of the independent variables determining individual behaviours. Providing an explanation for this, Frank (1998), citing Goldman (1993a, 1993b) maintains that underlying this differences are the integrative and protective effects of married life, as well as the obligations married roles entail for individuals on one hand, and the possible contribution of health selection into marriage, on the other hand. Wood *et al*. (2007) state that a rapidly growing literature opines that marriage may have a broad range of benefits that may include improvements in individual's economic well-being, mental and physical health, and the well-being of children of such individuals. According to Dűvel, Chiche and Steyn (2003), most female respondents in a study in Ethiopia, considered their quality of life of less quality than women whose husbands are around, because of the absence of a partner to support and to share the burdens and tasks of household responsibilities. Based on this, marital status was expected to be positive in this study. However, according to results, marital status of farmers relates significantly negative with farmers' adoption decision-making. The indication therefore is that increase in the marital status of farmers reduces the chance that farmers will prefer their own soil conservation practice to extension recommendation, which is in consonant with literature. This is also supported by the descriptive statistics. According to findings, 74% of farmers' population said they are married, and 59% said they prefer extension recommendations on soil conservation to their own practices (refer to Tables 6.1 and 6.3).

According to this research, farmers who have easy and more stable access to farmland are expected to be positively related with adoption decisions. This is because land as a main factor of agricultural production is one of the main determinants that motivate farmers to invest or not invest on farmland. As results indicate, sources of land (SOURLAND) are fairly negatively influential on farmers' adoption decision-making regarding extension recommended practices for soil conservation. Land by inheritance is arguably the most stable form of access to farmland. The percentage of farmers' population who accessed land through means like inheritance (21%) in the study was lower than those who accessed land through

the ‘other’ group (52%) of access to land (refer to Table 6.2). It therefore suggests that the more people access land for farming through the other means, the lower the chance that they will adopt their own practices at the expense of extension recommended practices. This is also as expected. Asafu-Adjaye (2008) posits that previous studies have revealed that farmers who own their own land are more likely to adopt soil conservation practices, as against those who do not. According to this view, the issue at play here is not just an issue of owning land per se, but issue of security of tenure.

Length of time of continuously farming on a piece of land (LENTFARM), in this study, was expected to be positive in this study. This is because, farming continuously on one spot for a long time, especially without appropriate soil conservation technologies, is expected to lead to quick nutrient depletion, which will serve as motivation for adoption of conservation. According to results, LENTFARM is negative and significantly influential on farmers’ adoption decision-making regarding soil conservation practices by extension at p< 1%. The suggestion therefore is that as the length of time of farmers’ farming continuously on one piece of land increases, the probability that they will adopt their own practices instead of extension recommended practices decreases. This is as expected, and it also agrees with the descriptive statistics of this study, as over 60% of the population of farmers have been farming on one piece of land for over 11 years (refer to Table 6.2).

According to prediction, education was expected to be significantly positive in affecting smallholder adoption decision-making processes regarding the use of soil conservation by extension officers in the study area. But as results indicate, education is statistically insignificant in the analysis, which is unexpected. Although several literature indications are that education significantly impacts positively on adoption decision-making, certain situational factors do sometimes impact negatively on expectations in researches. One reason that can be adduced for this is that, it could be because most of the soil conservation practices introduced by extension do not require much educational knowledge to operate. This is alluded to by a number of authors. Bayard, Jolly and Shannon (2006) in their study in Fort Jacques, found that education was among variables unexpectedly negative in their influence on the adoption of rock walls. Similarly, among the Fujian cane farmers, although education was positively significant in influencing adoption of soil erosion control measure, it

was however insignificant in exerting any influence on effort for soil conservation, as well as on the number of conservation practices used on farm (Asafu-Adjaye, 2008). More so, in the Upper and Lower Areas of Didimana, Eastern Cape, Ighodaro (2012) found that the impact of education in influencing the adoption of soil erosion control measures was also statistically insignificant.

7.3. The level and intensity of adoption decision-making in the study area

According to the thesis statement of this study, the level of adoption is the third stage that must not be neglected if justice can truly be done to any adoption decision-making measurement. This is because, according to research, adoption of innovations is not only an issue of whether or not farmers adopt innovations for change, but also relates to how much of the innovation or to what extent are farmers adopting the specific innovation. Supporting this, Asafu-Adjaye (2008) emphasizes that a farmer's decision to use a particular technology is not necessarily an issue of yes or no, but also may involve two or more variable quantities (multivariate in nature). He pointed further, citing Lynne, Shonkwiler and Rola (1988) and Dorfman (1996) that this is important because using a binary dependent variable could lead to the loss of useful economic information contained in the interdependent and simultaneous adoption decisions.

Obuobisa-Darko (2015) defines intensity of adoption as the level of adoption of a certain innovation (for example the number of hectares planted with an improved seed or the amount of fertilizer used per hectare of farmland). In this case of soil conservation practice, it could mean the number of soil conservation practices adopted by a farmer. According to research, evidences are that the adoption of agricultural innovations and soil technologies in particular is not just a binary issue, but multivariate. Asafu-Adjaye (2008) posits that the subject of the adoption of agricultural technologies, and soil technologies in particular, has been widely researched since the 1950s, but the problem has been, that most of those studies have treated the adoption of soil conservation only as a binary choice decision process. As a result of this, according to Asafu-Adjaye (2008), the extent and intensity of the adoption decision-making process is overlooked. Citing a seminar review on the adoption of various innovations in developing countries by Feder, Just and Zilberman (1985), Asafu-Adjaye (2008) observes that the adoption decisions of

various innovations are interrelated, but lamented the dearth of information along this line.

Supporting this view, Arslan *et al*. (2013), reporting Baudron *et al*. (2007) and Umar *et al*. (2011) maintain that although most applied literature on conservation agriculture (CA) seems to describe adoption decisions as a binary outcome, it is now generally accepted that adoption decision-making process is not a binary process but tends to be partial and incremental. In the view of Kaguongo *et al*. (2010), citing Wale and Yallew (2007) modelling farmers' adoption behaviour about whether or not to adopt an innovation consists of a discrete (whether or not to accept the innovation) and continuous (the intensity of use of the innovation) decision.

Although this stage of adoption decision measurement was interrogated using one of the most current measure, the multinomial regression analysis, the results as it relate to this study was however not recorded due to the inconsistency of data. It is however mentioned here due to the belief and argument upon which this study revolves, which is also supported by literature. This peculiar challenge may have been caused by situational factors, which may not be the same in other areas.

7.4. Influence of soil conservation decision of farmers on livelihoods

With regards to information and communication technologies (ICTs), as an example, according to Martin and Abbott (2011), citing Saunders, Warford and Wellenius (1994), benefits enjoyed by adopters in developing countries include increase in knowledge of market information; improvement in the coordination of transportation, especially during times of emergencies; and boosting the effectiveness of development-related activities. In support, Mulugeta and Hundie (2012) maintains that evidence reveals that wheat technologies (typified by improved wheat varieties grown based on recommended planting space) had a very strong and positive impact on impact on farmers' food consumption levels. Therefore, this section focuses on two aspects. The first consideration is the perception aspect, while the second part is the actual impact of adoption decision making on livelihood standards of farmers.

7.4.1. The effect of farmers' perception on soil conservation practices on livelihoods of farmers

Another focus of this study was trying to understand how farmers' perception on soil conservation practices introduced by extension practitioners relates with the livelihood standards of the farmers. In this study, perception was measured as 'farmers' views on soil conservation practices by extension officers'. Similarly, livelihood standards as used here imply the various measures for farmers' livelihood. Citing Chambers and Conway (1991), the International Recovery Platform (undated) defines livelihood as consisting of capabilities, assets (which includes both material and social resources) and activities needed to make a living. In this regard, measures of livelihood can be material or social. Variables used in measuring farmers' livelihood standards were education levels (EDUCATE), marital status (MARRIAGE), farm size (FARMSIZE), land ownership (LANDOWN), sources of land (SOURCLAND), farm income (INCOMAGC), off-farm income (OFFFINC), total income (TOTALINC), participation in extension (PARTEXT), farm type (FARMTYPE), time of continuously farming on a piece of land (LENTFARM), level of crop (CROPPROD) and livestock (LIVEPROD) productions.

Table 7.5: Correlation matrix of farmers' livelihood variables

	EDUCATE	LANDOWN	FARMTYP	LENTFARM	FARMYRS	LIVEPROD
EDUCATE	1					
LANDOWN	.017	1				
FARMTYP	.004	.112	1			
LENTFARM	.036	.231	-.090	1		
FARMYRS	.158	.137	.052	.325**	1	
LIVEPROD	-.123	.148	-.012	.076	.029	1

According to findings, although thirteen (13) variables were regressed, after a backward elimination process, only four came out significant. To check for multicollinearity, which is a basic prerequisite in regression, a correlation matrix of independent variables was implemented. As results (Table 7.5) suggest, except for the relationship between farmers' experience (FARMYRS) and length of time of continuously farming on same piece of land (LENTFARM), where there is fair correlation (0.325), all other values are low, with most of them falling below 0.2. Coupled with the adjusted R^2 of 0.4, the indication therefore is that there is no serious problem of multicollinearity among the independent variables. Similarly, the

overall significance level was less than 1%, indicating also the goodness of fit of model with respect to the study variables.

Table 7.6: Regression estimates for role of farmers' perception on their livelihoods

	Unstandardized Coefficients				95.0% Confidence Interval for B	
	B	Std. Error	t	Sig.	Lower Bound	Upper Bound
CONSTANT	1.809	1.095	1.653	.107	-.413	4.032
LANDOWN	-.263	.687	-.383	.704	-1.658	1.132
EDUCATE	.469	.194	2.423	.021**	.076	.862
FARMTYP	1.216	.482	2.525	.016**	.238	2.195
LENTFARM	.329	.186	1.771	.085*	-.048	.706
LIVEPROD	-.767	.239	-3.212	.003***	-1.252	-.282
FARMYRS	-.251	.220	-1.144	.260	-.697	.195
R	.694					
R2	.481					
Adjusted R2	.392					
Overall sig.	.000					

NOTE: Significance levels: *= p< 10%; **= p< 5%; ***= p< 1%

The four significant factors according to results (Table 7.6) are education levels (EDUCATE); farming type (FARMTYP); length of time of continuously farming on a piece of land (LENTFARM), as well as level of livestock production. Based on results, education and the type of farming practiced by farmers were statistically positively significant in association with farmers' perception on soil conservation practices introduced by extension officers. The indication therefore is that, a positive perception on soil conservation is likely able to raise the level of farmers' education, as well as improve the type of farming practiced by farmers. This is can be true because, if farmers adopt recommended soil practices, which ultimately aim at increased agricultural production and more income for the farmer, the farmer thus could have more access to avenues that can improve both his personal and farming educational levels. This can be by buying more agricultural informative materials (both print and electronic) that can improve his or her knowledge, attending agricultural schools or even hiring the extra services of private extension which to a large extent is generally perceived more efficient than public extension. Similarly, a farmer with a positive perception towards an introduced practice by extension has more opportunity to improve his or her farming type because the ultimate goal of every national agricultural development is for smallholder farmers to grow to become

commercial. This can happen if farmers continuously use their improved incomes, as a result of adherence to appropriate recommendations, judiciously to improve their farm.

Results further reveal that farmers' perception on soil conservation practices associated positively with length of time of continuously farming on a spot at low significance level of 10%, but negatively significantly with level of livestock production. The indication here therefore is that, although cultivation on same piece of land continuously over a long period has a negative effect on the production of such farmland, however with the advent of modern soil management technologies, this is largely non-existent, when farmers adopt such technologies. Therefore, based on findings in this study, a positive perception on soil conservation practices is largely able to assist farmers who farm on same piece of land continuously over a long period improve their motivations toward the adoption of such soil conservation practices, which ultimately improves their living standards. The level of livestock production was negatively significantly correlated with farmers' perception on soil conservation practices. As explained in previous section, the reason for this negative coefficient could be because livestock production, in this study, is not counted as part of farming activities of farmers. This was because, the agricultural focus of the irrigation scheme where data was collected for this research do not include livestock production as part of their farming activities, even though farmers on their own do rear some livestock outside of the scheme. This was why this study regarded livestock production only as an off-farm activity because the study was focused on farming at the irrigation scheme.

7.4.2. The effect of adoption decisions on livelihood standards

Based on the view of this study, the last stage of the adoption decision-making cycle is influence of farmers' adoption decision-making on their livelihood standards. Following Chambers and Conway (1991) definition, as cited by the International Recovery Platform (undated), measures of livelihood can be material or social. In this study, thirteen measures were adopted by this study (refer to section 7.3.1), which were regressed against two dependent variables in turn. Two similar questions, but asked differently, were provided for farmers to test how much, based on their perceptions adoption of soil conservation practices has benefited them. Two

regression estimates were thus obtained as specified in the Table 7.9. The reason for this was to provide a means of comparison, in order to ensure a reliability of results. After a backward elimination process, eight of the variables have been deemed sufficient enough to analyse this particular objective.

To ensure a check for multicollinearity, which is a main assumption to consider in regression analysis, a correlation coefficient was conducted for all the chosen independent variables. These are presented in the Tables 7.7 and 7.8. As specified in the two tables, two spotted cases that is of concern are the relationship of education (EDUCATE) and off-farm income (OFFFINC), where there is a fair correlation, with values of .393 (Table 7.7-comparison 1) and 0.380 (Table 7.8-comparison 2). The second one is that of total income (TOTALINC) and off-farm income (OFFFINC), where there is a fairly high correlation of variables, with values of -0.68 (Table 7.8-comparison 2). Apart from these, all the other values of correlation coefficients are low, with the absolute values of most of them falling below 0.2, thus suggesting that there is no serious problem of multicollinearity. One of the suggestions of the above is that more educated people in the study also engage more in off-farm activities for off-farm income. This is as expected, because education empowers individuals with skills and expertise to easily engage in off-farm activities. Further, the adjusted R^2 for the two comparisons indicate values less than 0.2, and the overall significant levels for 1 and 2 comparisons both are $p<1\%$ and $p<5\%$ respectively (Table 7.9), indicating also the goodness of fit of the models with respect to the independent variables.

Based on results (Table 7.9), adoption decision-making of farmers was seen to significantly affect education level of farmers (EDUCATE) and household size (HHSIZE) in both comparisons, but significantly impacting on total income (TOTALINC) in comparison 1 and off-farm income (OFFFINC) in comparison 2. Though impact of adoption differs in comparisons 1 and 2 in terms of total income (TOTALINC) and off-farm income (OFFFINC), income is a main variable of livelihood where adoption impact is first considered. Udin (2014), reporting IFAD (2003 & 2005) maintains that there are suggestions in literature that organic agriculture, a form of conservation agriculture, could contribute substantially to farmers' food security and livelihoods. Commenting, Nkala *et al*. (2011), argue that the commonly discussed

positive effects of conservation agriculture, amongst other things, include increases in productivity via higher crop yields which implies food security and ultimately improved economic and social wellbeing of the farmer.

Table 7.8: Correlation matrix for independent variables (comparison 1)

	OFFINCOM	LANDOWN	INCOMAGC	HHSIZE	EDUCAT
OFFFINC	1.000				
LANDOWN	-.051	1.000			
INCOMAGC	-.130	-.188	1.000		
HHSIZE	-.284	.091	-.003	1.000	
EDUCATE	.393	-.027	-.149	-.260	1.000

Table 7.9: Correlation matrix for independent variables (comparison2)

	TOTALINC	MARRIAGE	EDUCATE	FARMTYPE	LIVEPROD	HHSIZE	OFFFINC
TOTALINC	1.000						
MARRIAGE	-.048	1.000					
EDUCATE	-.163	.029	1.000				
FARMTYPE	-.034	-.166	-.026	1.000			
LIVEPROD	-.144	.195	.166	-.012	1.000		
HHSIZE	.022	-.099	-.280	.019	-.204	1.000	
OFFFINC	-.689	.122	.380	-.047	.112	-.221	1.000

According to results (Table 7.9), comparison 1 indicates a negative association between adoption and education, while it was positive for comparison 2. The suggestion of comparison 1 is that adoption of soil conservation practices impacts more on less educated farmers than the more educated ones. It does agree with the descriptive statistics, as in education in the study area was low, and more farmers (89%) say they participate in extension recommended practices. However, comparison 2 suggests that just as educated farmers have more tendency to adopt soil conservation practice, the more willing farmers are in adopting soil conservation practices, the more likely their educational capacity will improve. This is as expected, because , adoption of soil conservation should improve income, which assist in procuring whatever form of education required as farmers. In fact, Pretty (2000) emphasizes, inter alia, that improved economic and social wellbeing were among the livelihood benefits enjoyed by farmers who participated in the Machobane farming system in Butha Buthe and Tebellong communities in Lesotho. Further, Nkala *et al*. (2011b), as reported by Nkala (2011), maintain that the result of a study on the impact of conservation agriculture on livelihoods in Mozambique shows that CA positively correlated with crop productivity or higher crop yield. It was that the result further reveals an indirect impact of CA on household income and food security.

Table 7.10: Empirical results for impact of soil conservation decisions on farmers' livelihoods

Livelihood standard variables	Comparison 1		Comparison 2	
	B	Sig.	B	Sig.
CONSTANT	2.761	.003***	3.594	.002***
MARRIAGE	.162	.349		
EDUCATE	-.301	.032**	.357	.057*
FARMTYPE	.382	.244		
HHSIZE	.267	.037**	-.418	.015**
LIVEPROD	-.186	.137		
LANDOWN			-.855	.176
OFFINCOME	4.867E-05	.155	7.118E-05	.036**
INCOMAGC			-4.287E-5	.170
TOTALINC	-6.583E-5	.004***		
R2	.273		.161	
Adjusted R2	.191		.096	
Overall sig.	.005		.042	

1= How has adoption impacted your livelihoods? 2= How have you benefited from adoption? *= P<10%; **= p<5% ***= p<1%
NOTE: Significance levels: *= P< 10%; **= P< 5%; ***= P< 1%

Also, Table 7.9 reveals that there is a positive and significant relationship between adoption decision making of farmers and household size at 5%. The suggestion is that, just as large household has the likelihood of improving adoption decision regarding soil conservation practices, in the same manner adoption of soil conservation practices is capable of encouraging increase in household size. This is as expected, because the more economically empowered smallholder farmers are, the more they tend to want to have more children, especially to assist them with family labour, which most smallholder farmers depend upon for production. For example, it is said that in Malawi, most smallholder farmers still cultivate using crude implements like hoe, and rely heavily on family labour for production (Hailu, Abrha & Weldegiorgis, 2014). In Europe family farming, which rely mostly on family labour, is the most common operational farming model, thus of immense importance in the region (Sauthor, 2014). Reflecting on the role of household size, Anyanwu (2013) posits that following a micro-economic argument, in Nigeria, children are regarded as a vital part of the household's work force to generate household income, and as insurance against old age.

The relationship of adoption decision-making of farmers was negatively significant in association with total income (TOTALINC) of comparison 1, but positively significant with off-farm income (OFFINCOM) in comparison 2. The indication based on comparison 1 is that increase in adoption decision-making reduces the overall

income of the farmer. This is unexpected. However, this might be a perception problem, where sometimes adoption in certain areas has been delayed or hindered because of the fear that it will reduce production capacity. However, based on comparison 2, any unit increase in adoption decision-making of farmers increases the level of off-farm income of farmers. This is as expected, because an adoption decision is expected to improve farmers' net farm income, which indirectly assists the farmers in their off-farm activities such as livestock rearing. According to Jolly *et al*. (2007), farmers in Haiti expressed various benefits accrued due to the adoption of various conservation options presented to them. Among some of those conservation practices include crop bands, rock walls, contour hedgerows with alley cropping and gully plugs. In terms of alley cropping, for example, it was said that the innovation was adopted because of its various advantages and benefits (Jolly *et al*. (2007). According to them, one of its benefits is that the wood from the hedgerows planted are usually used for firewood, for making of charcoal, for maintenance of soil fertility and for fodder for animals.

7.5. Conclusion

This chapter focused on four major issues: the influence of farmers' perception on soil conservation on farmers' adoption decision-making process; factors responsible for farmers' adoption decision-making; the intensity or level of adoption decision-making by farmers; and the effect of adoption decision-making on farmers' livelihood standards. According to results, age, marital status, education, the level of livestock production, income from crops, off-farm income, total income, farmers' years of experience, awareness of soil conservation practices, as well as participation in extension programmes, were all significant in their relationship with farmers' perception on soil conservation practices promoted by extension. Age, marital status, education, incomes from crops, off-farm income, total income, awareness of soil conservation practices, and participation in extension, were all positively significant in the relationship, while level of livestock production and farmers' years of experience were negatively significant.

In the case of factors responsible for the adoption of soil conservation practices promoted by extension officers, the following were significant: age, gender, marital status, household size, sources of land, length of time of continuously farming on

same piece of land, and total income of the farmer. Age, gender, and total income of farmers were positively significant factors, marital status, household size, sources of land, and length of time of continuously farming on same plot of land, were all negatively significant factors influencing farmers to adopt soil conservation practices by extension. Although expected, education was discovered not statistically significant in influencing farmers to adopt soil conservation practices by extension officers. One reason that may have impacted on this result, according to this study, is that most of the conservation practices suggested by farmers do not actually require much education knowledge to operate. As relating to the third stage of adoption, that is the level of farmers' adoption of soil conservation practices, although the objective was interrogated using the multinomial regression analysis, results were however not recorded due to data inconsistencies.

The last stage was the effect of farmers' adoption decision on farmers' livelihood standards. This was analysed from two angles: influence of perception on farmers' livelihood standards and influence of adoption decision on farmers' livelihood standards. Based on the former, six independent variables were adopted to explain the model. These were education (EDUCATE), farm type (FARMTYP), farmers' years of experience (FARMYRS), land ownership (LANDOWN), length of time of continuously farming on a piece of land (LENTFARM), and level of livestock production (LIVEPROD). The dependent variable was farmers' perception on soil conservation practices introduced by extension. Based on the regression results, education, farm type, length of time of continuously farming on a piece of land, and level of livestock production, were significantly associated with farmers' perception on soil conservation practices.

Similarly, based on the actual impact of adoption decision-making of farmers on livelihoods, seven independent variables were regressed against two dependent variables, in turn. The independent variables are marital status (MARRIAGE), education levels (EDUCATE), farm type (FARMTYP), household size (HHSIZE), level of livestock production, land ownership (LANDOWN), off-farm income (OFFINCOM), income from crops (INCOMAGC), and total income (TOTALINC), respectively. Results indicate that education, household size, off-farm and total incomes were significant in association with adoption decision making.

Sequel to these, a profound and well reasoned commentary and implications of these results are provided in the next chapter that follows, which is the concluding chapter of this study.

CHAPTER EIGHT

Summary discussion of results, implications, conclusion and recommendations

8.0. Introduction

The goal of this chapter is to provide an overall summary for this study. The chapter therefore focuses on five main aspects. The first is a summary discussion of results. In this section, emphasis is on presenting all findings of this study in the simplest way possible, and their implications with respect to the outlined objectives of the study. The second aspect is a discussion on the theoretical, clinical and practical significance of findings. This is followed by the conclusion, theoretical and practical implication section, which is a well reasoned and justifiable commentary on the importance of findings, as well as how findings apply to theory and practice. In the fourth section, suggestions or recommendations are provided for policy implementations, while the last section provides a suggestion for further research.

8.1. Summary and discussion of results

This study was set to evaluate the nature and factors responsible for smallholder farmers' adoption decision-making regarding the use of soil conservation practices by extension officers, using the Qamata Irrigation Scheme, at Chris Hani District Municipality, in the Eastern Cape as a case study. The case study research design was adopted for the study, wherein characteristics of seventy smallholder farmers at the scheme were analysed to reveal the level of smallholder adoption decision-making regarding the use of soil conservation practices introduced by extension officers. The central argument (thesis) of the study was based on the ground that any holistic understanding and analysis of adoption decision-making especially as it relates to soil conservation practices must be driven from four perspectives. The first is the level where farmers form a perception, whether in terms of the incoming innovation or the problem that requires certain technology. The second level is when the farmer takes a decision whether or not he/she was going to adopt the innovation. The third level is where the farmer decides on the extent of conservation practices he/she is prepared to adopt, while the fourth aspect looks at how adoption impacts on the farmer as a person.

This study tried to provide answers to six basic objectives. The first objective was to assess smallholder farmers' perception on soil conservation practices introduced by extension officers in the study area. Basic focus of this objective was: to identify farmers' perception as it relates to extension recommended soil conservation practices in the study area, and to assess how farmers' perception contributes to adoption decision-making of farmers. As such, two analytic tools where used for the analysis of this objective. These are the descriptive statistics analysis process, which was used to identify perceptions on soil conservation practices by extension, as well as the multiple regression analysis, which was used to analyse the influence of farmers' perception on adoption decision-making of farmers. In terms of the latter, the dependent variable was measured as farmers' views on soil conservation practices introduced by extension officers. Seventeen different independent variables, as guided by literature, were regressed against the dependent variable. The following are the independent variables: age (AGE); gender (GENDER); marital status (MARRIAGE); education (EDUCATE); size of farm (SIZEFARM); farm type (FARMTYP); household size (HHSIZE); land ownership (LANDOWN); sources of land (SOURLAND); length of time of continuously farming on a piece of land (LENTFARM); level of crop production (CROPPROD); income of agricultural crops (INCOMAGC); off-farm income (OFFINCOM); total income (TOTALINC); farmers' years of experience (FARMYRS); awareness (AWARESCP); and participation in extension (PARTEXT).

The second objective was to identify what smallholder farmers currently are using for soil conservation in their area. Basic focus here was to have an overview of all soil conservation practices available for farmers' use, whether traditional or extension recommended. The descriptive statistics analysis process was used to analyse this objective.

The third objective was to determine the factors that influence smallholder farmers' adoption decision-making process regarding the use of soil conservation practices by extension officers. In order to ensure reliability as well as compare results, and since the dependent variable of this objective is binary in nature, three binary models were used in the analysis of the objective. These are the probit, logit and binary logistic regressions. The dependent variable was farmers' preference for own

practice as against extension recommended practices (FARMPREF), where those who preferred their own practices to extension was ascribed the number ‘0’ for ‘yes’, or ‘1’ if otherwise’. The following were the independent variables, as guided by literature: age (AGE); gender (GENDER); marital status (MARRIAGE); education (EDUCATE); size of farm (SIZEFARM); farm type (FARMTYP); household size (HHSIZE); land ownership (LANDOWN); sources of land (SOURLAND); length of time of continuously farming on a piece of land (LENTFARM); level of crop production (CROPPROD); income of agricultural crops (INCOMAGC); off-farm income (OFFINCOM); total income (TOTALINC); farmers’ years of experience (FARMYRS); awareness (AWARESCP); and participation in extension (PARTEXT).

The fourth objective was to evaluate the level and intensity of soil conservation practices adopted by farmers in the study area. The focus of this objective was to test the level and intensity of adoption decision-making of farmers, since adoption is not just only an issue of whether farmers perceive and adopt innovations for change or not, but also relates to how much effort, or to what extent has farmers participated in adoption? A most appropriate model adopted for this objective was the multinomial regression analysis, where soil conservation practices in the study area were classified into three as suggested by farmers, where the dependent variable was the most recommended practices by extension officers in the area (EXTMREP). Seventeen independent adoption variables chosen for the study were regressed against the dependent variable. The unfortunate situation was that there was grossly invalid result due to data inconsistency, hence it was not recorded.

The fifth objective was an evaluation of the effect of farmers’ perception on the adoption decision-making of farmers regarding their use of soil conservation practices by extension officers. The focus of this objective was to test for the role perception plays in adoption decision-making. As such, farmers’ perception, measured as “farmers’ views on soil conservation practices by extension officers” was regressed against seventeen independent adoption variables chosen for this study. These were: age (AGE); gender (GENDER); marital status (MARRIAGE); education (EDUCATE); size of farm (SIZEFARM); farm type (FARMTYP); household size (HHSIZE); land ownership (LANDOWN); sources of land (SOURLAND); length of time of continuously farming on a piece of land (LENTFARM); level of crop

production (CROPPROD); income of agricultural crops (INCOMAGC); off-farm income (OFFINCOM); total income (TOTALINC); farmers' years of experience (FARMYRS); awareness (AWARESCP); and participation in extension (PARTEXT).

The sixth objective was an evaluation of the influence of adoption decision-making on the livelihood standards of farmers. The goal of the objective was to see how adoption of soil conservation practices was fairing amongst farmers. The question here is, has farmers benefited from adoption of soil conservation practices or not? Literature indicates that the goal for any agricultural innovation dissemination is for improved agricultural production, and thus improved livelihoods for farmers. As such, this objective was analysed by first looking at the role of perception on soil conservation practices is playing in the analysis, before the actual influence of adoption decision. As part of the arguments of this study, perception plays a vital role in any human-related research. Therefore, farmers' perception (dependent variable) was measured as farmers' views on soil conservation practices by extension officers. This was regressed against thirteen independent livelihood standards variables, using the multiple regression analysis. The independent variables were: education levels (EDUCATE), marital status (MARRIAGE), farm size (FARMSIZE), land ownership (LANDOWN), sources of land (SOURCLAND), farm income (INCOMAGC), off-farm income (OFFFINC), total income (TOTALINC), participation in extension (PARTEXT), farm type (FARMTYPE), time of continuously farming on a piece of land (LENTFARM), level of crop (CROPPROD) and livestock (LIVEPROD) productions.

In terms of the second part of the analysis for objective six, the effect of adoption decision-making of farmers on livelihood standards, two dependent variables were chosen, consisting of two similar but asked-in-different-ways questions. These were: how has adoption benefited you (BENADOPT)? And how has adoption affected your livelihoods (ADOPTLIVE)? The goal was to compare results, and to ensure some level of reliability. These were also regressed against the earlier thirteen independent livelihood standard variables, as used in the perception measurement.

Based on this, the following is a provision of a brief summary and discussion of results as it relates to each study objective beginning first with the personal and demographic characteristics of farmers as revealed by the study.

8.1.1. Farmers' personal characteristics in the study area

According to findings, the study area consists of Qamata Irrigation Scheme, Chris Hani District Municipality, in the Eastern Cape. A population sample of seventy farmers was selected from the scheme through a focused group meeting with farmers, using the availability sampling technique, with the aid of a questionnaire. The availability technique was chosen in order to overcome challenges associated with the loss of interest of farmers which do sometimes occur during data collection, especially when some realize there is no immediate financial benefit associated with such a survey. A similar problem occurred at Zanyokwe Irrigation Scheme, one of the schemes that would have been considered as part of this project.

The study consisted of more males (60%) than females (40%), which seemed to favour adoption of soil conservation, especially because most soil adoption options required special man-power which only the men could provide, except for some females who have the means to buy such man-power. The farming population consisted of older people (60%). This presents a precarious situation for farming in the area, because farming decisions are supposedly left for old people. Old people are generally known to be very conservative, more resistant to change, afraid of risks, and majorly are social grant dependents as main means of livelihood, which do not present a favourable environment for sound adoption decision-making. Also, over 70% of the population are married, which should impact positively on adoption of recommended soil conservation practices by extension officers, and thus increase in agricultural production in the study area.

More so, findings reveal only 3% of farmers' population exceeded grade 12, and 20% had no formal education. This is quite significant, especially in terms of decision-making, because research has shown that education relates significantly positively with adoption of innovations. Majority (90%) of the farmers had farms not more than 5 hectares. This is quite significant, and does reveal the level of farming in the area, and well supported by literature. Based on this, the likelihood is, that efforts

for soil conservation practice participation by farmers will be low, as farmers may see efforts for soil conservation as a waste because they have very small farm. Farming also is both smallholder farming (89%) and commercial farming (8%). The implication is that, in terms of the achievement of national goal for agricultural development, this is a negative phenomenon.

Similarly, 90% of farmers claimed they own the land they farm, which seems to indicate a favourable environment for adoption decision-making, especially regarding soil conservation practices, of which the most part (21%) say they received by inheritance. Also, half of the population of farmers (50%) claimed they have been involved in farming activities for over 18 years, which seemed to indicate a relatively reasonable amount of experience for farmers in the study area, which also should impact positively on adoption decisions. According to literature, there is a positive relationship between experience and adoption decision-making.

8.1.2. Farmers' perception on soil conservation practices in the study area

As literature reveal, and according to the central argument of this study, perception is very crucial and an indisputable element in any social science, or any human-related research. Therefore farmers' perception in the study was described using basic descriptive statistics.

Descriptively, farmers' perception indicates that 86% of farmers said they are aware of the recommended soil conservation practices introduced by extension officers, which seemed to reflect that there should be more adopters in the extension practices, because literature also maintains there is a positive relationship between awareness and adoption decisions. Also, 66% of respondents said, that the recommended soil conservation practices are good and effective in assisting the improvement of their soils, as compared to the number (47%) who said their own practice is effective as against the recommended practice by extension officers. However, when the two types of practices where weighed on a Likert scale, 41% population of farmers preferred their own soil management practices than the recommended ones by extension officers (59%), which further indicate that more farmers participate in extension practices than the traditional ones in the area.

More so, except with a very little margin, all farmers' responses agree with literature on the advantages of using soil conservation practices. For examples, 29% said it improves soil quality and produce, while 33% said it prevents soil erosion and conserves the soil. Based on these results, the indication is that farmers in the study area have a right perception on the introduced soil innovation, which also is a reflection of some levels of acceptance by farmers.

8.1.3. Current soil conservation practices available in the study area

Apart from modern methods of conservation, research indicates that rural people have their indigenous methods for combating various challenges around them like soil degradation. Hence, farmers' response was required regarding their current practices, used for soil conservation. According to findings, a long list of practices was suggested by farmers, which were classified into the following categories: crop rotation; mixed cropping; contour ploughing; use of plant cover; use of fertilizer/manure; avoid overgrazing; fallowing; conservation tillage; and others which include use of drainage and engaging in soil samples before cultivation. Topping this list of suggestions by farmers are crop rotation and use of fertilizer/manure. These are very simple soil conservation practices amongst rural people, which nonetheless have assisted in rural soil conservation, which also are supported by literature.

With respect to extension most recommendation for soil conservation in the study area, the initial expectation was that, there should be one or two main soil conservation practices introduced by extension people. But field work exercise was shocking, as the concept of soil conservation seemed new to both farmers and extension workers. But further probing later revealed that even though the term seemed new to them, there were however various practices used by farmers to conserve their soils. Therefore, the research, after data collection, had to classify practices as suggested. Based on this, three classes of practices were adopted as follows: the use of crop rotation, conservation tillage, and others which ranged from use of fertilizer, chemicals, avoiding overgrazing, et-cetera. The indication was that crop rotation seemed also to top the list of extension recommendation for soil conservation.

8.1.4. Factors influencing the adoption decision making of farmers

According to literature, several factors prevail on farmers' adoption decision-making at various stages of the adoption decision-making process. However, for this study, seventeen (independent variables) were selected and regressed against the dependent variable: farmers' preference for own practice(s) as against extension recommended practices by extension. In order to check for multicollinearity, a correlation matrix of independent variables was also conducted. As expected, age had a fairly high negative correlation (r= -0.530) with education, indicating that older farmers tend also to be less educated. This is true amongst most smallholder farmers in most developing countries of the world. Off-farm income had a high positive correlation (r= 0.701) with total income, indicating also that farmers with high off-farm income have high total income, and vice versa. Apart from these aforesaid, the correlation coefficient of the remaining cases were low, with absolute values of majority (almost 75%) falling below 0.2, thus suggesting that the problem of multicollinearity was not serious among variables.

Further effort to ensure reliability of results and for better analysis of study objective, this study adopted three models of analysis: the probit and logit regression models, as well as the binary logistic model, to ascertain factors influencing farmers' adoption decisions regarding soil conservation practices introduced by extension. Based on these, except for household size, crop production and total income, where results of the probit and logit regressions vary from the binary logistic regression, values of all the other five significant factors were the same across all three models, thus indicating, to a large extent, reliability of results. From the binary logistic analysis, household size was a fairly significant ($p<10\%$) factor influencing farmers' adoption decision-making, but insignificant in the probit and logit regression analysis, though its coefficient was negative throughout all three models. The indication of this is that, any one increase in household size reduced the chance of farmers adopting their own practices as compared to extension recommendations, which partially is as expected. Based on literature, authors are not in agreement as per the contribution of household to adoption decision-making. This is because, on one hand, large sized household implies more mouth to feed, and thus a reduction of money that would have been meant for agriculture. On the other hand, large household implies more family labour for smallholder agriculture.

In terms of level of crop production, results of the probit and logit regressions indicated a negatively significant relationship with farmers' adoption decision-making, suggesting that every increase in the level of production of farmers' crops reduced the chance of adopting farmers' own practices, thus accepting extension recommendations. This was as expected, because increase in crop yield implies more income for the farmer, which eventually is ploughed back into farming. In the results of the binary logistic model, total income of farmers was positively fairly significant ($p<10\%$) in propelling adoption decision-making of farmers. The suggestion here was that every unit increase in farmers' overall income motivates them to accept their own practices as against extension recommendations.

Based on the three models adopted for this objective, results for impact of age, gender, marital status, sources of land, and length of time of continuously farming on one spot seemed to agree across all models, except with very insignificant variance.

Age as a factor in adoption decision-making could be dual in impact. There are areas where research has found age to be negatively related with adoption decision-making process, while it was positive in others. Hence, result for age is said to be unpredictable a priori. Regarding gender, according to the descriptive statistics of this study, there were more males (60%) in the study area than females (40%). Males were ascribed the code '0' while females were coded '1' respectively. Based on results, gender was positively significant in influencing farmers' adoption decision-making process regarding extension recommended practices for soil conservation, implying that women are more likely to adopt their own practices as compared to extension recommended practices, which is congruent with literature. Most conservation practices are highly labour-intensive, thus making it difficult for women, except the ones who have the financial means to buy man-power. Also, according to results, marital status of farmers related significantly positive with farmers' adoption decision-making. The indication therefore was that increase in the marital status of farmers reduces the chance that farmers will prefer their own soil conservation practice to extension recommendation, which is in consonant with literature. This is also supported by the descriptive statistics. According to findings, 74% of farmers' population said they are married, and 59% said they prefer extension recommendations on soil conservation to their own practices.

According to expectation, farmers who had easy and more stable access to farmland were expected to be adopters of extension recommendations for soil conservation in their area. This is because land as a factor of agricultural production is one of the main determinants that motivate farmers to invest or not invest in soil conservation. As results indicated, sources of land were fairly negatively influential on farmers' adoption decision-making regarding extension recommended practices for soil conservation. The percentage of farmers' population who accessed land through means like inheritance in the study was lower than those who accessed land through the 'other' group of access to land, It therefore suggests that the more people accessed land for farming through the 'other' group, the lower the chance that they will adopt their own practices at the expense of extension recommended practices. Based on further results, length of continuously farming on a piece of land was negative and significantly influential on farmers' adoption decision-making regarding soil conservation practices by extension at $p< 1\%$. The suggestion is that as the length of time of farmers' farming continuously on one piece of land increases, the probability that they will adopt their own practices instead of extension recommended practices will in like manner increasingly get smaller. Thus they will adopt extension recommendations, which is as expected.

According to prediction, education was expected to be significantly positive in affecting smallholder adoption decision-making processes regarding the use of soil conservation by extension officers in the study area. But as results indicate, education was statistically insignificant in the analysis, which was unexpected. Although several literature indications are that education significantly impacts positively on adoption decision-making, certain situational factors do sometimes impact negatively on expectations in researches. One of them could be because most of the soil conservation practices proposed by farmers do not really require much educational expertise to operate.

8.1.5. The intensity of smallholder farmers' adoption decision-making

According to this study, the fourth objective is to determine the level and intensity of smallholder farmers' adoption decision-making regarding their utilization of soil conservation practices by extension. Based on the central argument of this study, and supported also by literature, the stage in the adoption decision-making analysis

must never be by-passed for any holistic quest for the understanding and analysis of the adoption decision-making process. Thus, this objective was also evaluated using one of the most current measures, the multinomial regression analysis. But from findings, this objective was not achieved by the study, as result could not be recorded due data inconsistencies. Although this objective could not be achieved, this peculiar challenge may have been due to situational factors, as is sometimes the case in research, which may not be true in other areas. As such, the suggestion is that, this stage should never be omitted in any study like this.

8.1.6. The influence of farmers' perception on adoption decision-making

Based on the objective five of this study, smallholder farmers' perception, measured as 'farmers' views on soil conservation practices by extension' was regressed against seventeen independent adoption variables chosen for the study. Empirically, results suggest, that age, marital status and education of farmers were positively significant in the relationship between farmers' perception and adoption decision-making. The indication therefore is that older farmers, more educated and married (compared to the unmarried) farmers in the area, seemed to possess a higher likelihood to have a positive perception of the soil conservation practices introduced by extension officers, which is a major prerequisite for appropriate decision-making. Results also suggest, that the level of livestock production was negatively related with farmers' perception on soil conservation practices introduced by extension officers. The indication of this also is, that any increase in the level of production of livestock owned by farmers, lowers their perception on extension recommended practices, and the more their perception favour their own practices for soil conservation, which really is unexpected.

Also positively significant in influencing farmers' perception on soil conservation practices introduced by extension, were incomes from agricultural crops and off-farm, as well as the overall income of the farmer at 5% levels of significance each. This was as expected, because the income, from whatever source, means farmers' empowerment over poverty, and enhanced purchasing power, even of the technologies needed on-farm. Moreover, farmers' years involved in farming, which was the measure for farmers' experience in the study was negatively significant in its influence on farmers' perception on soil conservation practices by extension

practitioners at a low significance level of 10%. This was unexpected, because the expectation was that the more experienced a farmer is, the more likely he is disposed to perceive and adopt soil conservation practices by extension.

Furthermore, results of this study reveal that awareness of soil conservation practices by extension officers and participation in extension programmes on soil conservation were both statistically significant in their influence on farmers' perception on soil conservation practices by extension agents. These were as expected. In the model adopted, farmers' awareness and participation in extension were both coded as binary response variables, where awareness or participation were coded 'yes' or '1', while non-awareness or non-participants were as well coded 'no' or 'zero'. Interestingly, the signs of coefficients of the regression model were both positive, indicating that more of the farmers who claimed awareness and participating in the soil conservation practices introduced by extension, also have positive and better perception of the soil conservation practices, which also are both congruent with literature.

8.1.7. The effect of adoption decision-making on livelihood standards of farmers

Following the central argument of this study, this objective was implemented first by considering the role of perception in this analysis, before the actual influence of adoption decision-making on chosen livelihood standards variables, as guided by literature.

First of all, based on the effect of farmers' perception on farmers' livelihood standards, thirteen livelihood standard variables were regressed against farmers' view on soil conservation practices by extension, as the dependent variable. According to findings, although thirteen (13) variables were regressed, after a backward elimination process, only four came out significant. To check for multicollinearity, which is a basic prerequisite in regression, a correlation matrix of independent variables was implemented. Results suggest, except for the relationship between farmers' experience and length of time of continuously farming on same piece of land, where there was fair correlation (0.325), all other values are low, with most of them falling below 0.2. Coupled with the adjusted R^2 of 0.4, the indication therefore was that there was no serious problem of multicollinearity among the

independent variables. Similarly, the overall significance level was less than 1%, indicating also the goodness of fit of model with respect to the study variables. The four significant factors were education levels; farming type; length of time of continuously farming on a piece of land, as well as level of livestock production.

Based on results, education and the type of farming practiced by farmers were statistically positively significant in association with farmers' perception on soil conservation practices introduced by extension officers. The indication therefore is that, a positive perception on soil conservation is likely able to improve the level of farmers' education, as well as improve the type of farming practiced by farmers, and vice versa. Results further reveal that farmers' perception on soil conservation practices associated positively with length of time of continuously farming on a spot at low significance level of 10%, but negatively significantly with level of livestock production. The indication here also is that, although cultivation on same piece of land continuously over a long period has a somewhat negative effect on the production of such farmland, however with the advent of modern soil management technologies, this is largely non-existent nowadays, when farmers adopt such technologies. Therefore, based on findings in this study, positive perception on soil conservation practices is largely able to assist farmers who farm on same piece of land continuously over a longer period towards the adoption of recommended practices for soil conservation. The level of livestock production was negatively significantly correlated with farmers' perception on soil conservation practices. As explained in previous section, the reason for this negative coefficient could be because livestock production, according to this study, was not counted as part of farming activities of farmers at the Qamata Irrigation Scheme. This was because, the agricultural focus of the scheme do not include livestock production as part of their farming activities, even though farmers on their own do rear some livestock.

Based on the actual effect of farmers' adoption decision-making on livelihood standards, thirteen livelihood standard variables were chosen, guided by literature, and regressed against two similar but asked-differently-type questions, as dependent variables. As such, two regression estimates (comparison 1 and 2) were obtained. The reason for this was to provide a means of comparison, in order to ensure a reliability of results. After a backward elimination process, eight of the variables were

used to explain the equation. To ensure a check for multicollinearity, which is a main assumption to consider in regression analysis, a correlation coefficient was conducted for all the chosen independent variables. As results indicated, in the relationship of education and off-farm income, there was a fair correlation, and in that of total income and off-farm income also, there was a fairly high correlation of variables. Apart from these, all the other values of correlation coefficients were low, with the absolute values of most of them falling below 0.2, thus suggesting that there was no serious problem of multicollinearity. One of the suggestions of the above is that more educated people in the study also engage more in off-farm activities for off-farm income. This was as expected, because education empowers individuals with skills and expertise to easily engage in off-farm activities. Further, the adjusted R^2 for the two comparisons indicated values less than 0.2, and the overall significant levels for 1 and 2 comparisons both are $p<1\%$ and $p<5\%$ respectively, indicating also the goodness of fit of the models with respect to the independent variables.

Based on results of the two regression estimates, comparison 1 indicated a negative association between adoption and education, while it was positive for comparison 2. The suggestion of comparison 1 was that adoption of soil conservation practices impacts more on less educated farmers than the more educated ones. This is unexpected, but it does agree with the descriptive statistics, as education in the study area was low, and more farmers (89%) say they participate in extension recommended practices. However, comparison 2 suggests that the more willing farmers are in adopting soil conservation practices, the more likely their educational levels improve. This is as expected, because, adoption of soil conservation should improve income, which assist in procuring whatever form of education required as farmers.

Also, result of this study revealed that adoption decision making of farmers positively and significantly impacted on household size at a 5% p-value. The suggestion was that adoption of soil conservation practices was capable of encouraging increased household size. This is as expected, because the more economically empowered smallholder farmers become, as a result of benefits from adoption, the more they tend to want to have more children, especially to assist them with family labour, which most smallholder farmers depend upon for production.

8.2. Theoretical and practical implications of findings

The goal of this study was to understand the nature and factors influencing smallholder farmers in their decision-making regarding the use of soil conservation practices introduced by extension practitioners. It used farmers in a selected irrigation scheme in the Eastern Cape, South Africa, as a case study. This was to serve as a bench mark of understanding smallholder farmers' adoption decision-making process in general. As it is understood, smallholder farmers are generally informal and unorganized in their farming system. But those in an irrigation scheme are relatively more formal and organized, especially for the fact that they do have at least one extension officer who assists their farming operations on a day to day basis.

Using a central argument (thesis statement), the study stated that an adequate understanding and definition of smallholder farmers' adoption decision-making process is very crucial to solving the problem of soil erosion/ degradation problem amongst smallholder farmers. It thus argued that for any holistic understanding and analysis of smallholder farmers' adoption decision-making process, especially regarding the use of soil conservation practices, the adoption decision-making process must be viewed basically at four stages. These are: the perception stage; the adoption stage; the level of adoption stage; and the impact of adoption stage.

Although literature evidence indicates support in favour of this view, either implicitly or explicitly, however, there seems to be no clear representations as presented in this study. The only closest are views that included the intermediary variables called the intervening or mediating variables, in-between their independent and dependent variables, like that of Lewin (1951) field theory, Tolman (1967), which was improved upon by Dűvel (1991). But the difference is that, while these views emphasized on need, perception and knowledge as basic constituents of the mediating variables, this study argued that though perception is part of the aforesaid, it however is the particular variable, through which every other variable, including need and knowledge, reflect.

According to the empirical results, perception is seen as very relevant in adoption decision-making, interacting significantly with nine of the seventeen adoption variables chosen for this study. Factors found significantly associating with farmers' perception were: age; marital status; educational levels; incomes from crop, off-farm

activities, total income; awareness of recommended practices; and participation in extension. Age, marital status and education levels of farmers were positively significant in association with perception, indicating that older people, which also reflect measures of experience, more educated, and married farmers, have more potentials of improved farmers' perception. Incomes from crops, off-farm and overall incomes were also significantly positive in association with perception, suggesting that incomes, from whatever source, was likely capable of improving farmers' perception regarding soil conservation, and subsequent adoption. Awareness of the soil practices and extension participation, were similarly positively significant in association with perception, indicating that farmers who are aware of the soil practices are also those who participate in the use of the practices.

In line with literature, the study discovered that the nature of adoption decision-making processes of smallholder farmers is complex (not straight), being affected by various factors. Factors discovered influencing significantly on smallholder farmers' adoption decision-making regarding soil conservation practices were: age, gender, marital status, sources of land, length of continuously farming on same piece of land, level of crop production, and total income of farmers, respectively. While age, gender, total income impacted positively, marital status, sources of land, length of continuously farming on same piece of land, and level of crop production impacted negatively. The indication was that older farmers prefer their own practices to the recommended practices from extension, which is in line with literature. Also, more females prefer their own practices to extension recommended. This means more males prefer the recommended practices, which also is as expected. Based on results, married people, those who own land for farming, those who have continued farming on one spot for a long time, and increase in the level of crop production, all had a propensity to motivate farmers to adopt extension recommended practices as against farmers' practices.

One variable that was unexpectedly insignificant in the analysis was education levels of farmers. Although there is literature support where education was insignificant in adoption decision-making, one situational factor that may have impacted on results of this study, is the fact that most of the soil conservation practices suggested by farmers do not require any special educational expertise to operate. As such, the low education level of the study area does not have any tangible statistical effect.

Although the level of adoption decisions of smallholder farmers was interrogated, due to the inconsistency associated with data, result was however not recorded. To see how adoption decisions impact on livelihood standards of farmers, a regression estimate was obtained. Based on results, adoption decision-making was found significantly affecting farmers' education, household size, and income (off-farm and total). The indication therefore is that, adoption decision-making is potentially capable of improving education level of farmers; increase the size of household, thus a provision of easy family labour; and as well improved level of income for the farmer.

Perception is said to be very relevant in the four-stage process proposed for a holistic understanding and analysis of adoption decision-making process, especially as relating to the use of soil conservation practices. However, certain precautions must be taken into due consideration. Firstly, though perception is affected by a number of factors, like the personal, institutional, economic, and environmental or physical factors, it is however the human variable that translates and provide meanings to impulses received from every other variable, including the so-called needs and knowledge variables. Certain factors, however, prevail on perception, which determine the ultimate interpretation that is given to any stimuli. These factors could be structural (factors inherent in the in-coming stimuli) or functional (factors inherent in an individual) factors. Secondly, as indicated, perception measurement is very subjective, that is it is dependent on what factors are prevailing on any particular person in question. This is why great care must be taken with its measure.

8.3. Conclusion and implications for theory and extension practice

Based on the central argument of this study, as well as on findings, this study concludes that technology dissemination and adoption must begin from a clear understanding of individuals' (farmers) perception and should end with the impact of the technology. Due to the particular relevance of perception in the process, technology disseminators (extension), researchers and policy makers alike must never conclude that any technology was rejected, not until factors determining perception of individuals have been well studied. Examples of such factors are the structural factors (factors inherent in the technology), and functional factors, that is

those inherent in the individual adopter. Examples of these are the moods of individuals at the time of the introduction of such innovations; the motives of such individuals; and perhaps their former experiences or learning, as it relates to the expectations of the individual in question.

It therefore suggested that even at the confirmation stage of an individual adopter, when a rejection has been confirmed, for an example, analysing factors of the adopter's perception at play at the particular time of the innovation in question, will go a long way to redirecting the course of the adoption process of the said individual. Therefore, it is only after the aforementioned has been engaged, that a conclusion on rejection should be made.

8.4. Policy recommendations

Research is all about solving problems or filling identified gaps. The problem that began this study was that, despite the availability and inherent benefits of many modern and improved soil management technologies or practices, farmers' adoption is low, as such many soil problems abound. Therefore, based on findings of this study, a number of suggestions are provided in this section, to assist policy makers know where to focus policy for the improvement of agriculture in the Eastern Cape in particular, and South Africa in general.

Firstly, though explicitly or implicitly, there are suggestions in literature which seem to support the central argument of this study, in whole or in part, this study however provides an unambiguous conceptualization for the understanding and analysis of the nature and factors that influence smallholder farmers in their decision making processes regarding the use of soil conservation practices in the Eastern Cape. It was able to prove that all human behaviours are linked to their perception. Hence, for a holistic understanding and analysis of any social science or human-related research, beginning from the perception of individuals under study should be thought worthwhile.

Also, findings indicate that female farmers opt more for the traditional soil practices than the extension recommended, due to the fact that, most soil conservation practices require special man-power to operate. It therefore means, for female farmers to operate, they must have the financial means. Based on this, government should provide some special financial support assistance to such females, so they

do not have any hindrance to their adoption of extension programmes on soil conservation.

The population of farmers also consisted of older people, who prefer their own traditional practices than extension recommended, which implies the ageing phenomenon problem prevailing in the area, as suggested by Ayinde (2011). It also reveals that farming decisions are left in the hands of old people, as well as the absence of able-bodied youth in the farming system of the area, who may have migrated to urban centres for so-called greener pastures. The government should therefore hasten the development process of rural areas, at least with the basic social amenities such as good roads, electricity, adequate supply of water, market and banking facilities, internet services, and all those facilities which are usually pull factors to able-bodied youth to the cities.

As marriage was one of the factors that improve the perception of farmers in favour of soil conservation practices, as well as influenced farmers to accept extension soil conservation practices as against traditional practices, marriage therefore should be encouraged. This can be by strengthening the various institutions responsible for marriage, such as the leaders of communities, families, as the case may be.

Similarly, as education levels of farmers was low in the study area, with only 3% exceeding grade twelve, and education was found as a main factor that boost farmers' perception regarding the use of soil conservation practices, efforts should be raised in reducing this menace. This can be by encouraging more educated people into farming, which also can be by providing more incentives that lure educated individuals of society to see farming as a lucrative means of living, provision of more means of education to farmers, and strengthening extension services for farmers.

The ultimate national goal for agricultural development in South Africa is for food security. There can be no food security without improved agricultural production, both in quality and quantity. More so, the national objective for all smallholder farmers is to grow into commercial farming. Therefore, adequate land should be made more available to farmers in South Africa, since majority of farmers were smallholder farmers in the study area, who had farmland not more than 5 ha, and have continuously farmed on one piece of land for more than 11 years. This can be by speeding up the rate of the redistribution process and the processes of acquiring

title deeds to land. Moreover, more programmes should be designed to assist farmers with all the necessary skills to improve.

As awareness was discovered as one of the factors which influenced farmers' perception in the study area, efforts for propagating innovation around soil conservation in South Africa should include awareness programmes, to sensitize the people on the importance of such innovation. Similarly, since participation in extension was as well found positively impacting on farmers' perception, extension should encourage more meetings with farmers on soil conservation, or any innovation to be disseminated, to provide more avenues for education and training on those technologies.

As income, whether from crop, off-farm, or the overall income of farmers was positively associated with farmers' perception in favour of soil conservation practices, adequate financial support should be made more readily available government to farmers. This can be in the form of soft loans, or agricultural inputs.

Basic soil conservation practices found by the study were simple practices that have been used for a long time. Although these practices, to a large extent, help in soil conservation, there is therefore the need for more modern proven soil conservation practices to be introduced to smallholder farmers in South Africa.

Based on findings, off-farm income had a fairly high positive correlation with total income, indicating that farmers with off-farm income also have high total income, and income was found to influence adoption decision-making, to a large extent. Therefore, efforts should be gingered towards encouraging off-farm income activities, so that farmers can have more money to invest in their farms. A main off-farm income activity that was discovered in the study area was livestock rearing. This should be encouraged, especially as the Eastern Cape is noted to be the largest producers of most livestock in South Africa.

The level of crop production was found significantly positive in causing farmers to accept extension recommended practices instead of their traditional practices. This means that increase in the level of crop yield would significantly motivate farmers to accept extension recommendations. Therefore, both policy and government programmes that will enhance crop yield should be pursued.

Findings indicate that increase in perception of farmers has a corresponding increase in education level of farmers, as well as move farmers from smallholders to

commercial farmers. This is why efforts should be mobilized to encourage farmers' perception in the right direction.

8.5. Suggestions for further research

According to literature, factors that affect adoption of technologies change over time. Therefore, future research should focus on determining factors, as discovered in this study that affect adoption over time. Examples are age, gender, marital status, household size, sources of land for farming, length of time of continuously farming on a piece of land, level of crop produced, and the overall income of farmers.

This study only studied smallholder farmers' behavioural tendencies regarding soil conservation practices by extension officers in an scheme, therefore other studies need to look at smallholder farmers outside of irrigation schemes, as well as a comparison of the two.

Moreover, since the sample size for this study was relatively small, efforts for further research should focus on using larger sample size, to see the differences in results.

Furthermore, as the goal for the third stage (i.e. the level of farmers' adoption) of the logic of analysis and argument for this study was not achieved, due unfortunately data inconsistencies, other efforts of research should include the level and extent of adoption decision-making, to ascertain differences in results.

References

Abdu-Raheem, K.A. & Worth, S.H. 2011. Household food security in South Africa: evaluating extension's paradigms relative to the current food security and development goals. *S. Afr. J. Agric. Ext*., 39 (2): 91-103.

Adediji, A., 2000. The politics on erosion issues. In: H.I. Jimoh and I.P. Ifabiyi, eds. *Contemporary issues in environmental studies*. Kwara State: Haylee Press and Publishing Company, Ltd.

Ajayi, O.C., Akinnifesi, F.K., Sileshi, G. & Chakeredza, S. 2007. Adoption of renewable soil fertility replenishment technologies in the southern African region: lessons learnt and the way forward*. Natural Resources Forum* 31 (2007):306-317

Ajayi, O.C., & Kwesiga, F. 2003. Implications of local policies and institutions on the adoption of improved fallows in western Zambia. *Agroforestry Systems* 59(3): 327-336.

Al-Baguri, S.H. 2014. The problem of food insecurity jn Africa. African Perspective, 12(41): 25-29.

Aliber, M., 2009. Exploring Statistics South Africa's national household surveys as sources of information about household food security. *Agrekon* 48(4):384-409.

Aliber, M., & Mdoda, L. 2015. The direct and indirect economic contribution of small-scale black agriculture in South Africa. *Agrekon*, 54(2).

Amrhein, J., Salovey, P., & Rosenhan, D. L. 1982. *Joy and sadness generate attributional vulnerability in men.* Unpublished manuscript, Stanford University.

Anim, F. D. K. 1999. A note on the adoption of soil conservation measures in the Northern Province of South Africa. *Journal of Agricultural Economics* 50 (2): 336-345.

Annor-frempong, C. & Dűvel, G.H. 2009. *The comparative role of intervening variables in understanding farmers' adoption behaviour.* Puerto Rico: AIAEE, Proceedings of the 25th Annual Meeting, InterContinental San Juan Resort.

Annor-Frempong, C. & Dűvel, G.H. 2011. The comparative role of intervening variables in understanding farmers' adoption behaviour. *Journal of Agricultural Science and Technology*, 5 (3): 290-297.

ARDRI, 1996. Qamata Irrigation Scheme. Alice: Faculty of Agriculture and ARDRI, University of Fort Hare.

Arslan, A., McCarthy, N., Lipper, L., Asfaw, S. and Cattaneo, A. 2013. *Adoption and intensity of adoption of conservation farming practices in Zambia.* Agriculture, Ecosystems and Environment, In Press, Available online 1 October 2013.

Asafu-Adjaye, J. 2008. Factors affecting the adoption of soil conservation measures: a case study of Fijian can farmers. *Journal of Agricultural and Resource Economics*, Vol. 33(1): 99-117.

Asrat, P., Belay, K. & Hamito, D. 2004. Determinants of farmers' willingness to pay for soil conservation practices in the south eastern highlands of Ethiopia. *Land Degrad. Develop*., 15:423-438.

Babbie, E., 2010. *The practice of social research*. Belmont, CA: Wadsworth.

Baidu-Forson, J. 1999. Factors influencing adoption of land-enhancing technology in the Sahel: lessons from a case study in Niger. *Agricultural Economics* 20(3):231-239.

Baiphethi, M.N., & Jacobs, P.T. 2009. The contribution of subsistence farming to food security in South Africa. *Agrekoon* 48(4):459-482.

Barham, B, Carter, M.R. & Sigel, W. 1995. Agro export production and peasant land access: examining the dynamics between adoption and accumulation. *Journal of Development Economics* 46:85-107.

Barungi, M. & Maonga, B.B. 2011. Adoption of soil management technologies by smallholder farmers in central and southern Malawi. *Journal of Sustainable Development in Africa*, 13(3).

Baudron, F., Mwanza, H.M., Triomphe, B., & Bwalya, M. 2007. *Conservation agriculture in Zambia: a case study of Southern Province.* Kenya: African Conservation Tillage Network (ACT).

Bayard, B., Jolly, C.M. & Shannon, D.A. 2006. The adoption and management of soil conservation practices in Haiti: the case of rock walls. *Agricultural Economics Review*, 7(2):28-39.

Bean, S. 2010. *Accountant salaries: experience plays a significant role*. [O]. Available: http://ezinearticle.com/Accountant-Salaries---Experience-Plays-a-significant-Role. Accessed on 11th Dec. 2010.

Becerril, J., & Abdulai, A. 2009. The impact of improved maize varieties on poverty in Mexico: a propensity score-approach. *World Development* 38:1024-1035.

Bekele, W. & Drake, L. 2003. Soil and water conservation decision behaviour of subsistence farmers in the Eastern Highlands of Ethiopia: a case study of the Hunde-Lafto Area. *Ecological Economics* 46: 437-451.

Bembridge, T. J. 1990. *An agricultural extension model for developing areas in Southern Africa.* Paper presented in the South African Society for Agricultural Extension Conference held in Cape Town.

Bembridge, T.J. 1991. *The practice of agricultural extension: a training manual*. Development Bank of Southern Africa.

Berelson B & Steiner G A. 1964. *Human behavior: an inventory of scientific findings*. New York: Harcourt, Brace & World.

Besley, T., & Case, A. 1993. "Modelling technology adoption in developing countries. *The American Economic Review* 83:396-402.

Bishop-Sambrook, C., 2005. Contribution of farm power to smallholder livelihoods in Sub-Saharan Africa. *Agricultural And Food Engineering Technical Report 2*, prepared for the Food and Agriculture Organization of the United Nations, Rome, 2005.

Blankenship, D.C. 2013. Steps of the research process. *Human Kinetics*.[O]. Available: http://www.humankinetics.com/excerpts/excerpts/steps-of-the-research-process. accessed on 17th January, 2013.

Boeree, C.G. 2006. *Abraham Maslow (1908-1970): biography*. [O]. Available: http://webspace.ship.edu/cgboer/Maslow.html. Accessed on 17th November, 2014.

Bonabana-Wabbi, J. 2002. *Assessing factors affecting adoption of agricultural technologies: the case of integrated pest management (IPM) in Kumi District, Eastern Uganda*. An M.Sc thesis, submitted for examination, at Virginia Polytechnic Institute and State University, Virginia, Blacksburg.

Botterill, L. & Mazur, N. 2004. *Risk and risk perception: a literature review*. Publication no. 04/043. Rural Industries Research and Development Corporation. ISBN 0642587531.

Bradmore, D. 2004. *Demographic characteristics*. Australia: Department of Marketing , Faculty of Business and Economics, Monash University.

Bromley, D. B. 1990. Academic contributions to psychological counselling: a philosophy of science for the study of individual cases. *Counselling Psychology Quarterly, 3*(3), 299-307.

Brown, S. & Shrestha, B. 2000. Market-driven land-use dynamics in the middle mountains of Nepal. *Journal of Environmental Management (*2000)59:217-225.

Bryceson, D. 1996. Deagrarianization and rural employment in sub-Saharan Africa: a sectoral perspective. *World Development* 24(1):97-111.

Brynard, P.A. & Hanekom, S.X. 2006. *Introduction to research in management-related fields.* 2nd ed. Pretoria: Van Schaik Publishers.

Bultena, G. L., & Hoiberg, E.O. 1983. Factors affecting farmers' adoption of conservation tillage. *Journal of Soil and Water Conservation* 38 (May-June): 281-284.

Byerlee, D., deJanvry, A. & Sadoulet, E. 2009. Agriculture for development: toward a new paradigm. *Annual Review of Resource Economics*, 1: 15-31.

California State University 2012. *Findings primary sources.*[O]. Available: http://www.calstatela.edu/library/guides/pswhat.htm. accessed on 18th January, 2013.

Caswell, M., Fuglie, K., Ingram, C., Jans, S., & Kascak, C. 2001. *Adoption of aricultural production practices: lessons learned from the U.S.* Department of Agriculture area studies project, Washington DC, U.S. Department of Agriculture, Resource Economics Division, Economic Research service, Agriculture Economic Report No. 792. January 2001.

Chambers, R., & Conway, G. 1991. *Sustainable rural livelihoods: practical concepts for the 21st century*. [O]. Available: http://www.smallstock.info/reference/IDS/dp296.pdf. Accessed 3rd February, 2010.

Chi, T.T.N. & Yamada, R. 2002. Factors affecting farmers' adoption of technologies in farming system: a case study in OMon District, Can Tho Province, Mekong Delta. *Omonrice* 10: 94-100

Chirwa, P.W. & Quinion, A.F. 2012. *Impact of soil fertility replenishment agroforestry technology adoption on the livelihoods and food security of smallholder farmers in central Malawi.* University of Pretoria, Faculty of Natural and Agricultural Sciences.

Colorado State University Extension 2014. Soil compaction. [O]. Available: http://www.ext.colostate.edu/mg/gardennotes/215.html 5th Dec 2015. Accessed on 5th December, 2015.

Cooper, C. L. Sloan, S.J., & Williams, S. 1988. *The occupational stress indicator*. Windsor, UK: NFER-Nelson.

Cousins, B., 2011. What is a "smallholder"?: Class analytical perspectives on small-scale farming and agrarian reform in South Africa. In P*. Hebinck & Charlie Shackleton (eds.). Reforming land and resource use in South Africa: Impact on livelihoods.* ISS Series in Rural Livelihoods*.* Oxford: Routledge, pp. 86-111.

Cruz, F.A. 1978. Adoption and diffusion of agricultural extensions. In: J.B. Valera, V.A. Martinez & R.F. Plopino (eds.). 1987. *An introduction to extension delivery systems.* Manila: Island Puplishing House, pp. 97-127.

DAFF 2012. *A framework for the development of smallholder farmers through cooperatives development.* Directorate Co-operative and Enterprise Development, Department of Agricultre, Forestry and Fisheries, Republic of South Africa.

Day, A.D. & Ludeke, K.L. 1993. *Plant nutrients in desert environments*. Berlin Heidelberg: Springer Verlag. [O]. Available: http://link.springer.com/chapter/10.1007/978-3- 642-77652-6_9#page-1. Accessed on 5th December, 2015.

DeJong-Hughes, J., Moncrief, J.F., Voorhees, W.B. & Swan, J.B. 2015. *Soil compaction: causes, effects and control.* Regents of the University of Minnesota.

De Franco, M., & Godoy, R. 1993. Potato-led growth, the role of agricultural innovations in transforming Bolivian agriculture: a macroeconomic perspective. *Journal of Development Studies* 29(3): 561-587.

Delgado, C.L., Rosegrant, M.W., Simeon, H.S., & Courbois, E.C. 1999. *The coming livestock revolution*. Department of Economic and Social Affairs, Food and Agriculture Organization (FAO).

Department of Agriculture 2001. The strategic plan for South African agriculture. Pretoria, South Africa: Directorate of Agricultural Information Service.

Department of Agriculture 2002. *The Integrated Food Security Strategy for South Africa*. Pretoria: Department of Agriculture.

Department of Agriculture, Forestry and Fisheries, 2012. *Integrated Growth and Development Plan 2012.* Pretoria: Department of Agriculture, Forestry and Fisheries.

Department of Agriculture, RSA, 2002. *The Integrated food security strategy for South Africa*. Pretoria: Department of Agriculture.

Department of Environmental Affairs, RSA. 2007. *State of the environment: environment affairs*. [O]. Available: http://soer.deat.gov.za/47.html. Accessed on 11th Dec. 2010.

Diao, X., Hazell, P., Resnick, D., & Thurlow, J. 2005. The Role of agriculture in pro-poor growth in sub-Saharan Africa. *Processed. IFPRI: Washington, D.C.*

Diao, X., Hazell, P., Resnick, D., & Thurlow, J., 2007. The role of agriculture in development: implications for Sub-Saharan Africa. *Research Report 153 for International Food Policy Research Institute (IFPRI)*, Washington, D.C.

Dimitri, C., Effland, A. & Conklin, N. 2005. The 20th century transformation of U.S. agriculture and farm policy. United States Department of Agriculture, Economic Research Service, Economic Information Bulletin Number 3.

Dixon, C., Brunson, L.E., Roy, M.M., Smothers, D., Sehorn, M.G., & Mathias, N. 2003. Overproduction of polypeptides corresponding to the amino terminus of the F-box proteins Cdc4p and Met30p inhibits ubiquiin ligase activities of their SCF complexe. Eukaryot Cell 2(1):123-133.

Dixon, J., Taniguchi, K., & Wattenbach, H. (Eds). 2003. Approaches to assessing the impact of globalization on African smallholders: household and village economy modelling. Proceedings of a working session on Globalization and the African Smallholder Study. Rome: Food and Agriculture Organization.

Dollar, E.S.J. & Rowtree, K. 1995. Hydroclimatic trends, sediment sources and geomorphic response in the Bell River catchment, Eastern Cape Drakensberg, South Africa. *South African Deographical Journal*, 77 (1). Pp. 21-32.

Dorfman, J.H. 1996. Modelling multiple adoption decisions in a joint framework. *Amer. J. Agr. Econ.* 78(1996):547-557.

Doss, C.R., & Morris, M. L. 2001. How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agricultural Policy* 25:27-39.

Durosaro, D.O. Undated. *Importance of data collection, analysis and storage in our education system.* Ilorin: Department of Educational Management, University of Ilorin.

Dűvel, G.H. 1991. Towards a model for the promotion of complex innovations through programmed extension. *S. Afr. J. of Agric. Extension*, 20, 70-86.

Düvel, G. H., Chiche, Y., & Steyn, G. J. 2003. Maize production efficiency in the ArsiNegele farming zone of Ethiopia: a gender perspective. *S. Afr. J. Agric. Ext./ S. Afr. Tydskr. Landbouvoorl, 32*, 60-72.

Emeagwali, G. & Dei, G.J.S. 2014. *African Indigenous Knowledge and the Disciplines* (Eds.). Rotterdam: Sense Publishers.

Espinosa, P. & Garett, P. 1987. The relevance of gender in farming systems research: experience in Ecuador. *Agricultural Administration and Extension*, Vol. 26(2):101-117.

Ervin, C.A., & Ervin D.E. 1982. Factors affecting the use of soil conservation practices: hypotheses, evidence, and policy implications. *Land Economics* 58(3): 277-292.

Ethical Trading Initiative 2005. *ETI smallholder guidelines: recommendations for working with smallholders*. Cromwell House, 14 Fulwood Place, London.

FAO 1998. *Food balance sheet*. http://armanncorn:98ivysub@faostat.fao.org/lim...ap.pl. Accessed on 10th December, 2000.

FAO 2001. Food and Agriculture Organization of the United Nations' Press Release 10/22.

FAO 2006. *The state of food and agriculture*. Rome: U.N.- Food and Agriculture Organization.

FAO 2012. FAO news release 2012. Rome: Food and Agriculture Organization of the United Nations.

FAO 2015. Regional overview of food insecurity in Africa: African food security prospects brighter than ever. Food and Agriculture organization of the United Nations, Accra, 2015.

Featherstone, A. M., & Goodwin, B.K. 1993. Factors influencing a farmer's decision to invest in long-term conservation improvements. *Land Economics* 69 (1): 67-81.

Feder, G., & Slade, R. 1984, The acquisition of information and the adoption of new technology. *American Journal of Agricultural Economics*. Pp. 312-320.

Feder, G., Just, R. E., & Zilberman, D. 1985. Adoption of agricultural innovations in developing countries: a survey. *Economic Development and Cultural Change*, 33(2), 255.

Festinger, L. 1957. *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Flett, R., Alpass, F., Humphries, S., Massey, C., Morriss, S., & Long, N. 2004. The technology acceptance model and use of technology in New Zealand dairy farming. *Agricultural Systems* 80: 199-211.

Frank, T., 1998. Nativity, marital status and mortality in Canada. *The Canadian Review of Sociology and Anthropology,* Vol. 35(1).

Friedrich, T. & Kienzle, J. Undated. Conservation agriculture: impact on farmers' livelihoods, labour, mechanization and equipment. Rome: Viale delle Termer di Carcalla.

Garcia, Y.T., 2001. Analysis of Farmer decision to adopt soil conservation technology. In: Argao. R. A. Cramb. *Soil conservation technologies for smallholder farming system in the Philippine uplands: a socio economic evaluation.* Canberra, Australia: ACIAR, pp 160–178.

Garrity, D., Dixon, J. & Boffa, J. 2012. Understanding African farming system: science and policy implications. Food Security in Africa, Bridging Research and Practice, Sydney, 29-30 November, 2012.

Gidi, L. 2013. *Rural households' livelihoods strategies and opportunities with regard to farming: a case of Intsika Yethu Local Municipality*. An unpublished dissertation, submitted at the Department of Agricultural Economics and Extension, University of Fort Hare, South Africa.

Giller, K.E., Witter, E., Corbeels, M. & Tittonell, P. 2009. Conservation agriculture and smallholder farming in Africa: the heretics view. *Field Crops Research* 114: 23-34.

Godoy, R., Franks, J.R., & Claudio, M.A. 1998. Adoption of modern agricultural technologies by lowland indigenous groups in Bolivia: the role of households, villages, ethnicity and markets. *Human Ecology* 26(3): 351-369.

Goel, M. 2007. *The importance of education*. [O]. Available: http://www.keydegree.com. Accessed on 5th Decl. 2010.

Goetz, S.J. 1992. Markets, transaction costs, and selectivity models in economic development. In: G.J Scott (ed). *Prices, products and people: analysing agricultural markets in developing countries*. Boulder: Lynne Rienner.

Gould, B. W., Saupe, W.E., & Klemme, R.M. 1989. Conservation tillage: the role of farm and operator characteristics and the perception of soil erosion. *Land Economics* 65 (2): 167-182.

Hailu, B.K., Abrha, B.K. & Weldegiorgis, K.A. 2014. Adoption and impact of agricultural technologies on farm income: evidence from Southern Tigray, Northern Ethiopia. *International Journal of Food and Agricultural Economics*, 2(4): 91-106.

Hazell, P., Poulton, C., Wiggins, S. & Dorward, A. 2007. The future of small farms for poverty reduction and growth. International Food Policy Research Institute (IFPRI) 2020, *Discussion Paper 42*, May 2007, Washington D.C.: IFPRI.

Hobbs, P.R., 2007. Conservation agriculture: what is it and why is it important for future sustainable food production? *Journal of Agricultural Science*, 145, 127-137.

Hobbs, P.R., Sayre, K. & Gupta, R. 2008. The role of conservation agriculture in sustainable agriculture. *Phil. Trans. R. Soc*. B (2008) 363: 543-555.

Hoffman, T., Todd, S., Ntshona, Z. & Turner, S., 1999. Land Degradation in South Africa. Prepared for Department of Environmental Affairs and Tourism. 245

Hofstee, E. 2009. *Constructing a good dissertatin: a practical guide to finisghing a Masters, MBA or Ph.D on schedule.* Sandton: EPE Registered Office: NBC Building, Second Floor, C Block 113 Katherine Street, South Africa.

Horrigan L, Lawrence RS, Walker P (2002) How sustainable agriculture can address the environment and human health harms of industrial agriculture. *Environ Health Perspect* 110:445–456

Hosu, S. & Mushunje, A. 2013. Optimizing resource use and economics of crop-livestock integration among small farmers in semiarid regions of South Africa. *Agroecology and Sustainable Food Systems*, 37(9):985-1000.

Hosu, S., Sibanda, M., & Mushunje, A. 2013. *Scenario simulation of small farms' production efficiencies in the Eastern Cape Province, South Africa.* Paper presented at the 4th International Conference of the African Association of Agricultural Economists, September 22nd to 25th, 2013, at Hammanet, Tunisia.

Howley, P., Donoghue, C.O. & Heanue, K. 2012. Factors affecting farmers' adoption of agricultural innovations: a panel data analysis of the use of artificial insemination among dairy farmers in Ireland. Journal of Agricultural Science, 4(6): 171-179.

Hruschka, E. 1969. Versuch einer theoretischen Grundlegung des Beratungaprozesses Psychologia Universalis Band 16 Meisenheim am Glan Versag Anton Hein.

Ighodaro, I.D., 2007. *Analysis of gully erosion in Benin: a case study of Ekosodin Gully*. Nigeria: Unpublished B.sc (Geo) dissertation, University of Benin.

Ighodaro, I.D. 2010. *The role of agricultural extension in the control of soil erosion in Sheshegu community, Eastern Cape, South Africa*. Unpublished B.A Agriculture (Honours), Agricultural Extension dissertation, University of Fort Hare, Alice.

Ighodaro, I.D. 2012. *The perceived impact of soil erosion on the food security of the Upper and Lower Areas of Didimana, Eastern Cape, South Africa*. An unpublished Master's dissertation, presented at the Department of Agricultural Economics and Extension, University of Fort Hare, South Africa.

Ighodaro, I.D., Lategan, F.S. & Mupindu, W. 2016. The impact of soil erosion as a food security and rural livelihoods risk in South Africa. *Journal of Agricultural Science*: In press.

Ingram, J.S.I., Gregory, P.J. & Izac, A.M., 2008. The role of agronomic research in climate change and food security policy. *Agric Ecosyst Environ* 126:4-12.

International Recovery Platform (undated). Guidance note on recovery: livelihood. [O]. Available: http://www.recoveryplatform.org. Accessed on 4th May, 2016.

Isabirye, B.E., Isabirye, M. & Akol, A.M. 2010. Picturing adoption of below-ground biodiversity technologies among smallholder farmers around Mabira rorest, Uganda. *TROPICULTURA,* 2010, 28, 1, 24-30.

Johnston County Government 2015. *What is soil conservation*? Agricultural Building, 2736 NC Highway, 210, Smithfield, NC.

Jolly, C.M., Shannon, D., Bannister, M., Flauretin, G., Dale, J.Z., Binns, A. & Pauline, L. 2007. Food security and value added production and marketing of tropical crops. Proceedings of the 26th West Indies Agricultural Economics Conference (Caribbean Agro-Economics Society).

Kabwe, G., Bigsby, H. & Cullen, R. 2009. Factors influencing adoption of agroforestry among smallholder farmers in Zambia. Paper presented at the 2009 NZARES Conference Tahuna Conference Centre- Nelson, New Zealand, August 27-28, 2009.

Kaguongo, W., Ortman, G., Wale, E., Darroch, M., & Low, J. 2012. Factors influencing adoption and intensity of adoption of orange flesh sweet potato varieties: evidence from an extension intervention in Nyanza and Western provinces, Kenya. *African Journal of Agricultural Research* 7(3): 493-503.

Kakembo, V. 2000. Artificial drainage induced erosion: the case of railway culverts on the Kwezana ridge, near Alice, Eastern Cape, South Africa. *Geographical Journal*, 82:3, 149-153.

Kakembo, V. & Rowtree, K.M. 2003. The relationship between land use and soil erosion in the communal lands near Peddie town, Eastern Cape, South Afrricca. *Land Degradation and Development*, Volume 14, Issue 1, pp. 39-49.

Kavanagh, D.J. & Bower, H. 1985. Mood and self-efficacy: impact of joy and sadness on perceived capabilities. *Cognitive Therapy and Research*, 9(5): 507-525.

King, R.N. & Rollins, T.J. 1995. *Factors influencing the adoption of a nitrogen testing program.* Journal of Extension Vol. 33, No 4.

Krech, D., & Crutchfield, R. 1958. Elements of psychology. Knopf Publications in Psychology, The Core Series.

Kumar, R. & Ramachandra, T.V. 2003. *Water soil and sediment investigation to explore status of aquatic ecosystem.* Bangalore: Centre for Ecological Sciences, India Institute of Science.

Kumo, W., Rielander, J., & Omilola, B. 2014. South Africa, African Economic Outlook. . [O]. Available: http://www.africaneconomicoutlook.org/countries/southern-africa/south-africa/>. Accessed on 2nd December, 2014.

Laerd Statistics 2013. *Binomial logistic regression using SPSS statistics*. Lund Research Ltd.

Lal, R. 1993. Tillage effects on soil degradation, soil resilience, soil quality and sustainability. *Soil Tillage Res* 27:1–7

Lal, R. 1994. Water management in various crop production systems related to soil tillage. *Soil and Tillage Research* 30, 169–185.

Lal, R. 1997. Degradation and resilience of soils. *Philos Trans R Soc Lond* (B) 352:997–1010

Lal, R. 2009. Soil degradation as a reason for inadequate human nutrition. *Food Sec*. (2009) 1:45-57.

Lategan, F.S. 2007. *Towards a framework for assessing risk perception concerning commercial springbuck (Antidorcas marsupialis) ranching and its influence on management decision making*. A Doctoral Thesis in Agriculture, at the Faculty of Science, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

Lategan, F.S. & Van Niekerk, P. DU P., 2007 An analysis of perceived prominent decision making areas in commercial springbuck (Antidorcas Marsupialis*)*

production decision making. *S. Afr. Tydskr. Landbouvoorl./S. Afr. J. Agric. Ext. Vol. 36.*

Lee, L. K., & Stewart, W.H. 1983. Land ownership and adoption of minimum tillage. *American Journal of Agricultural Economics* 65 (2): 256-64.

Lele, U., & Agarwal, M. 1989. *Smallholder and large-scale agriculture in Africa: are there tradeoffs between growth and equity?* MADIA Discussion Paper 6. Washington, DC: World Bank.

Le Roux, J.J., Newby, T.S. & Sumner, P.D., 2007. Monitoring soil erosion in South Africa at a regional scale: review and recommendations. Pretoria*: South African Journal of Science*, Vol. 103.

Le Roux, J.J., Morgenthal, T.L., Malherbe, J., Pretorius, D.J. & Sumner, P.D. 2008. Water erosion prediction at a national scale for South Africa. *Water SA* Vol. 34(3). [O]. Available: http://www.wrc.org.za

Lewin, K. 1951 *Field theory in social science; selected theoretical papers*. D. Cartwright. New York: Harper & Row.

Li, L., Huang, G., Zhang, R., Bill, B., Guangdi, L. & Kwong, Y., 2011. Benefits of conservation agriculture on soil and water conservation and its progress in China. *Agricultural Sciences in China*, Vol. 10(6):850-859.

Livingston, G., Schonberger, S. & Delaney, S. 2011. *Sub-Saharan Africa: the state of smallholders in agriculture*. A paper presented at the International Fund for Agricultural Development (IFAD) Conference on New Directions for Smallholder Agriculture, 24-25 January, 2011, Italy, Rome.

Loulseged, M. & McCartney, M., 2000. *Agriculture and livelihoods in Sub-Saharan Africa*. International Water Management Institute.[O]. Available: http://ehproject.org/PDF/phe/loulseged-iwrm.pdf. Accessed on 30th June 2011.

Lynne, G.D., Shonkwiler, J.S., & Rola, L.R. 1988. Attitudes and farmer conservation behaviour. *Amer. J. Agr. Econ*. 70(1988): 12-19.

Maitin, P. E. 1990. *An investigation into the drainage problems of the Qamata Irrigation Scheme.* Johannesburg: Loxton, Venn and Associates/en Genote

Manona, S.S. 2005. *Smallholder agriculture as local economic development (led) strategy in rural South Africa: exploring prospects in Pondoland, Eastern Cape*. Unpublished Master‟s Thesis. University of Western Cape, Cape Town.

Marsh, W.M. & Grossa, J. 2005. *Environmental geography: science, land use and earth systems*. 3rd ed. United States of America: John Wiley & Sons Inc.

Martin, B.L. & Abbott, E. 2011. Mobile phones and rural livelihoods: diffusion, uses, and perceived impacts among farmers in rural Uganda. Creative Commons Attribution-Non Commercial-Share Alike 3.0, 7(4): 17-34.

Maslow, A. 1970. *Personal theories*. [O]. Available: http://webspace.ship.edu/cgboer/maslow.html. Accessed on 13th of June, 2016.

Mayhew, S. 2004. *Oxford Dictionary of Geography*. [O]. Available:http://www.answer.com/topic/age-structure. Accessed on 6th Dec. 2010.

Melusi, S. 2012. *Market potential and profitability of improved maize Open Pollinated Varieties in the Eastern Cape of South Africa.* Alice: Department of Agricultural Economics and Extension, University of Fort Hare.

Menong, J.M., Mabe, L.K. & Oladele, O.I. 2013. Analysis of extension needs of commercial farmers in North-Western Province, South Africa. *J. Hum Ecol*, 44(2): 139-147.

Mendola, M., 2007. Agricultural technology adoption and poverty reduction: a propensity score analysis for rural Bangladesh. *Food Policy* 32:372-393.

Mhlaba, S., & Brey, Z. 2014. *Smallholder agriculture: job creator or livelihood provider*? DNA Economics. [O]. Available: http://www.dnaeconomics.com/pages/public_finance/?zDispID=NewsArtSmallholder_agriculture_job_creator_or_livelihood_provider. Accessed on 13th June, 2016.

Minnesota Department of Agriculture 2014. Conservation practices. [O]. Available: http://www.mda.state.mn.us/protecting/conservation/practices.aspx. Accessed on 13th June, 2016.

Morgan R.P.C. 1995. *Soil erosion and conservation* (2nd ed). London: Longman.

Mouton, J. 2008. *How to succeed in your master's and doctoral studies: A South African guide and resource book.* 11th ed. Pretoria: Van Schaik.

Mudhara, M. 2010. *Agrarian transformation in smallholder agriculture in South Africa: a diagnosis of bottlenecks and public policy options*. Conference paper presented at 'Overcoming inequality and structural poverty in South Africa: towards inclusive growth and development' Johannesburg, 20-22 September, 2010.

Mulugeta, T. & Hundie, B. 2012. Impacts of adoption of improved wheat technologies on households' food consumption in South Eastern Ethiopia. Selected poster prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguacu, Brazil, 18-24 August, 2012.

Myers, N. 1993. *Gaia: An Atlas of Planet Management*. Garden City, NY: Anchor/Doubleday

Nakhumwa, T.D. 2004. *Dynamic costs of soil degradation and determinants of adoption of soil conservation technologies by smallholder farmers in Malawi.* An unpublished PhD thesis submitted at Department of Agricultural Economics, Extension and Rural Development, Faculty of Natural and Agricultural Sciences, University of Pretoria, South Africa.

Napier, T. L. 1991. Factors affecting acceptance and continued use of soil conservation practices in developing societies: a diffusion perspective. *Agriculture, Ecosystems and Environment* 36: 127-140.

National Audit Office, Statistical and Technical Team,1992. A practical guide to sampling. [O]. Available: https://www.nao.org.uk/wp-content/uploads/2001/06/SamplingGuide.pdf. Accessed 5th December, 2015.

National Department of Agriculture, Republic of South Africa, 2007. *Estimated statistics: livestock numbers per province, at May 2007*.

Niewoudt, W.L. 2000. An economic evaluation of a crop insurance programme for small- scale commercial farmers in South Africa. *Agrekon* 39(3):269-291.

Nkala, P., Mango, N., Corbeels, M., Veldwisch, G.J. & Huising, J. 2011. The conundrum of conservation agriculture and livelihoods in Southern Africa. *African Journal of Agricultural Research*, 6(24): 5520-5528.

NnadI, F.N., Chikaire, J., Echetama, J.A., Ihenacho, R.A., Umunnakwe P.C. & Utazi, C.O. 2013. Agricultural insurance: a strategic tool for climate change adaptation in the agricultural sector. *Net Journal of Agricultural Science* 1(1): 1-9.

Norris, P.E, & Batie, S.S. 1987. Virginia farmers' soil conservation decisions: an application of Tobit analysis. *S. J. Agr. Econ*. 19(1987):79-80.

Obuobisa-Darko, E. 2015. Socio-economic determinants of intensity of adoption of cocoa research innovation in Ghana. *International Journal of African and Asian Studies* 12:29-40.

Odendo, M., Obare, G. & Salasya, B. 2009. Factors responsible for differences in uptake of integrated soil fertility management practices amongst smallholders in western Kenya. *African Journal of Agricultural Research*, 4(11): 1303-1311.

Odendo, M.O., Obare, G. & Salasya, B. 2010. *Determinants of the speed of adoption of soil fertility-enhancing technologies in western Kenya.* Cape Town: African Association of Agricultural Economists (AAAE) 3rd Conference/ AEASA 48th Conference, September 19-23, 2010.

Oosterbaan, R.J. 2003. Soil alkalinity: a lecture note on International Course on land drainage (ICLD). Wageningen, Netherlands: International Institute for Land Reclamation and Improvement (ILRI). [O]. Available: http://www.waterlog.info/pdf/acidalka.pdf- Accessed on 5th December, 2015.

Orr, G. 2003. *Diffusion of innovations by Everett Rogers (1995).* [O]. Available: https://web.stanford.edu/class/symbsys205/Diffusion%20of%20Innovations.htm . Accessed on 13th June, 2016.

Oyewole, S.O. & Ojeleye, O.A. 2015. Factors influencing the use of improved farm practices among small-scale farmers in Kano State of Nigeria. *Net Journal of Agricultural Science* 3(1):1-4.

Pannell, D.J., Marshall, G.R., Barr, N., Curtis, A., Vanlay, F., Wilkinson, R. 2006. Understanding and promoting adoption of conservation practices by rural landholders. *Australian Journal of Experimental Agriculture* 46(11): 1407-1424.

Patton, M. 2002. *Qualitative Research Methods*. London: Sage.

Paudel, G.S., & Thapa, G. B. 2004. Impact of social, institutional and ecological factors on land management practices in mountain watersheds of Nepal. *Applied Geography* 24:35–55

Pender, J. & Hazell, P., 2000. *Promoting sustainable development in less-favoured areas overview.* Washington D.C.: International Food Policy Research Institute (IFPRI).

Perez, Y.A. Undated. *Cognitive consistency theory*. [O]. Available: http://astro.temple.edu/~yperez/Consistency.htm. Accessed 5th December, 2015.

Pimentel, D., et al. 1995. Environmental and economic costs of soil erosion and conser- vation benefits. *Science* 267: 1117-1123.

Pimentel, D., 2006. Soil erosion: a food and environmental threat. *Environmental Development and Sustainability* (2006) 8: 119-137.

Polson, R.A. & Spencer, D.S.C. 1991. The technology adoption process in subsistence agriculture: the case of cassava in Southwestern Nigeria. *Agricultural Systems* 36(1):65-78.

Poverties 2013. Causes of poverty in Africa: lost continent or land of opportunities? [O]. Available: http://www.poverties.org/poverty-in-africa.html. Accessed on 11th June, 2016.

Pretty, J. 2000. *Can sustainable agriculture feed Africa? New evidence on progress, processes and impacts*. Netherlands: Kluwer Academic Publishers.

Queensland Government 2013. Soil fertility decline. The State of Queensland 1995-2015. [O]. Available: https://www.qld.gov.au/environment/land/soil/soil-health/fertility- decline/. Accessed 5th December, 2015.

Rahm, M. R., & Huffman, W.E. 1984. The adoption of reduced tillage: the role of human capital and other variables. *American Journal of Agricultural Economics* 66 (4): 405- 413.

Republic of Transkei 1991. *Transkei agricultural development study*. Umtata: Department of Agriculture and Forestry.

Rezvanfar, A., Samiee, A. & Faham, E. 2009. Analysis of factors affecting adoption of sustainable soil conservation practices among wheat growers. *World Applied Sciences Journal* 6(5): 644-651.

Robinson, L. 2009. *A summary of diffusion of innovations*. [O]. Available: http://enablingchange.posterous.com. Accessed on 8th January, 2013.

Rogers, E.M. 1983. *Diffusion of innovations* (3rd Ed.). London: Collier Macmillan.

Rogers, E. 1995. *Diffusion of Innovations.* (4th Ed.). New York, NY: The Free Press.

Rogers, E.M., and Shoemaker, F.F., 1971. *Communication of innovations*. New York: Free Press.

Rosenberg, M.J., 1968. Hedonism, in-authenticity, other goads toward expansion of a consistency theory. In: R.P. Abelson, et al. (eds), *theories of cognitive consistency: a source-book*. Chicago: Rand McNally.

Salami, A., Kamara, A.B. & Brixiova, Z. 2010. *Smallholder agriculture in East Africa: trends, constraints and opportunities,* Working Papers Series Number 105, African Development Bank, Tunis, Tunisia.

Sanchez, P.A., 2002. Soil fertility and hunger in Africa. *Science*, 295: 2019–2020.

Sanchez, P.A., Shepherd, K.D., Soule, M.J., Place, F.M., Buresh, R.J., Izac, A.N., Mokwunye, A.U., Kwesiga, F.R., Ndirity, C.G. & Woomer, P.L. 1997. Soil fertility replenishment in Africa: An investment in natural resource capital. In: R.J. Buresh, P.A. Sanchez & F. Calhoun (eds.). 1997. *Replenishing soil fertility in Africa*. SSSA Special Publication Number 51. Madison: SSSA.

Sargent, S.S. & Williamson, R.C., 1966. *Social psychology*. 3rd ed. University of Minnesota: Ronald Press Co.

Saunders, R., Warford, J., & Wellenius, B. 1994. *Telecommunications and economic development*. Baltimore: The Johns Hopkins University Press.

Scoones, I. & Toulmin, C. 1999. Policies for Soil Fertility Management in Africa. Department for International Development, London.

Scott, J. 2000. Rational choice theory. In G. Browning, A. Halcli, & F. Websteer (Eds.), *From understanding contemporary society: Theories of the present*. Sage Publication. http://dx.doi.org/10.4135/97814 46218310.n9

Shaw, M.E. & Constanzo, P.R. 1970. *Theories of social psychology*. New York: McGraw Hill. Pp. 122-125.

Shelton, M.H., Franzel, S. & Peters, M. 2005. Adoption of tropical legume technology around the world: analysis of success. *Tropical Grasslands* (2005), 39: 198-209.

Sikwela, M.M. 2013. The impact of farmer support programmes on market access of smallholder farmers in the Eastern Cape and KwaZulu-Natal Provinces, South Africa. A doctoral thesis submitted at the Department of Agricultural Economics and Extension, University of Fort Hare, South Africa.

Sims, B., Friedrich, T., Kassam, A.H. and Kienzle, J. 2009. *Agroforestry and conservation agriculture: complementary practices for sustainable agriculture*. Paper presented at the 2nd World Congress on Agroforestry, ICRAF, August, Nairobi, Kenya.

Smaling, E.M.A., Nandwa, S.M., Janssen, B.H., 1997. Soil fertility in Africa is at stake. In: Buresh, R.J., Sanchez, P.A., Calhoun, F. (Eds.) Replenishing Soil Fertility in Africa. SSSA special publication, 51: 47– 62.

Southern African Trust. 2013. *Challenges facing smallholder farmers*. [O]. Available: http://www.southernafricatrust.org/changemakers/january2013/page4.html.

. Accessed on 12th June, 2016.

Spehr, K., & Curnow, R. 2011. *Influence on pro-environmental change*. Community Change Behaviour Environment Research Education. [O]. Available: http://www.communitychange.com.au/component/content/article/15-insights-and- tools/influencing-pro-environmental-behavioural-change/influences-on-pro- environmental-change/6.html. Accessed on 13th June, 2016.

Stake, R. 1995. *The art of case study research*. Thousand Oaks, CA: Sage, pp. 49-68.

Statistics Canada 2013. Probability sampling. [O]. Available: http://www.statcan.gc.ca. Accessed on 12th June, 2016.

StatSA 2013. *Mid-year population estimates: Statistical release P0302*. Statistics South Africa.

Strahler, A.N. 1973. *Environmental geosciences*. New York: John Wiley & Sons. Pp. 1-17.

Strauss, J., Barbosa, M., Teixeira, S., Thomas, D., & Gomes, J.R. 1991. Role of education and extension in the adoption of technology: a study of Upland rice and soybean farmers in Central-West Brazil. *Agric. Econ*., 5(4): 341-359.

Sumberg, J. 2002 The logic of fodder legumes in Africa. *Food Policy* 27: 285–300.

Tittonell, P., Shepherd, K.D., Vanlauwe, B., & Giller, K.E. 2008. Unravelling the effects of soil and crop management on maize productivity in smallholder agricultural systems of western Kenya: an application of classification and regression tree analysis. *Agriculture, Ecosystems and Environment* 123 (2008): 137-150.

Tiwari, K.R., Sitaula, B.K., Nyborg, I.L.P. & Paudel, G.S., 2008. Determinants of farmers' adoption of improved soil conservation technology in a middle mountain watershed of central Nepal. *Environmental Management* (2008) 42: 210-222

Toborn, J. 2011. Adoption of agricultural innovations, converging narratives, and the role of Swedish agricultural research for development. Draft Discussion Paper, version 2011-01-28

Toenniessen, G., Adesina, A., Devries, J. 2008. Building an alliance for a green revolution in Africa. *Ann. N.Y. Acad. Sci.* 1136:233-242.

Tolman, E.C. 1967. A psychological model. In: T. Parsons & E.A. Shils. *Toward a general theory of action*. Cambridge: Harvard University Press.

Torero, M. 2011. A framework for linking small farmers to markets. Paper presented at the International Fund for Agricultural Development (IFAD) Conference on New Directions for Smallholder Agriculture, 24-25 January, 2011 in Italy, Rome.

Toy, T.J., Foster, G.R. & Renard, K.G. 2002. *Soil erosion: processes, prediction, measurement and control*. New York: John Wiley and Sons Inc.

Tranmer, M. & Elliot, M., 2008. *Binary logistic regression*. Cathie Marsh Institute for Social Research, Teaching Paper.

Traoré, N., Landry, R. & Amara, N. 1998. On-farm adoption of conservation practices: the role of farm and farmer characteristics, perceptions, and health hazards. *Land Economics* 74 (1): 114-127.

Underwood, B., Froming, W. J., & Moore, B. S. 1980. Mood and personality: a search for the causal relationship. *Journal of Personality, 48* 331–339.

Udin, N. 2014. Organic farming impact on sustainable livelihoods of marginal farmers in Shimoga District of Kamataka. *American Journal of Rural Development*, 2014, 2(4): 81-88.

Umar, B. B., Jens, B. A., Fred H. J., & Obed, L.I. 2011. Options for improving smallholder conservation agriculture in Zambia. *Journal of Agricultural Science* 3(3): 50–62.

van Averbeke, W. & Mohamed, S.S. 2006. Smallholder farming styles and development policy in South Africa: the case of Dzindi Irrigation Scheme. *Agrekon*, 45(2): 136-157.

Vanlauwe, B. & Giller, K.E. 2006. Popular myths around soil fertility management in sub- Saharan Africa. *Agricultural Ecosystem and Environment*, 116: 34–46.

Verbeek, M., 2004. *A guide to modern econometrics* (2nd ed.). Rotterdam: John Wiley and Sons Ltd.

Vrieling, A. 2007. *Mapping erosion from space.* Doctoral Thesis, Wageningen University.

Wale, E., & Yallew, A. 2007. Farmers‟ variety attribute preferences: implications for breeding priority setting and agricultural extension policy in Ethiopia. *African Development Review* 19(2): 379-396.

Waller, B.E., Hoy, C.W., Henderson, J.L., Stinner, B., & Welty, C. 1998. Matching innovations with potential users: a case study of potato IPM practices. *Agriculture, Ecosystems and Environment*. 70(1998):203-215.

Wiskerke, J.S.C., & Ploeg, J.D. van der (Eds.). 2004. *Seeds of transition. Essays on novelty production, niches and regimes in agriculture* (European Perspectives on Rural Development). Assen, The Netherlands: Van Gorcum.

Wolkowski, R. & Lowery, B. 2008. *Soil compaction: causes, concerns and cures*. Board of Regents of the University of Winsconsin.

Wood, R.G., Goesling, B. & Avellar, S., 2007. The effects of marriage on health: a synthesis of recent research evidence. *An ASPE Research Brief prepared for the U.S. Department of Health and Human Services* Office of the Assistant Secretary for Planning and Evaluation, Office of Human Services Policy, June 2007.

Workineh, M.Y., Garfield, M.J. & Boudreau, M.C. 2010. Indigenous knowledge creation practices: the case of Ethiopia. *Eighteenth European Conference on Information Systems*, Ecis 2010.

World Bank. 2003. *Reaching rural poor: a renewed strategy for rural development*. Washington, DC.

Xu, P., & Wang, Z. 2012. Factors affect Chinese producers' adoption of a new production technology: survey results from Chinese fruits producers. *Agricultural Economics Review* 13(2):5-20.

Yin, R.K. 1994. *Case study research design and methods: applied social research methods series volume 5*. New Deihl, London: Sage Publications International Educational and Professional Publisher.

Young, A., 1989. Agro forestry for soil conservation. Wallingford, UK: C.A.B.

Young, A., 1998. *Land resources: now and for the future*. Cambridge: Cambridge University Press.

Zimbardo, P.G.& Ebbesen, E.B., 1970. *Influencing attitudes and changing behaviour: a basic introduction to relevant methodology, theory, and applications.* Reading, Mass., Addison-Wesley Pub. Co. Pp. 67-72.

Zucker, D.M. 2001. Using case study methodology in nursing research. *The Qualitative Report* (on-line serial), 6(2). [O]. Available: http://www.nova.edu/ssss/QR/QR6- 2/zucker.html.

Appendix 1

Research questionnaire

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION, UNIVERSITY OF FORT HARE, ALICE

Questionnaire on smallholder farmers' adoption decision-making processes in their utilization of soil conservation practices in Amathole District Municipality, Eastern Cape

Please mark with an X the correct answer, fill in the blank spaces or number in the appropriate boxes. Example: Gender of respondent: Male=1 ( ); Female=2 (**X**):

Name of enumerator: _____Date:_____

(A) Demographic and personal characteristics

1). Please fill in or mark with an "X" the right answers in the table below:

Village name	**Age**	**gender**	**Marital status**	**Household head**
		Male	Married	Father
		Female	Single	Mother
			Divorced	Children
			Widowed/ widower	

2) What is your highest level of education?(**Mark with an X**).

None	**1-6 yrs**	**7-10 yrs**	**11-12 yrs**	**Diploma**	**Any degree**	**Agric degree**
1	2	3	4	5	6	7

3). Please fill in or mark with an X the appropriate answer in the table below:

Religion	**Ethnic group**	**Size of farm**	**Farming type**
			Smallholder
			Commercial
			Others (specify)

4). Indicate the composition of your household members living with you:

Composition of household members	**Indicate number**
Number of males less than 12 years	
Number of females less than 12 years	
Number of males between 12 and 18 years	
Number of females between 12 and 18 years	
Number of males more than 18 years	
Number of females more than 18 years	

5). Are you the owner of the land you are currently farming? (A). Yes ( ); (B). No ( )

6). How did you get it? (A). From the government; (B). Rented/ lease; (C). Inherited; (D). By purchase; (E). Community; (F). Others (specify): .....

6). How long have you been farming continuously on this plot of land? (A). <5 yrs; (B). 5-10 yrs; (C). 11-20yrs; (D). 21-40; (E). >40 yrs.

7). What is your farming status? (A). Full time farmer; (B). Part time farmer

8). How often do you participate in extension programmes in your area? (A). Not at all; (B). Rarely; (C). Sometimes; (D). Often; (E). Very often.

9). State which category you belong: (A). I don't have any production assets; (B). I have few production assets; (C). I have some; (D). I have almost all; (E). I have all production assets.

10). List types of crops grown in your farm?

_____

_____

_____

11). Details of livestock reared?

Type of livestock	**Total number owned**	**Annual income for one**
1.		
2.		
3.		
4.		
5.		
6.		

12). Describe your following farm operations:

Type of crop grown	**Total income for the crop yearly (R)**

13). Please describe your current farming system and indicate your production levels:

Farming system-(A)	Insufficient for self consumption	It's just enough for self consumption	Just enough for self consumption and ceremonies	There is sufficient excess for limited sale	There is sufficient excess for large sale
	1	2	3	4	5
1). Livestock					

2). Crops					
3). Others					

14). Indicate the relative contribution of the following sources to **YOUR** total income:

Sources of income	**Amount (R)**
List all sources of income to you which are not related to agriculture	How much do you receive from each source?
1.	
2.	
3.	
4.	
Income from all agricultural crops	
Income from all agricultural livestock	
Total	

15). How many years have you been involved in farming? _____

B). Farmers' adoption decision-making characteristics

1). Are you aware of the recommended soil conservation practice introduced by extension officers in your area? (A). Yes ( ); (B). No ( )

2). If yes, are you using it? (A). Yes ( ); (B). No ( )

3). If no, why are you not using it?

_____

_____

_____

4). What are the general measures for soil conservation and improving soil quality in your area?

_____

_____

_____

5). What is the most used method for soil conservation and improving soil quality in your area?

_____

_____

_____

6). Who recommended it? _____

7). How effective is this most used method in improving the soil quality of your farmland?

Ineffective	**A little effective**	**Moderately**	**effective**	**Very effective**
1	**2**	**3**	**4**	**5**

8). Have you being using it? (A). Yes ( ); (B). No ( )

9). If yes/No, why?

_____

_____

_____

10). What is the most recommended soil conservation measure by extension officers for soil management or soil conservation in your area?

_____

_____

_____

11). Are you using it? (A). Yes ( ); (B). No ( )

12). If yes/no, why

_____

_____

_____

13). How often do you use the most recommended soil practice by extension officers?

Not at all	Rarely	Sometimes	Often	Very often
1	2	3	4	5

14). From your mind, how effective is it for soil conservation, improving soil quality and erosion control in your area?

ineffective	A little effective	Moderately	effective	Very effective
1	2	3	4	5

15). Do you think that the use of the recommended soil conservation practice by extension officers is important in your agricultural and food security strategies? (A). Yes ( ); (B). No ( )

16). How important is it?

Unimportant	A little important	Moderately	Important	Very important
1	2	3	4	5

17). What are your major reasons for accepting to use the recommended soil conservation practice by extension officer(s)?

_____

_____

_____

18). What measures have you as a farmer being using to conserve the soil quality of your farmland and protect your farm from soil erosion?

_____

_____

_____

19). Are you satisfied with your own soil conservation practice? (A). Yes ( ); (B). No ( )

20). How effective do you think it is in improving the soil quality of your farm and helping to protect your farm from soil degradation?

ineffective	A little effective	Moderately	effective	Very effective

1	**2**	**3**	**4**	**5**

21. How effective is your own soil conservation practice compared with the recommended practice by extension officers?

ineffective	**A little effective**	**Moderately**	**effective**	**Very effective**
1	**2**	**3**	**4**	**5**

22). Do you prefer your own soil conservation practice to the recommended practice by extension officers? (A). Yes ( ); (B). No ( )

23). If yes, why?

_____

_____

_____

24). Do you think the recommended soil conservation practice is more costly to use than your own practice? (A). Yes ( ); (B). No ( )

25). Give an estimate of how much it cost you (in Rands) to use your own soil conervation practice in a year?

<R500	**R500-R1000**	**R1001-R5000**	**R5001-R10000**	**>R10000**
1	**2**	**3**	**4**	**5**

26). Give an estimate of what you think it cost to use the recommended soil conservation practice in a year?

R1000-R5000	**R5001-R10000**	**R10001-R20000**	**R20001-R50000**	**>R50000**
1	**2**	**3**	**4**	**5**

27). How easy is it for you to get the recommended soil practice by extension officer?

Very difficult	**A little easy**	**Moderately**	**Easy**	**Very easy**
1	**2**	**3**	**4**	**5**

28). Do you have enough money to purchase/ use the recommended soil practice?

(A). Yes ( ); (B). No ( )

29). Do you know any advantages of using the recommended soil conservation practice?
(A). Yes ( ); (B). No ( )

30). If yes, what are they?

_____

_____

_____

31). Do you know how to use the recommended practice introduced by extension officers?
(A). Yes ( ); (B). No ( )

32). Is it difficult to implement? (A). Yes ( ); (B). No ( )

33). Compared to your own practice how easy is it to operate the recommended practice?

Very difficult	**A little difficult**	**Moderately**	**Easy**	**Very easy**
1	**2**	**3**	**4**	**5**

C). Nature and extent of farmers' participation in soil conservation

1). Have you participated in the use of the recommended conservation practice since its introduction in your area? (A). Yes ( ); (B). No ( )

2). Did you accept using it immediately you knew about it? (A). Yes ( ); (B). No ( )

3). How long did it take you to accept using it?

Immediately	**2-4 weeks**	**Within 6 months**	**6-12months**	**More than 1 year**
1	**2**	**3**	**4**	**5**

4). Why did it take you so long?

_____

_____

_____

5). How often do you use extension recommendation for soil conservation in your area?

Not at all	Rarely	Sometimes	Often	Very often
1	2	3	4	5

6). What can you say of the recommended soil conservation practice by extension officers?

_____

_____

_____

7). What can you say of your own soil conservation practice?

_____

_____

_____

D). Impact of adoption decision-making on farmers' livelihoods

1. Has the adoption of extension recommended practice affected your livelihood at all? Yes ( ); No ( ).

2. How has it affected you? Positive ( ); Negative ( ).

3. Describe how your adoption of recommended practice has affected your livelihoods:

……

……

……

4). Please mark with an X the appropriate answer:

Has there been any noticeable improvement of the quality of your soil since your adoption of recommended soil conservation practice?	Has there been any improvement of your crop yield or income since adoption of recommended soil conservation practice?	Will you recommend the soil conservation practice to other farmers who do not know about it or are not using it?
Yes	Yes	Yes
No	No	No

Appendix 2: Ethical clearance certificate

University of Fort Hare
Together in Excellence

ETHICAL CLEARANCE CERTIFICATE
REC-270710-028-RA Level 01

Certificate Reference Number:	MUS0111SIGH01
Project title:	**Smallholder farmers' adoption decision-making processes in the application of soil conservation practices for improved agricultural production, in Amathole District Municipality, Eastern Cape**
Nature of Project:	PHD
Principal Researcher:	Ikponmwosa David Ighodharo
Supervisor:	Prof A Mushunje
Co-supervisor:	

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the UREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

Special conditions: Research that includes children as per the official regulations of the act must take the following into account:

Note: The UREC is aware of the provisions of s71 of the National Health Act 61 of 2003 and that matters pertaining to obtaining the Minister's consent are under discussion and remain unresolved. Nonetheless, as was decided at a meeting between the National Health Research Ethics Committee and stakeholders on 6 June 2013, university ethics committees may continue to grant ethical clearance for research involving children without the Minister's consent, provided that the prescripts of the previous rules have been met. This certificate is granted in terms of this agreement.

The UREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
  - Any unethical principal or practices are revealed or suspected
  - Relevant information has been withheld or misrepresented
  - Regulatory changes of whatsoever nature so require
  - The conditions contained in the Certificate have not been adhered to

- Request access to any information or data at any time during the course or after completion of the project.

- In addition to the need to comply with the highest level of ethical conduct principle investigators must report back annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to the Dean of Research's office

The Ethics Committee wished you well in your research.

Yours sincerely

Professor Gideon de Wet
Dean of Research

24 July 2014