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The Perceived Impact of Soil Erosion on Food Security in the Upper and Lower Areas of Didimana in the Eastern Cape of South Africa

BY

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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 is indeed a product of various efforts. This is why certain personalities deserve some recognition.

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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 heat, my lovely wife Mrs Etinosa Beauty Ighodaro, and to my loving and God-given son Osamudiame David (Jnr) I. Ighodaro.

Abstract

Due to the particular nature of accelerated soil erosion, its impact on food security is usually very intense. The impact starts first on the farmer, and then to his/ her environment. This is why soil erosion, when unchecked, is very devastating. Therefore this study was set to evaluate the perceived impact of soil erosion on food security in the Upper and Lower Areas of Didimana, Eastern Cape of South Africa, and the role farmers' adoption behaviours play in the interaction.

Three specific objectives were put forward by the study, vis-à-vis: (1) to establish farmers' perceptions on the impact of soil erosion on food security of the study area; (2) to establish farmers' innovation adoption behaviour with respect to soil erosion control in the study area; and (3) to establish farmers' perceptions on the impact of extension activities with respect to soil erosion-control in the study area. The central argument of discussion is that soil erosion like every other agricultural problem, is the result of farmers' non-adoption or inappropriate adoption of improved and recommended soil management technologies in the study area. The survey method of research was adopted for the study, where data were collected, using a well structured questionnaire, from a total of 60 farmers in the study area, through a simple random sampling process.

Farmers' perception suggested that the impact of soil erosion in their area is severe. This severity is demonstrated firstly in the form of climate change, as the time of rain in their area is gradually changing, and thus changing their time of cropping. Similarly the livelihoods of farmers are being negatively affected, as farmers' crops, livestock, and even household feeding are being affected. More so, findings indicate that most farmers now plant fewer crops and there is an estimation of crop loss by most farmers of well between 21-60% of crops every year. Farmers' perception further revealed that due to soil erosion, over 50% of farmers are unsustainable and a total of 71.7% of farmers' population admitted that the amount of food available for their households is being severely affected.

In virtually every sphere of human endeavours improved technologies have been developed to solve human problems, but the main reason problems like soil erosion is still very evident is the fact of farmers' non-adoption or inappropriate adoption of specific recommended technologies. In the study area, the role of farmers' adoption behaviour in the interaction of the impact of soil erosion on food security was very prominent. Findings indicate that despite the presence of certain recommended soil management technologies in the study area, majority of farmers do not use them neither extension advices. Moreover their satisfaction

with those technologies was found to be low, which could be an explanation why they do not use them.

For innovation to be adopted, rejected or utilized inappropriately, the effectiveness and performance of agricultural extension, as well as farmers' perception play a great role. Thus in the study area, farmers' perception on extension effectiveness indicates that extension hardly talk about soil erosion and its control during times of their visit. Similarly, farmers' rating for extension services and advices was as well very low (23.4%). In fact, a comparison of farmers' traditional methods of soil erosion control with extension recommendations (53.4%) indicated that farmers perceive their local methods of more importance than extension methods. In the same vein, majority of farmers in the area indicated that extension officers are inadequate in their jobs. Reasons offered range from issues of unreliability, lack of regular visits, communication problems, less attention for crop farming, and other reasons such as extension being unconcerned for subsistence farmers, as well as the fact that they focus more on cooperatives.

In all, the findings of the descriptive statistics reveal that the impact of soil erosion on food security in the study area is very significant, and the results of the linear regression model of relationships in the study reveal that soil erosion relates positively with age of farmers, their product quality, and their sustainability. In a similar note, the innovation adoption behaviours of farmers was also found to be positively related to farm yield and food accessibility. Thus showing that innovation adoption behaviour of farmers in the interaction of soil erosion and food security in the study area is significant. Therefore, efforts should be geared toward improving factors that increases yield and accessibility of farmers to serve as boosters of farmers' motivation towards the adoption of appropriate soil management technologies in their area.

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List of acronyms and abbreviations

Agric	Agriculture
BGBD	Below-ground biodiversity technologies
^{0}C	Degree Celsius
DoA	Department of Agriculture
DoE	Department of Environment
E.G	Example
FAO	Food and Agriculture Organization
Ha	Hectare
HSRC	Human Sciences Research Council
IDP	Integrated Development Plan (IDP
K	Potassium
Kg	Kilogram
M	Meters
MM	Millimetres
N.d	No date
N.p	No page
N	Nitrogen
N/A	Non applicable
NGO	Non-governmental organization
P	Phosphorus
PAMS	Polyacrylamides
RSA	Republic of South Africa
RSFR	Renewable soil fertility replenishment
SA	South Asia
SSA	Sub-Saharan Africa
Ton/t	Tonnes
UN	United Nations
US	United States

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The impact of soil erosion the world over is a well-researched phenomenon. Governments in all parts of the world have special environmental departments, whose duty it is to address and combat soil erosion and other environmental problems resulting from soil degradation. The Food and Agriculture Organization (FAO), as cited by Kumar and Ramachandra (2003:n.p), estimates that the global loss of productive land through soil erosion varies between five to seven million ha/ year. In terms of spatial variability, Sundquist (2010:n.p) commented that the world's highest soil erosion rates are in the crescent from Korea to the Middle East, with a rate of about 5000 tons/ km^2/ year. He further stated that, excluding the US and Europe, the rest of the world (Africa inclusive) is next highest in erosion rates, with a rate of about 3000 tons/ km^2/ year, while Europe and the US have the lowest rate of about 1700 tons/ km^2/ year.

According to Pimentel and Kounang (1998:417), citing Myers (1993), approximately 75 billion tons of fertile soil gets lost from world's terrestrial/ agricultural systems annually. Two key issues are obvious from this: agriculture is a major human activity responsible for erosion, and there is a colossal amount of fertile soil lost annually.

Usually soil erosion is a slow process. Pimentel (2006:131) noted that one millimetre of soil, easily lost in one rain or wind storm, is so small that its loss goes unnoticed, yet this loss of soil over a hectare of cropland can amount to 15 tons / ha. The danger of soil erosion is that, as small as this soil loss may seem to be, replenishing it under agricultural conditions require approximately 20 years, and the worst part of this problem is that the more the soil loss, the more the soil is increasingly less able to support crop growth (Pimentel 2006:131).

Hunger, which results from food insecurity, is one of the world's most deadly ills. The new hunger report by FAO (2010:4) addressing "the state of food insecurity in the world" estimated a total of 925 million people in the world who do not have adequate access to quality and available food in 2010. The U.S. Composting Council (2012:2), speaking on the economic impact of soil erosion in the United States of America, estimates that soil erosion in the USA costs the nation, in terms of loss of productivity, about $37.6 billion each year. Based on such magnitudes, the impact of such losses on the economies of less developed and developing countries can therefore just be assumed.

In China for example, Chonghuan and Lixian (1992:430) study indicates that "land degeneration resulting from soil erosion is a widespread phenomenon, and the annual loss of nitrogen (N), phosphorus (P) and potassium (K) caused by erosion is up to 40 million tons". A huge loss of nitrogen, phosphorus and potassium as in above indicates the great danger inherent in soil erosion as an agricultural problem in any environment. In South Africa, the impact is revealed through the consideration of the following statements by Kumar and Ramachandra (2003:n.p): annual soil loss in South Africa is estimated at 300 – 400 million tons, nearly three tons for each hectare of land, and that it will take R1000 million to replace the soil nutrients carried out to sea by rivers in South Africa each year, with fertilizer. Another study which gave credence to this assertion is that by Huntley et al. (1989). According to them, soil erosion is rated as one of South Africa's most significant environmental problems, and the annual soil loss for the entire country is often estimated as 400 million tons/ year.

Le Roux, Newby and Sumner (2007:329) arguing along this line, state that in South Africa, the loss of topsoil is one of the principal soil degradation problems confronting agriculture. If any nation can have an undeniable access to quality and sufficient food at all times (food security), the problem of soil erosion is sure one of the agricultural problems to deal with. Ighodaro (2010:55-56) in his study indicated, that soil erosion impacts on all spheres of farming efficiency such as profitability, product quality, yield and sustainability.

According to Vrieling (2007:3), soil erosion is one of the problems facing the sustainability ideal, and it is defined as a natural process that detaches and transports soil particles through the activities of an erosive agent. These agents could be water, wind, ice, man and gravity (Onokerhoraye 1994:164-166). Soil erosion impacts first on the soil which also impacts on agricultural crops and animals. This inevitably translates into food insecurity, resulting in limited ability of all members of a household to be able to both physically and economically access food that meets their dietary needs as well as their food preferences (WHO 2012:n.p).

Soil erosion can be the result of many factors basically divided into two groups: natural and human or anthropogenic factors. Natural factors can be rainfall, wind and temperature, while human factors can be endless, such as agricultural activities, bush burning, deforestation activities, construction works, and mining activities (Onokerhoraye 1994:163). However, in this study the emphasis is on factors associated with innovation adoption, which is a human factor, as explanatory indicator for soil erosion development in the study area. According to Duvel (1991:73), problems that are normally addressed in agricultural development are ultimately that of a non-adoption or inappropriate adoption of innovation for increased efficiency.

Based on the above, this study will assess the perceived impact of soil erosion on food security (secure access to quality and sufficient food at all times) in the Upper and Lower Didimana areas of the Eastern Cape in South Africa. Emphasis is given to finding how the factors influencing farmers' innovation adoption processes impact on soil erosion, which ultimately impacts on food security in the study area. The main assumption here is that most (if not all) agricultural problems result from none or inappropriate adoption of improved agricultural technologies.

1.2 Statement of research problem

Despite the much given attention received by soil erosion from various institutions around the world the incidence of soil erosion is still just as evident.

In the Eastern Cape, several studies on soil erosion activities are being conducted. Examples according to Muliban (2001:26-160) are: (1) the determination of maximum permissible slope limits for identification of arable lands by D'Huyvetter (1985) and (2) the effects of clay mineralogy and exchangeable cations on some of the hydraulic properties of soils by Levy (1988). Others are (3) artificial drainage induced erosion: the case of railway culverts on the Kwezana Ridge, near Alice, Eastern Cape by Kakembo (2000:149-153); (4) 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 by Kakembo and Rowtree (2003:39-49); and (5) hydroclimatic trends, sediment sources and geomorphic response in the bell river catchment, Eastern Cape Drakesberg by Dollar and Rowntree (1995:21-32). In all of these, there seem to be very little to no work on the impact of soil erosion on food security, as well as the role farmers' innovation adoption behaviours play in their interaction in the Upper and Lower areas of Didimana in the Eastern Cape as represented in this study. This is an important factor determining the significance and relevance of this study.

Keeping in mind Duvel's argument (Duvel 1991:73) that agricultural problems usually occur as a result of farmers' none or inappropriate adoption of technological innovations for change, the following perspectives will be maintained in this study, namely:

1). the problem of none or inappropriate adoption of innovations by farmers;

2). inappropriateness of recommended soil conservation-related innovations.

1.3 Research questions

Soil erosion is a main threat to environmental quality and food security worldwide (Pimentel 2006:119). On the world scale, in conjunction with increasing population, it is said that soil erosion, water availability, energy, and loss of biodiversity rank as the prime environmental problems throughout the globe (Pimentel 2006:119). In South Africa, it is regarded as one of the most significant environmental problems (Meadows 2003:17). In the Eastern Cape, which constitutes the study area, the incidence of soil erosion is very obvious. It happens to be one of the three poorest (Bank, Minkley, & Kamman 2010:5), as well as one of the three most degraded provinces in South Africa (Department of Environmental Affairs, Republic of South Africa 2007). Understanding farmers' perceptions on the activities of soil erosion and how it impacts on their food security is vital to the understanding of the cause-effect variables of erosion in the study area. Based on this, the following research questions are the focus of this study:

- what is farmers perception on the impact of soil erosion on their food security?
- What is perception on the innovation adoption behaviour of farmers with respect to soil erosion control in the study area?
- What are agricultural extension measures on soil erosion control in the study area?

1.4 Aim and objectives of the study

The aim of this study is to ascertain how soil erosion impacts on food security measures in the Upper and Lower Didimana areas of the Eastern Cape in South Africa, and the role farmers' innovation adoption behaviour play in the interaction. This laudable objective shall be achieved through the following specific objectives:

1. To establish farmers' perceptions on the impact of soil erosion on food security of the study area;
2. To establish farmers' innovation adoption behaviour with respect to soil erosion control in the study area;
3. To establish farmers' perceptions on the impact of extension activities with respect to soil erosion-control in the study area.

1.5 Thesis statement

According to Hofstee (2006:19), your thesis is the central argument of your study, and your thesis statement names that argument. He further said that, once you identify a problem, you then take a stand about that problem, or better put, you hypothesize a solution. Like is already done in this study, the problem has been identified: the persistence of soil erosion in the study area despite the much attention given it by various stakeholders. Therefore, based on this, the thesis statement of this study is that soil erosion, which also is an agricultural problem, is the result of non-adoption or inappropriate adoption of improved and recommended soil conservation technologies by farmers in the study area. This argument shall be pursued throughout this study.

This position also is suggested by Duvel (1991:73): problems normally addressed in agricultural development are ultimately that of non-adoption or inappropriate adoption of certain recommended practices.

1.6 Problem conceptualization

Duvel (1991:72) posited that the basis of problem conceptualization is born out of the general awareness and conviction that "a problem well put, is also a problem half solved". He therefore defined problem conceptualization as a hypothetical construct which provides a scientific basis for purposeful, systematic probing into the causes of a problem and offering a frame of reference from where extension problems and the non-adoption (of agricultural practices) are investigated- adoption behaviours.

Lewin (1951), as cited by Duvel (1991:75-76), maintains that individual behaviour is the result of a decision making process that is influenced by the interaction between an individual and his/ her environment, sometimes referred to as the individual life space or total situation. Following on and influenced by this thinking Tolman (1967), as reported by Duvel (1991:76-77), tried to create a more measurable concept and framework for interpreting and possibly explaining human behaviour.

This progress offered important philosophical and framework support for Duvel to develop and formulate important reasoning around techniques and epistemological postulates to evaluate and possibly explain farmers' adoption behaviour (Duvel 1991:72). A very important outcome of this was the development of a model suitable for describing and interpreting the cause-effect environment of farmers in terms of human and economic-technical aspects.

Probably the most important and essential progressive difference in this reasoning came from acknowledging the role of intermediating variables (knowledge, perception, aspirations or needs) in the interaction between environmental (independent) and human-technical (dependent) variables in farmer adoption decision making. This provided a powerful mechanism for not only explaining farmer adoption decision making but also provided a platform from where farmer decision making can be anticipated, influenced and probably predicted (Lategan 2007:15, 168 – 171)

In Agricultural Extension research this reasoning and mechanisms has gained much ground due to the recognition it offers to the analysis of the field forces directly responsible for farmers' adoption behaviour.

From the foregoing, needs are defined as a situation in which a person experiences a lack of something and then strives to overcome it (Bembridge 1991:271). It constitutes a mechanism for creating a state of tension or psychological inconsistency (cognitive dissonance) in the individual (Festinger 1957:1-3) which motivates him/ her to take action in the direction where the need can be solved. It therefore stands to reason that if a certain technological innovation does not match with farmers' needs (created as a result of cognitive dissonance) rejection or inappropriate acceptance and adoption of such innovations will follow.

Of particular importance is the recognition of and the inclusion of the impact of perception in interpreting and evaluating farmer decision making. Berelson and Steiner (1964:84) defines perception as a complex process by which people select, organize and interpret sensory stimulation into a meaningful and coherent picture of the world (their environment). Sargent and Williamson (1966:214) emphasises the subjective nature of this process arguing that individuals play an active part in determining what will be allowed to stimulate them.

In terms of farmers' knowledge, Duvel (1991:81), defines this variable in three respects: farmers' basic knowledge of principles of the particular innovation; farmers' knowledge associated with the awareness of relative advantages of the innovation; and farmers' knowledge in respect of the application of the innovation or technology. Figure 1.1 below offers a broadly conceptualized proposed adaptation of the model proposed by Duvel (1991) for use in this study to investigate the perceived impact of soil erosion of farmers' food security position.

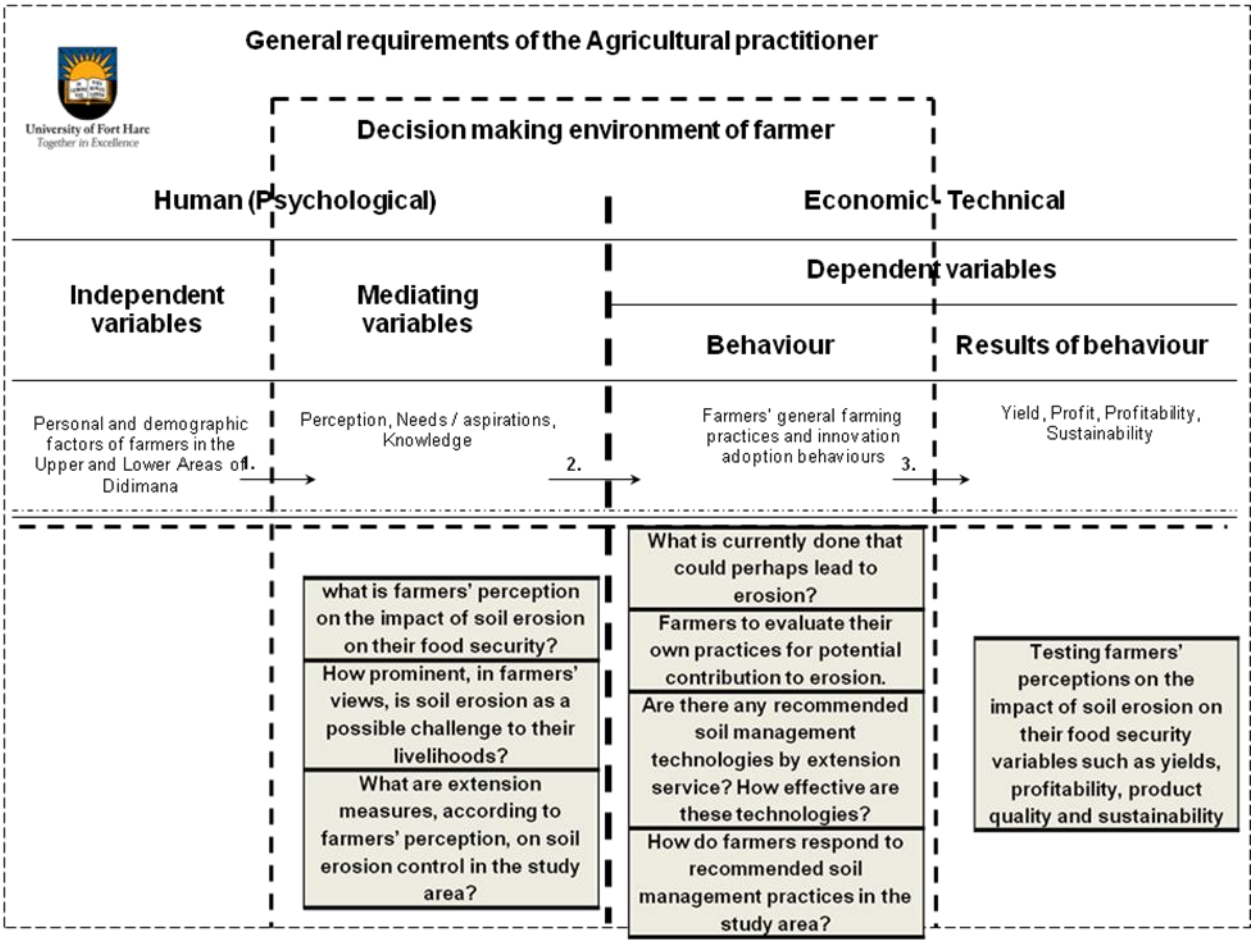

Figure 1. 1: A conceptualized model for the study of the impact of soil erosion on food security (adapted from Duvel 1991:77)

1.7. Significance of the study

1. Upper and Lower Didimana Area is a remote rural location in the Eastern Cape. The implication is that it is somewhat distanced from main government efforts and interventions. As such, a study like this will go a long way to act as a "whistle blower" on the impact of soil erosion activity on the livelihoods of rural smallholder farmers in the area.

2. In the light of this study, the central argument (which is also supported by Duvel's 1991:73) states that agricultural problems in rural areas are the result of farmers' none adoption or inappropriate adoption of improved and recommended agricultural innovations. Amongst other things, this study seeks to evaluate the potency of this argument or idea in the study area

3 A study like this will assist government policies for the development and improvement of agricultural production in the study area in many ways. For example, the

understanding of food security variables of the study area like farm type, crop yield, farmers' income, crops planted and time when crops are planted, are viable variables which assist the creation of agricultural programmes and policies which are directly tailored after the needs and life situation of people in the area. Also knowledge of information like farm type, crop yield, income of farmers, for example will help to understand the poverty level of the area, which will assist government of the area to know what type of programmes or assistance that can be provided to lift people out of poverty.

4 Similarly, a study like this will enable government to assess the results and efficiencies of certain programmes implemented in the area. Examples could be the land reform and irrigation programmes. Farming information such as farm size, farmer's income and the likes, indicate level of production of farmers in an area, which in turn will generate questions on why things are the way they are. Immediate questions that can be raised are: did farmers now have adequate access to farm lands as a result of effective distribution of lands? Are all the farmers having adequate access to the irrigation scheme provided in their area? Is there any farmer who is deprived or relegated by the system in their area? These and more help government assessment of their programmes and to understand areas of possible adjustments.

5 Accelerated soil erosion is usually the result of the negative human impact in their environment, and like in the study area, the adoption of inappropriate soil management practices. As such, a study like this will help farmers understand their role in soil erosion development and thus avoid such practices.

6 Also a study such as this will assist students of agriculture, and agricultural extension in particular, correlate classroom lessons on the operation of phenomena such as soil erosion, food security, farmers' adoption behaviours, or their interplay as in this study with real life situation. These most times are abstract terms to the learner, but a study like this helps students' understanding of their operation in real life.

7 Moreover, a study like this will serve to a large extent, as an evaluation mechanism for extension programmes with respect to soil erosion control in the study area. The role of extension is to provide support and assistance to farmers, which thus enables them overcome their farming problems. Adequate monitoring and evaluation of such initiatives help provide quality services, which often times are lacking or very weak in many extension institutions. Misra (1997:n.p), citing FAO (1990:27), said that the

Global Consultation on Agricultural Extension observed that though monitoring and evaluation are important, yet they are often neglected functions in most organizations. He said further that a statistical figure of worldwide survey of national extension systems show that only about one half of all national extension systems have some type of monitoring and evaluation (M & E) capacity.

As such an external study such as this will go a long way to reveal the effectiveness of extension services with respect to the interplay of soil erosion, food security and the role farmers' adoption behaviour is playing in the process in the study area.

8 Finally, since one of the weaknesses of South Africa soil erosion research is that of limited information on where the worst problem is (Le Roux, Newby and Sumner 2007:333), a study such as this will serve as a good source of information in terms of the scale of soil erosion in the study area. According to Mpumalanga DACE (2002), errors are often assumed to be high in certain areas because of the unknown input factors of soil erosion, especially the vegetation cover factor for various land-use practices. As such, it was said that more researches are required to assess the limits of confidence for the estimates of erosion generated for South Africa at a national scale (Le Roux, Newby and Sumner 2007:333).

1.8 Scope of the study

Limitations in a human environment usually set boundaries to their activities. As such, due to limitations associated with the exercise of this project, effort is specifically focused on the following areas:

1. The focus of this study is on accelerated soil erosion only (excluding geologic erosion). Geologic erosion, according to Strahler (1973:1-17), is the slow removal of soil by various denudation agents such as running water, wind, ice and waves, under natural environmental conditions. In other words, it is a natural phenomenon which occurs through what is called geologic time scale (Tricart and Kiewietdejonge 1992). Determining such a phenomenon is absolutely outside the scope of a study such as this. On the other hand, accelerated erosion mainly occurs where humans have negligently tampered with the environment, especially through the removal of vegetation (Adediji 2000:165). Unlike geologic erosion which is very slow, spanning through millions of years (geologic time), accelerated soil erosion is usually very significant and devastating, not only in areas where it is occurring (on-site), but also outside of areas where it is occurring (off-site). Due to its significance, it is the one of utmost importance to humans, and most researched, as in this study.

2. The Upper and Lower Didimana areas of the Eastern Cape is the only area of study. This area includes Upper Didimana, Lower Didimana and Romanslaagte, respectively. The reason for this is because, according to Pretorius (1998), over 70% of land surface in South Africa has been affected by varying degrees and types of soil erosion. This seems to indicate the magnitude and extent of soil erosion in South Africa. Hence, it is not possible for a master's degree study to be able to study erosion in such a scale, especially because of time and resources. This is why this study only focuses on the Upper and Lower Areas of Didimana.

3. Emphasis shall be on variables associated with soil erosion, food security and farmers' adoption behaviours in the study area. Soil erosion is the main variable of this study. Its impact is usually very many: all spheres of human endeavour, which is practically impossible to determine together at once. This is why food security or farmers livelihood is chosen. In the same vein, soil erosion is caused by several factors, which can be natural or human, or both. Studying all factors at once is also very difficult, considering time and resources. In like manner, this study also chooses only one human variable, which is farmers' innovation adoption behaviour, to see its relevance in the study area.

4. Data collection procedure also shall be with the aid of structured questionnaires. Due to the technicalities of soil erosion as a phenomenon, questionnaires are designed with specific questions according to the objective of the research. In other words, the choice of using structured questionnaires is basically to guide the data collection process and avoid unnecessary deviations.

1.9 Assumption of study

An assumption of this study is that food security is equated as food production. Although these two terms, in an ideal case, are different, this study assumes that a farmer who actively engages in food production should be food secure, all other things being equal. One of the reasons for this is that, in most rural areas, the main aim for agricultural production is to feed the home. It is the left-over that is taken to the market, which in most cases is not always so.

1.10 Definition of key concepts

1. Soil erosion: is the gradual detachment and transportation of top-soil materials by agents such as water and wind.

2. Food security: could be said to occur when all people of a household, region or nation have secure access to quality and sufficient food at all times.

3. Adoption of innovation: adoption is defined as the act of accepting an innovation/ new idea/ improved technology for change, as in this case, soil conservation technologies.

4. A farmer: is any person who cultivates crops or rears animals for personal consumption or profit (economic or otherwise), or both. According to this definition, the quality, quantity, sustainability and profitability of crops or animals produced is irrelevant.

1.11 Conclusion

As indicated, the Eastern Cape where this study is conducted is rated as one of the three poorest provinces, as well as one of the three most degraded provinces in South Africa. Despite the much attention received by soil erosion, which is also reflected in the number of soil conservation researches and projects conducted in the area, the incidence of soil erosion remains a problem. The relationship between poverty and soil erosion/ degradation is more or less a vicious cycle. Poverty is a basic cause of soil degradation, while soil degradation through low agricultural productivity is a basic cause of poverty among rural smallholder farmers. The need for a research like this, to unveil how soil erosion impacts on the agricultural potential and food security of the Upper and Lower Areas of Didimana, and the role farmers adoption behaviour plays in the process is therefore to be thought worthwhile.

CHAPTER TWO

SOIL EROSION AND ITS IMPACT ON FOOD SECURITY

2.0. Introduction

This study focuses on the impact of soil erosion on food security in the Upper and Lower Areas of Didimana in the Eastern Cape, and the role farmers' adoption behaviour plays in the interaction. Against this background, in this section effort is made to provide a profound understanding of soil erosion and food security as basic concepts of the study, as well as their interaction in the study area.

2.1. Soil erosion

The study of soil erosion is very vital in environmental and agricultural studies because soil erosion is the most widespread and conspicuous forms of land degradation (Lal 2003:437). In Europe for example, soil erosion is regarded as one of the main and most widespread forms of land degradation (Gobin, Jones, Kirkby, Campling, Govers, Kosmas and Gentile 2004:25). In the words of Vrieling (2007:3), "soil erosion is one of the menaces to the sustainability ideal". In relation to South Africa, citing Clem Sunter, The Star, 20th August (1990), Muliban (2001:98) maintained that "soil erosion is the biggest environmental problem in South Africa".

In this section, an exhaustive discourse is given on the subject. This is largely because soil erosion is the core variable of this study. Specific areas of discussion are definition, forms, agents, types, influencing factors, problems and principles of soil erosion control.

2.1.1. Conceptual definition of soil erosion

Various definitions appear in the literature for soil erosion. Firstly, Onokerhoraye (1994:161) views soil erosion as the detachment or removal of the top-soil, either partially or completely. A second definition of note is that by Park (1997:303), which defines soil erosion as the movement of rock particles by active transporting agents such as running water, moving ice or blowing wind. Adediji (2000:165) describes erosion as the process of the detachment of soil materials as well as its transportation by water, wind and ice. The Longman Dictionary of Contemporary English (2003) defines soil erosion as the process by which rock or soil is gradually destroyed by wind, rain or the sea. Similarly, Marsh and Grossa (2005:345) state that erosion involves the dislodgement of particles from the soil. In a further account, Vrieling (2007:3) views the term as a natural process which detaches and transports soil material through the action of an erosive agent. A last definition to consider here is that by Le Roux, Newby and Sumner (2007:329), reporting Morgan (1995). According to them, soil erosion is a process of detachment and transportation of soil materials by wind or water.

From the above varied definitions, certain elements are obvious. First is that, erosion involves a process of weathering (breaking down) of rocks. All seven authors agree to this except Park (1997:303), who though not explicitly expressed, agrees implicitly. The only difference in the definitions is the use of different terminologies. For example, Onokerhoraye (1994), Adediji (2000), Vrieling (2007), Le Roux, Newby and Sumner (2007), all used the term “detachment”; Marsh and Grossa (2005) used the term “dislodgement”, while Longman (2003) was comfortable with the use of the term “destroyed”. A second element that is obvious from the definitions above is that soil erosion involves a transportation of detached or broken soil materials. This was explicitly expressed by all seven authors above. A basic gap that can be identified from all definitions above is that the last stage of soil erosion development or processes (figure 2.1 below) is not reflected. This is “deposition”. Deposition actually is the laying down of transported soil particles, which usually occurs when the velocity of transporting medium lowers down (Ighodaro 2007:23), citing Onokerhoraye (1994). The following statement by Le Roux, Morgenthal, Malherbe, Pretorius and Sumner (2008:305) seem to support this: “eroded soil materials lead to sedimentation/ siltation of reservoirs”.

Figure 2. 1: The three stages of soil erosion

Plate 2. 1: An example of deposition of eroded soils in the study area

2.1.2. Forms of soil erosion

Toy, Foster and Renard (2002:18-19), Adediji (2000:165), and Onokerhoraye (1994:161), all agree to the fact that erosion can be geologic and accelerated. Geologic erosion involves the slow removal of soil by various denudation agents such as running water, wind, ice and waves, under natural environmental conditions (Strahler 1973:1-17). This form of erosion is very slow and as a result is not much injurious to the soil cover (Onokerhoraye 1994:161). On the other hand, accelerated soil erosion mainly occurs where humans have negligently tampered with the environment, especially through the removal of vegetation (Adediji 2000:165). It often results in the physical losses of the top soil constituents, leading to severe economic loss arising from reduced crop yield or total crop failure (Faniran & Ojo 1980:299). Vrieling (2007:3) arguing along this line defined accelerated soil erosion as the disequilibrium which exists between the rate at which soils are formed and soil erosion. According to Vrieling, it is principally caused by anthropogenic land use changes like deforestation and agricultural practices. Due to the spectacular nature of accelerated soil erosion and its devastating impact on the environment, it is the type of utmost concern and the most studied by humans.

2.1.3. Agents of soil erosion

The agents responsible for the transportation of broken soil materials at the earth’s surface are many. Onokerhoraye (1994:164-166) defines agents of soil erosion as instruments of soil erosion, and was disposed to classify these agents as water, wind, ice, man and gravity. Vrieling (2007:3) classified them as water, wind, gravity and anthropogenic disturbances, which seems to resemble that of Onokerhoraye, except for the exclusion of ice. In the consideration of Faniran’s (1990:101) views, agents of erosion are water, wind, ice and animals, especially humans, which somehow look like Onokerhoraye’s views. However, it differs in that gravity was not included, and man was termed animals, which is more encompassing, because animal includes humans and other animals, which play significant roles in the transport of broken soil particles.

Therefore, a summary list of all agents of soil erosion includes water, wind, ice, gravity and animals (humans and other animals). However, because of the scope of this study, emphasis is on water as basic agent of erosion. One reason for this is because water is the most significant agent responsible for soil erosion in South Africa (Le Roux et al. 2008:329, citing Laker 2004) where this study is conducted and the world at large (Onokerhoraye 1994).

Wind as an agent of soil erosion is less widespread as water erosion. It is however significant in the arid and semi-arid desert areas, where it constitutes a great problem for agriculture. Wind erosion is significant in the desert areas because soil erosion by wind is practicable where there is an extensive area with loosed, dry and reasonably fine-grained soil, a smooth soil surface, sparse or even vegetation cover and strong and constant wind (Faniran & Ojo 1980:303). In South Africa, 25% of the land area is highly susceptible to wind erosion (Hoffman & Todd 2000). Discussing on wind erosion, Pimentel (2006:120) stated that wind energy has great power to detach surface soil particles and transport them great distances. According to him, a vivid example was the wind erosion that occurred in Kansas during the winter of 1995-1996. It was suggested that an approximate amount of 65 t/ ha was eroded from valuable cropland during one winter.

In terms of how ice, humans and gravity play a part in erosion processes, Onokerhoraye's (1994:161) analysis seems to suffice. As regards ice, the freezing and melting of water in Polar Regions tears particles of the soil surface and then begin to move them along cavities of rocks, which later form gullies. Human beings form agent of soil erosion by tempering with the equilibrium state of the topsoil, through their various activities. As such, there is the exposure of the topsoil to other agents of erosion. The effect of gravity is felt more through mass wasting, and in areas where there is a slope. This is because gravitational force can only operate on bodies with mass, like soil particles, and in areas where there is a difference in height (slope). This is why acceleration due to gravity on bodies resting on flat surfaces is always zero (Onokerhoye 1994:161).

Further deductions from Onokerhoraye (1994:168) indicate that apart from relatively dry areas like the deserts, water is the most important agent of soil erosion in the world. Soil erosion by water is carried out in two major ways. Firstly, raindrops cause rain-splash erosion, which arises from the impact of raindrop splashes on the soil particles, moving them both vertically and horizontally. The amount of soil loss due to raindrop erosion is influenced by factors such as the amount of energy in the raindrops, which is intensity, as well as the resistance of the soil in question, topography, and vegetation cover. Secondly, water erodes the soil through surface flow. This occurs when the rate of precipitation exceeds the rate of which water soaks into the ground surface. Surface flow may be in sheets, rill, and channel or gully.

Faniran (1990:101), commenting on the role of water in erosion processes, said, not only is the presence of water the major cause of rock weathering, it is also a major determinant of the main forms or types of mass wasting on slopes. He however said further, while water tends to play subdued roles in these processes, it is the major force in the transportation and deposition of the materials produced by both weathering and mass wasting from one part of the land to another usually over long distances.

2.1.4. Types of accelerated soil erosion

Accelerated soil erosion can be by water or wind. Water erosion, which is the most frequent, is further sub-divided, but authors are not agreed on the number. For example, Onokerhoraye (1994:161), Adediji (2000:165) both favour a three classification scheme: sheet, rill, and gully; Faniran (1990:137), Park (1997:303), Vrieling (2007:3-4), Le Roux et al. (2008), all favour a four classification scheme: splash, sheet, rill and gully erosion respectively; while Toy, Foster and Renard (2002:55-68) were disposed towards a ten division classification: interrill-rill areas; sheet and rill; concentrated-flow areas; ephemeral gully; permanent, incised gully; stream-channel; watershed sediment yield; erosion by irrigation; erosion by snowmelt and rainfall on thawing soil; and erosion by piping. However, taking a cursory look at the ten different types given by Toy, Foster and Renard (2002), except for erosion by piping, it is obvious that many of the different forms are one type of the other four divisions already given by the first six authors above. Therefore by synthesis, the researcher shall classify water erosion into the five following classes: splash, sheet, rill, gully, and erosion by piping, respectively.

Splash erosion occurs when soil particles are splashed out of their positions in all directions by raindrops (Park 1997:303). Sheet erosion or un-concentrated flow (Le Roux et al. 2008:305) largely, is an even removal of thin layers of soil from a sloping land surface. This removal may not be very noticeable and perhaps the only clue to this form of erosion is that streams, which normally run clear, begin to be cloudy and muddy. According to Oldeman (1997), sheet erosion occurs when a thin film of soil is removed from land surfaces. In his account, this is the dominant type of soil degradation. In the case of rill erosion or concentrated flow (Le Roux et al. 2008:305), water moving under the influence of gravity on any sloping land tends to channel itself, especially when the top-soil materials are very erodible. Gully erosion by definition, is a channel cut so deeply into underlying earth materials that the surface cannot be easily smoothened out. A last form of accelerated erosion is erosion by piping. According to Zachar (1982), as cited by Toy, Foster and Renard (2002:55-68), it is a well known fact that water frequently flows through the soil just below the surface. The soil may contain macro pores, other small openings, and channels left by decaying roots, burrowing insects and animals, and other processes. These internal open spaces in the soil may become pipes, and pipe flow can erode the soil, causing a type of erosion known as piping.

Judging from the work done by Toy, Foster and Renard (2002:55-68), fundamentally erosion by wind occurs in the same way as erosion by water. Wind erosion can be classified on the basis of the sediment transport mode. These are: (1) creep; (2) saltation; (3) suspension; (4) shear; (5) abrasion. Creep is sediment transport along the soil surface by skidding, bouncing, and rolling. Saltation is sediment transport by the wind lifting particles from the soil surface and moving them downwind in an arc, similar to the trajectory of a projectile. Also, suspension is sediment transport by the wind of any small soil particles, especially fine particles. These are transported great distances as dust before being deposited. Shear erosion occurs when the wind exerts forces on the soil sufficient to overcome the resistance of the soil and removes sediment from the soil surfaces. Finally, abrasion occurs when soil particles in motion strike off from the soil other soil particles, removing them from such soil surfaces.

2.1.5. Factors influencing soil erosion

From the literature, findings of authors all agree on the two main causes of soil erosion: natural and human-induced (anthropogenic) causes. For instance, Snyman (1999), maintained that although soil erosion is considered as a natural process, it is often accelerated by human activities like clearing of vegetation or by overgrazing. Also, in support of this idea, Keay-Bright and Boardman (2008) opined that both natural and anthropogenic factors are suggested as contributing factors to erosion process.

According to Onokerhoraye (1994:161-166), although Ofomata (1975:45-49) has argued that human component in soil erosion is often exaggerated, there is little doubt that the depletion of rural and/ or agricultural lands in many places, such as Nigeria through human activities is extensive. Intensive concentration of domestic animals and the careless act of bush burning are such human acts, which have started or exacerbated soil erosion in the area. Rates of erosion vary a great deal from place to place, reflecting variations in key controlling factors such as climate, vegetation cover, changes in land use, geology and soil type, and topography (Park, 1997:303).

To buttress the above, a synthesis of the ideas of Toy, Foster and Renard (2002:25-50) and Onokerhoraye (1994:162) subdivides these two groups of erosion causes into the following subdivisions:

2.1.5.1. Nature of the soil

The degree of erosion in any area is influenced by the soil structural stability. Hence, low resistant soils are described as structurally unstable soils, while those of high resistance are described as structurally stable soils. Soils with large stable particles such as sand grains or iron-cemented aggregates seldom erode because erosive forces may not be strong enough to move them (Onokerhoraye 1994). Bajracharya and Lal (1992), cited by Pimentel (2006:120), commenting on the impact of the soil in erosion development indicated that soil structure influences the ease with which the soil can be eroded, that usually, soils with medium to fine texture, low organic matter content, and weak structural development are most easily eroded. Pimentel (2006:120), also supporting, said that these soils have low water infiltration rates and are subject to high rates of water erosion and the soil particles are easily displaced by wind energy.

2.1.5.2. Nature of the land surface

The basic attributes of the land that play a part in erosion development are slopes/ gradient of land, relief or topography. In the consideration of Onokerhoraye (1994:162), areas characterized by steep slopes tend to experience more soil erosion than lowland areas. By far the most conducive areas to erosion are those characterized by concave slopes, which are often badly gullied. Slope or gradient strongly influences flow velocity and thus sediment transport within a river and this dimension of channel geometry appears to be much more stable and persistent than cross-sections and meanders. Also, relief influences the speed at which some important weathering and erosion processes operates. An increase in elevation (caused by uplift) increases gravitational forces and speeds up many erosion processes and vice versa (Park 1997:318). The impact of land surface is further established through the following statements by Lal and Stewart (1990), as reported by Pimentel (2006:121): “in the Philippines, where more than 58% of the land has a slope of greater than 11%, and in Jamaica, where 52% of the land has a slope greater than 20%, soil erosion rates as high as 400 t/ ha-yr have been reported”.

2.1.5.3. Climate as a factor

Three main climatic elements in operation with respect to soil erosion development are rainfall, temperature and wind (Onokerhoraye 1994:162). In a semi-arid region that is marked with rains falling in sudden torrential storms, serious erosion problems do occur. Also, in tropical areas where there is heavy rainfall and rainfall seasonality, erosion is also devastating. Also wind, which is an agent of soil erosion, is a major factor influencing soil erosion in the arid and semi-arid areas. In these regions where rainfall is small and variable in amount and where there is a dry season, removal of vegetation gives way to the wind to sweep the earth’s surface.

2.1.5.4. Vegetation as a factor

Vegetation as a factor in erosion development is very significant. This is because plants usually act as protective cover for the soil. When this protection is destroyed through any form of human activity, the soil is laid bare, and the beating and splashing action of the rain becomes uninterrupted, as such the rainwater can easily run-off causing erosion. Park (1997:303) gave credence to this factor in one of his findings, "where rainfall is higher, vegetation grows more extensively and this protects slope surfaces and limits erosion". The findings of Agriculture California (2002) and SWAG (2002), as cited by Pimentel (2006:121), further buttress this point. It was stated that "land areas covered by plant biomass, living or dead, are more protected and experience relatively little soil erosion because raindrop and wind energy are dissipated by the biomass layer and the topsoil is held by the biomass"

Vegetation as a factor arguably could be considered as the most significant factor in soil erosion development. This is because, according to Adediji (2000:165), accelerated soil erosion mainly occurs where human has tempered with the environment, especially through the removal of vegetation. In the account of Pimentel (2006:121), the extensive removal of forests for cultivation of crops and pastures is usually followed by extensive soil erosion. This means that the more vegetation is removed, the more the rate of soil erosion. To further reinforce the above idea, Roose (1988) and Lal (1994), emphasized that, in a stable forest environment, where the soil is protected by vegetation, erosion rates are relatively low.

2.1.5.5. Anthropogenic (human-induced) factors

There are so many anthropogenic activities which lead to soil erosion. Examples are agricultural activities, mining activities, construction works, lumbering, settlement and urban sprawl. In fact, anywhere humans have imprinted their activities usually shows some level of deterioration, which becomes forerunners to natural agents of erosion. For example, Lal (2009:45-57) found out that brick making, in rapidly urbanizing India, annually uses up 1m of topsoil from 0.5% to 0.7% of cropland area in the northern states of Haryana and Punjab.

According to FAO (2002), cited in Pimentel (2006:122), agricultural production accounts for about ¾ of the soil erosion worldwide. In their opinion, erosion usually occurs whenever humans remove vegetative cover. In areas where there is overgrazing on pastures, Pimentel (2006:124) argued that erosion rates intensifies. WRI (1994), reported by Pimentel (2006:124-125), stated that high erosion rates are typical on more than half of the world's rangelands. This again impresses the potentials of agricultural activities in erosion development.

In areas where minerals are in abundance, mining is a major human factor of soil erosion (Onokerhoraye 1994:163). In the process of extracting these minerals, the soil is excavated and exposed to agents of erosion. Henao and Baanante (2006) maintained that mining of soil nutrients, for example, in Africa is estimated at an annual depletion rate of 22kg N, 2.5kg P and 15kg K per hectare of cultivated land for the past 30 years since 1975. Sanchez and Swaminathan (2005:357), estimated this annual loss of nutrients in Africa to the tune of US $4 billion in fertilizers. Also, the removal of surface materials thus reduces available land, which leads to too much pressure on land, which also exposes the land to agents of erosion. Construction work is another form of human activities. The construction of various routes and settlements, as found in South Africa and other areas of the world, generally entail the removal of vegetation cover, which as expected permits a direct effect by raindrops, while the roads and footpaths also provide easy channels for running water. These developments tend to increase soil erosion.

Humans have always interacted with land and will continue to do so, because virtually all their requirements for livelihood come from the land. According to Jimoh (2000:2), the quest for National Development all over the world has spurred the desire to explore the possibilities of harnessing all resources to advantage. These efforts have been such that due cognizance has not been given to the environment where the entire processes take place. Consequently, various levels of environmental related problems emerge.

2.1.6. Problems of soil erosion

Effects of soil erosion can be on-site and off-site. On-site effects are effects which directly impacts on agricultural crops, lands and farmers, while off-site effects are those effects outside of spots where erosion takes place, such as in rivers and lakes. Generally, effects of soil erosion are numerous, including the loss of topsoil, sedimentation and siltation of reservoirs, ravines and gullies, which threaten lives and properties (Adediji 2000:165). Examples are as follows:

1. According to Pimentel (2006:125), soil erosion reduces the productivity of terrestrial ecosystems. Several problems result because of this. One of such is that soil erosion brings about an increase in water runoff, thereby decreasing the water infiltration and the water-storage capacity of the soil (Jones et al. 1997, in Pimentel 2006:125). Also, whenever erosion occurs, organic matter and major plant nutrients are removed from the soil, as well as a reduction in soil depth (Pimentel 2006:125). The above changes not only hinders plant growth, but also reduce the presence of valuable biota and the

overall biodiversity in the soil (Troeh et al. 1991, in Pimentel 2006:125), which indeed are some of the main on-site effects of soil erosion.

2. When topsoil layers are destroyed as a result of soil erosion, this invariably impacts negatively on the individual farmer and the entire nation at large. As a well known fact, most members of developing nations depend on farming as their main means of livelihood. Agriculture of any kind thrives best on the nutrient-carrying part of the land. When these are destroyed by erosion, agricultural production would be hindered. As such, farmers suffer directly, and the entire nation suffers indirectly. From a latest cost estimate in the Environment Report of South Africa, annual cost of soil erosion is about R2 billion, including off-site costs for purifying silted dam water (Hoffman and Ashwell 2001).

3. The eroded materials from different erosion sites are eventually washed off into various river channels. According to FEMAT (1993) and Ziemer (1998), the effects of soil erosion goes beyond just damages to agricultural and forestry ecosystem, into surrounding environments. This is one of the ways erosion impacts off-site. Myers (1993, discovered in one of his studies, that in some areas, heavy sedimentation leads to river and lake flooding. In Pimentel (2006:130) example, some of the flooding that occurred in the Midwestern United States during the summer of 1993 was as a result of increased sediment deposition in the Mississippi and Missouri Rivers and their tributaries. In a further finding by Wind Particles (2002), it was demonstrated that wind-eroded soil also has off-site effects because soil particles propelled by strong winds act as abrasives and air pollutants.

   Similarly, Pimentel (1997) stated that, of the billions of tons of soil lost from US and world cropland, almost 2/3 of that amount eventually ends up in lakes and rivers. Valuing the impact of off-site erosion, Huszar and Piper (1985), argued that annually, off-site erosion costs in New Mexico, including health and property damage, are estimated to about US $465 million. In the same vein, Pimentel et al. (1995), estimated the cost of off-site damage from wind erosion in the United States as about US $10 billion each year.

4. Soil erosion impacts on landscape. The severe erosion which manifest in the form of ravines and gullies have destroyed the landscape of tropical environments. For instance, gullies have been responsible for some of the spectacular badlands topographies in certain parts of eastern Nigeria (Adediji 2000:165-170).

5. Severe soil erosion also threatens lives and properties. For instance, many houses have collapsed; roads and communication equipments have been endangered. A typical example can be found in eastern Nigeria, where head ward erosion has cut off communication routes. Also, soil erosion causes many types of serious damage to farmlands and settlements (Adediji 2000:165-170).

6. Impact on global warming: Soil erosion has been discovered to contribute to global warming development. As argued by Walsh and Rowe (2001) and Lal (2004), soil erosion contributes to global warming, because of the carbon (iv) oxide (CO_2) which is usually added to the atmosphere when the enormous amounts of biomass carbon in the soil are oxidized. In fact, a vicious circle is set up between erosion and global warming. Increased global warming intensifies rainfall which, in turn increases erosion and continues the cycle (Lal 2002, cited by Pimentel 2006:130-131).

As seen in this section, the most immediate and foremost consequence of soil erosion is the destruction of the most fertile/ nutrient-carrying part of the land. This is the reason why uncontrolled erosion impacts negatively on the agricultural potential of any nation, and ultimately on its food security. The reason is because agricultural productivity thrives best on this nutrient-carrying part of the soil, which is washed away during severe erosion.

2.1.7. Fundamental principles of erosion –control

Different authors have posited many different ideas for the control of soil erosion and conservation of the soil. A very comprehensive approach is offered by Toy, Foster, and Renard (2002:201-202). This includes:

1 Maintain vegetative cover. Vegetative cover reduces erosion by providing canopy, plant litter for ground cover and incorporation into the soil, and root network. The goal is simply to maintain the highest-producing vegetation with the densest root network near the soil surface. Short vegetation is best for water erosion control, and tall vegetation is best for wind erosion control.

2 Maintain ground cover. Keeping the ground cover by leaving last year's crop residue on the surface, growing plants that produce a high level of litter, or applying cover, such as natural or manufactured mulch materials when no residues are available from plant growth is highly effective for controlling erosion.

3 Maintain cover during periods when erosivity is highest if cover cannot be maintained at all times during the year. Having cover during the criteria period is determined by the crop

choice in a farming system or by scheduling soil disturbance for times other than the period of maximum erosivity.

4 Incorporate biomass into the soil. Adding to and incorporating organic material such as manure, sewage sludge (bio solids), or paper-mill waste in the soil can reduce erosion significantly.

5 Minimize soil disturbance but if the soil must be disturbed mechanically, leave the soil surface rough, with large clods.

6 Add soil amendments such as PAMS (polyacrylamides) that reduce the erodibility of the soil and increase infiltration. Wind erosion and dust at a construction site can be controlled by water applications.

7 Add supporting practices, such as creating ridges and orienting them perpendicular to the direction of wind and runoff. Also, reduce surface runoff with surface drainage systems.

8 Avoid long field lengths, which can greatly increase wind erosion.

9 Use barriers such as wind breaks around field.

2.2. Food security

As revealed in the previous section, anything that affects successful agricultural production leads to food insecurity. In the month of May 2007, at the 33rd session of the Committee on World Food Security, the Food and Agriculture Organization issued a statement to reaffirm its goal for a world that is food secure (FAO 2008:3). The world's population is on a continuous increase, especially in the developing countries. The world population got over 6.9 billion on the 1st of July 2011 (UN 2011:1), and grew to 7.06 billion in the middle of 2012, in which developing countries account for 97% of this growth (Population Reference Bureau 2012:n.p) This makes the discussion on food security very important, because the need to provide food for all is without rival. The indication is that the millennium development goal of halving hungry people by 2015 may eventually not be met (Bruinsma 2003a), especially in South Asia and Sub-Saharan Africa (Fan 2010:1), because of poverty and population growth as compared to some other parts of the world (World Hunger Education Service 2012:n.p). Therefore, this section aims at providing a definition for food security as a concept; identify some measures of food security; and highlights food security status of households in South Africa.

2.2.1. Defining food security as a concept

Food security as a concept is such an important subject that its adverse effects cannot be overlooked. According to Clay (2002:1, 6), the concept is flexible and multi-dimensional. This as he said is reflected in the many attempts of its definition in research and policy usage. This was also supported by the World Health Organization (2012:n.p) report that food security is a complex sustainable development term, which is linked to issues of health through malnutrition.

According to Hlanganise (2010:1), food security is a global concern. He also said that since 1948, the United Nations (UN 2005) has indicated that access to adequate food is both an individual right and a collective responsibility. To further buttress the central importance of food security, the United Nations (1999:n.p) argued that the right to food is the most fundamental and enabling human right of all. Due to the all-important nature of the term "food security", most governments of the world have it as part of their constitutional obligations. For example, as indicated by the Department of Agriculture, Republic of South Africa (2002:11), "the right of access to sufficient food is enshrined in Section 27 of the South African Constitution". When food security is not ensured, the consequences are usually dire, especially on the poor of the society. That is why Obi (2004), reported by Hlanganise (2010:1), maintained that the weight of food insecurity is on those already at the margins. These are the poor of the society.

The population of the world is on a continuous increase. It was suggested that food security will remain a major global worry throughout the 21st century (Rosegrant and Cline 2003). Reporting on the issue, FAO (2005) and (2007), gave important reports on the increasing vulnerability of large populations to hunger and malnutrition. FAO (2010:8) estimated a total of 925 million undernourished people in the world in 2010, wherein developing countries constituted a total of 98% of that figure.

The continuous appearance of hunger and malnutrition in research studies seem to suggest that hunger and malnutrition are good indicators of food security or insecurity in a place. Whilst recognizing the complexity of the concept and its development over more than three decades, the World Food Summit of 1996, defines food security as being "...achieved when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996a). This definition includes reference to the importance of aspects like access to food, affordability, quantity and quality of food. At this juncture, it is beneficial to consider some other literature views on food security, apart from the World Food Summit definition.

According to the definition of Koc and MacRae (2001:8), food security is the condition where all people at all times can acquire safe, nutritionally adequate, and personally acceptable foods in a manner that maintains human dignity. In their view, this definition requires the satisfaction of four inter-related components: availability, which speaks of the sufficiency of food for all; accessibility, which has to do with access at all time to food by all; acceptability, which brings in the cultural content and distribution systems; and adequacy, which considers variables like the nutritional quality, safety and sustainability.

In the consideration of prof. Kinabo, during the International Workshop Experts on Health and Human Well-being in Africa, held in Pretoria, South Africa on the 25th to 27th August, 2008, food security relates to three key elements which are: availability, accessibility and utilization. From her view, availability is determined by factors such as the adequacy and stability of food supply, which also is determined by a whole range of factors like production (quantity), nutritional adequacy, acceptability, safety and quality, storage, processing, social and environmental sustainability, trade policies and world food prices; access is determined by factors such as income, employment, purchasing power, private transfers, transportation and market infrastructures, socio-cultural contexts; while food utilization is determined by factors like health status, level of activities, metabolic efficiency, diseases and food factors.

In a similar note, the Department of Agriculture, Republic of South Africa (2002:16) defined food security in four dimensions: food availability, which is determined by continuous supply of food, input and output market condition, as well as production capabilities of the agricultural sector; food access, which speaks of effective demand, ability to acquire sufficient food on a sustainable basis; reliability of food, which talks of utilization and consumption; and food distribution, which considers the equitable provision of food to areas of demand at the appropriate time and place.

A last definition to consider here is that by Schmidhuber and Tubiello (2007), as cited by Lal (2009:45). In their opinion, food security has four distinct components: food production, which is through agronomic management of soil resources; stability of food production and availability at all times; access through economic capacity; and food safety, determined through nutritious and biological quality.

In all four definitions above, certain points are remarkable. One is that all definitions drew inspiration from the World Food Summit definition of 1996. Another remark is that, though the different classifications of food security pillars vary slightly, the intentions of some of the classes of one author are intended by the other author even though the classes may not be the same. So that, at the end, there is really no significant difference between the classes. For example, while acceptability, which talks of the cultural context of food security, is one of the classes of food security pillars, as intended by Koc and MacRae (2001:8), it is defined under availability by Kinabo (2008:5), while culture context is described under accessibility of food by Kinabo. Similarly, while food utilization, which is determined by factors such as health status, level of activities, is a main component of food security according to Kinabo (2008), it is however a description under reliability, a main component of food security, according to the Department of Agriculture, Republic of South Africa (2002:16).

One spectacular remark from the definitions is the point relating to one of the components of food security as considered by Schmidhuber and Tubiello (2007), as cited by Lal (2009:45): food production, which is through agronomic management of soil resources. In this view, the issue of the scientific management of the soil resources is brought to bear in food security discussion. This is very remarkable, because any sound effort for adequate food security must of necessity deal with soil resources sustainably, otherwise degradation results, which inevitably leads to food insecurity.

When the concept of food security is applied to the family household level, with individuals within households as emphasis, the focus is on household food security. Therefore food security can be at an individual level, household level, national, and even at a global level. According to Koc and MacRae (2001:8), food security at a national level does not automatically indicates food security at a community, household, or individual level. Hence, Kinabo (2008:5) defined individual, household and national food securities as: individual food security is the ability of an individual person to access and consume food and for the food to be properly utilized in the body for a healthy life. Also household food security is defined as the ability of households to acquire food either through direct production, or purchase/ transfer/ exchange, which is adequate in quantity and quality, to actualize the nutritional requirements of all members of the particular household. Similarly national food security is the assured national availability or supply of food to meet per capita minimum needs of the population during a particular period, and this is determined by factors such as domestic food production, trade policies, world food prices, imported food and food aid (Kinabo 2008:5).

On the other hand, food insecurity can be said to exist when people do not have adequate physical, social or economic access to food as defined above FAO (2010:8). According to the Parliamentary Office of Science and Technology (2006:1-2), food insecurity is the absence of food security, and it applies to a wide range of variables, from famine to periodic hunger to uncertain food supply. Also, it says that hunger can be experienced temporarily by both people who are food secure or insecure. Speaking further, it was said that hunger can be acute, when lack of food is short term, and is often the result of the impact of shocks caused by drought or war on vulnerable population members; chronic, caused by a constant or recurrent lack of food and leads to underweight and stunted children and high infant mortality; and hidden hunger, caused by a lack of essential micronutrients in diets and it affects more than two billion people worldwide.

2.2.2. Food security measures

Due to the flexible nature of food security concept, as indicated by Clay (2002:1), Maxwell and Smith (1992) said there had been about 200 definitions already in published writings as at 1992. This makes discussion on the subject very difficult (Clay 2002:1). Hence Maxwell (1996) advised that it is very necessary to look closely to ascertain the explicit or implied meaning whenever the subject is introduced. The implication of the aforementioned is that there are several indicators that could be used in the measurement of food security. This is well supported by Hlanganise (2010:13), citing Maxwell and Frankenberger (1992), that there are close to 200 definitions and 450 indicators for household food security. However, this study shall limit itself to the following indicators as reflected in the definitions reviewed in previous section.

1. Access to food;
2. Affordability of food;
3. Availability of food;
4. Food utilization;
5. Acceptability;
6. Quality of food;
7. Quantity of food;
8. Hunger;
9. Malnutrition;
10. Employment and spendable income;
11. Food production, which is through agronomic management of soil resources; and
12. Stability of food production and availability at all times

Among other things, the above is a reflection of the complexity of food security as a subject. It also shows the development in the definition of food security. Food security has grown beyond mere issues of availability, to include issues like accessibility and acceptability. In fact, FAO (2002:3) indicated that a broader perspective was adopted in the UNDP 1994 Human Development Report, which promoted human security, bringing in the human rights perspective of food security.

2.2.3 Factors influencing food security/ insecurity

As revealed implicitly from the discussion above, food security is affected by several factors. Among these are population increase, environmental problems such as soil erosion, socio-economic problems such as poverty and unemployment. Speaking on the factors influencing food security status of individual households in North Central Nigeria, Sanusi et al. (2006), as cited by Babatunde, Omotesho and Shlotan (2007:352), said that the socio-economic characteristics and resources of individual households are basic factors affecting the food security status of households. Also, the Parliamentary Office of Science and Technology (2006:1) maintained that factors which affect food security or insecurity are: poverty, health, food production, political stability, infrastructure, access to markets, and natural hazards.

In the views of Sanchez et al. (1997), as cited by Odendo, Obare and Salasya (2010:2), soil fertility degradation on smallholder farms is reported as the main biophysical root cause of food insecurity and poverty in sub-Saharan Africa.

2.2.4. Highlights of food security status of households in South Africa

According to Altman, Hart and Jacobs (2009:349-355), in South Africa, a lot can be learnt about the food security status of households:

1. There is great level of uncertainty with baseline estimates on household food security status in South Africa.
2. Since 2002, there has been a remarkable drop in the experience of hunger.
3. While the incidence of hunger has fallen, the problem of under-nutrition remains a grave dilemma.
4. Food insecurity can be chronic or transitory, and the two can as well be experienced on huge scale.
5. It is discovered, that from expenditure decile, rural households spend more on food but less per person than their urban counterparts.

6. One of the main ways that the deficit of food security has been provided for is through the provision of grants. However, about 50% of households that are often or always hungry are eligible but do not receive grants.
7. More and more, the reason small household producers engage in production is for extra food.
8. There is no specific and accepted measure of food security in South Africa.
9. Compared to other middle income countries, South Africa has extremely high levels of absolute poverty.
10. Achieving household food security is a crucial element in meeting the South African government objective of halving poverty between 2004 and 2014.

As the Parliamentary Office of Science and Technology (2006:1) indicated, one of the causes of food security or insecurity is poverty. In other words, poverty is linked closely with food security. Citing the Human Sciences Research Council (HSRC), Altman, Hart and Jacobs (2009:48) posited that food security at a national level does not automatically indicates food security at a community, household, or individual level. And the main causes are widespread chronic poverty and unemployment. One deduction from this is that poverty is seen as a main determinant of the level of food security in a place like South Africa, all things being equal. This also seems to be the position of Hlanganise (2010:7), citing van Zyl and Kirsten (1992), in his study. It was stated that poverty is one of the main reasons for food insecurity in South Africa.

Discussing on the level of food security in South Africa, the Department of Agriculture, Republic of South Africa (2002:20) maintained that nationally South Africa is food secure. In fact, it was said that South Africa has met its food needs for its growing population from domestic sources in the past 20 years. Quoting Statistics South Africa (2000), the Department of Agriculture, Republic of South Africa (DoA, RSA 2002:22) further said that there is currently about 35% of total population (14.3 million) of South Africans that are vulnerable to food insecurity. This seems to agree with Koc and MacRae (2001:8) statement, that food security at a national level does not automatically indicates food security at a community, household, or individual level.

Referring to the Eastern Cape, Bank, Minkley and Kamman (2010:5) reported that the Eastern Cape is one of South Africa's poorest provinces: poverty is deepest, poverty gap is also widest and the rate of poverty, especially in the predominantly rural areas is over 70%. Westaway (2012:117) also accounted that the Ciskei and Transkei (which comprise the Eastern Cape) are today characterised by pervasive chronic poverty, low levels of economic activity, a dearth of employment opportunities, and high levels of dependency on social welfare grants. This somewhat concurs with Altman et al. (2009:349-355) view on food security status of households in South Africa as related above.

2.3. Impact of soil erosion on food security

Food security in most societies largely hinges on effective and efficient agricultural production (Parliamentary Office of Science and Technology 2006: 4). This therefore implies that anything that obstructs agricultural production without doubt can potentially cause food insecurity.

Keatinge et al. (1999), as reported by Tiwari et al. (2008:210), commenting on the impact of soil erosion and fertility decline in the mountains of Nepal, indicated that soil erosion and fertility decline are major problems in the mentioned area, with grave implications for food security and the livelihoods of farmers in the area.

Soil erosion impacts on the security of food of an area indirectly by firstly impacting on the soil quality and then on the agricultural potential, which invariably affects the availability, quality and quantity, as well as access to food of the area. Lal (2009:45-57) suggests that soil degradation, closely associated with poverty, is an important cause of food insecurity, malnutrition, social/ ethnic conflicts and civil political unrest.

Soil is a very valuable resource. According to the FAO (1998), cited in Pimentel (2006:119), more than 99.7% of human food (calories) comes from the land. If this is the case, then there is an impending and urgent need to protect land resources from depletion.

This has not always been the case. Young (1998) argued that the changes inflicted on soil by continuous accelerated erosion activities over the years are indeed significant and have resulted in valuable land becoming unproductive and often eventually being abandoned. 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 1995:1117, citing Myers 1993).

In a further study by Pimentel and Kounang (1998:416), findings indicate that soil erosion diminishes the quality of soil through the loss of water, soil organic matter, nutrients, biota, and depth of soil, thus reducing the productivity of natural, agricultural and forest ecosystems. Through this process of soil erosion, valuable biodiversity in the soil is also damaged – sometimes irrevocably.

The impact of soil erosion on soil potential is also substantial and significant, especially in terms of damage to the most fertile part of the soil. For example, according to Sundquist (2000), as reported by Pimentel (2006:126), a typical fertile soil contains about 100 tons of organic matter per hectare. Speaking on the composition of organic matter, Allison (1973), as cited by Pimentel (2006:126) said that about 95% of soil nitrogen and 25-50% of phosphorus is contained in soil organic matter. This is why the impact of soil erosion is very significant, because this is the main focus of erosion influence. The reason is that most of the soil organic matter is found close to the soil surface as decaying leaves and stems, as such erosion significantly decreases soil organic matter (Pimentel 2006:126-127). In a nutshell, soil erosion/ degradation impact on the soil is in three dimensions: the physical, example is decline in soil structure; chemical, as in nutrient depletion; and biological, example is in the depletion in soil organic matter (Lal 1997:997-1010).

The impact of soil erosion on agricultural productivity is indirect. Pimentel (2006:119-137) further suggests that soil erosion, through the diminishing of soil organic matter and soil quality, reduces overall biomass and productivity. When plant nutrients and organic matter in the soil are washed away, plant food is lost, which indeed has great consequences on plant growth and development.

As such, agricultural productivity is negatively affected. In this sense Young (1989), cited by Pimentel (2006:126), states that “eroding soil contains about 3 times more nutrients than are left in the remaining soil”. In another word, Young (1989:45) said that eroded sediment contains a considerably higher measure of organic matter and nutrients than that of the topsoil from where it is derived. According to him, two reasons for this are that, firstly the uppermost few millimetres of soil are richer in organic matter and soil nutrients than the 15 or 20 cm which is normally bulked for analytic purposes. Another reason is that soil erosion selectively removes soil nutrient-rich materials. Addressing the same issue in their studies, Pimentel et al. (1995:1118), citing El-Swaify et al. (1985), maintained that water and wind erosion adversely affects the quality of soil and productivity by reducing infiltration rates, water-holding capacity, nutrients, organic matter, biota and soil depth. In support of this, Pimentel et al. (1995:1118) posited that, when nutrient resources become depleted as a result of erosion, growth of plant also becomes stunted and this reduces overall productivity.

Further work by Follett and Stewart (1985), as reported by Pimentel et al. (1995:1118), revealed that nutrient deficient soils produce 15 to 30% lower crop yields than undamaged soils. Plant nutrients are usually a composite of organic matter which makes up the topsoil layer. According to Pimentel et al. (1995:1118), because most of the organic matter is near the soil surface as decaying leaves and stems, erosion of topsoil leads to a rapid decrease in levels of organic matter, which thus affects plant growth and development.

Allison (1973), as reported by Pimentel et al. (1995:1118), emphasized that several studies demonstrate that during soil erosion, the soil washed away by either water or wind erosion, is 1.3 to 5 times richer in organic matter than the remaining soil left behind. This indicates that organic matter (which is the main source of plant food) lost during soil erosion activities is richer than that occurring in the soil after soil erosion. Once the organic matter layer is damaged, the productivity of the ecosystem declines both because of the depleted soil structure and also that of the depleted nutrients contained in the organic matter (Pimentel 2006:127). Describing the cost implication of soil-nutrient depletion, Stoorvogel et al. (1993), reported by Lal (1997:999), estimated the annual soil fertility depletion rates in 38 sub-Saharan Africa countries as 22 kg of N, 3 kg of P and 15 kg of K / ha. Also in South Asia, annual economic nutrient loss is estimated at $600 million.

Similarly, agricultural productivity impacts on food security in terms of the type of agricultural yields, product quality and income realized. In an earlier study by Faniran and Ojo (1980: 299), it was found that soil erosion often results in the physical losses of the top soil constituents, leading to severe economic loss arising from reduced crop yield or total crop failure. When productivity from the farm becomes reduced or there is total crop failure because of erosion, farmers will be impacted negatively, as well as the entire community.

Ultimately, impact of soil erosion is expressed in the form of food insecurity. According to Pimentel (2006:119-137), soil erosion is known to impact on water runoff, soil water-holding capacity, soil organic matter, nutrients, soil depth, and soil biota. All of these are found to influence soil productivity. Lal (2009:48) posited that apart from the land area affected by accelerated erosion, estimates show that 95 million ha of arable land in Africa have got to such a state of degradation that huge investments are needed to make them productive again.

According to Eswaran, Lal and Reich (2001:n.p), “the productivity of some lands has declined by 50% due to soil erosion and desertification”. It was said that reduction in yield in Africa because of past erosion may range from 2 to 40%, with an average loss of 8.2% for the entire continent. They further indicated that for South Asia, annual productivity loss is estimated at 36 million tons of cereal at an equivalent value of US$5,400 million by water erosion, and US$1,800 million because of wind erosion. On a global scale, the 75 billion tons of soil lost annually costs the world about US$400 billion yearly, or approximately US$70 per person annually (Eswaran et al 2001:n.p). All of this can be interpreted as being indicative of or constituting a position of food insecurity.

2.4. Conclusion

The literature gave various definitions for soil erosion. In a nutshell, erosion could be defined as the gradual detachment of topsoil materials, as well as its transportation by agents such as water, wind and ice. Although authors' views seem to be similar on the term, a major gap that seems to exist is that the last stage of erosion development is not well represented in all the definitions. Erosion goes through three stages of development. That is weathering, transportation and deposition. The first two was explicitly represented, the last stage was not. Hence the study suggested a redefinition of soil erosion that will depict all three stages of erosion processes. Soil erosion was said to be caused by many factors. However, the removal of vegetation especially for agricultural purposes was found to be the most significant factor responsible for soil erosion, which when allowed unchecked ultimately impacts on the food security level of an area.

The concept of food security was found to be flexible. It was said that there is over 200 different definitions for the concept in the literature, which gave credence to its flexibility and complexity. However, the 1996 World Food Summit defines food security as "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". Various measures were found as possible indicators for the understanding of food security of an area. Examples are: food access; food availability; food quality; food quantity; hunger; malnutrition; employment and spendable income.

It was noted that food security at a national level does not automatically indicate food security at a community, household, or individual level. In fact, though South Africa was said to have met its food needs for its growing population from domestic sources in the past 20 years, its main problem is that of household food security. Food security was also linked strongly with poverty. Poverty was suggested as one of the main reasons for food insecurity in South Africa. The case was said to be worse in the Eastern Cape because the poverty level in the area was said to be deepest, poverty gap is widest and the rate of poverty, especially in the predominantly rural areas is over 70%.

The literature also revealed that soil erosion impacts significantly on food security by first impacting on the food productive capacity of an area. When the soil nutrients are washed away because of soil erosion, agricultural potential is hindered, as such food insecurity is the end result.

CHAPTER THREE

INNOVATION ORIENTATION AND ADOPTION BEHAVIOUR OF FARMERS AND ITS IMPACT ON SOIL EROSION DEVELOPMENT

3.0. Introduction

Farmers' decision making process, which relates to their innovation adoption behaviours, is a major factor in the success of any agricultural interventions. According to Bayard, Jolly and Shannon (2006:29) several studies like that of Ervin and Ervin (1982) and Napier (1991), have been carried out to explain farmers' attitudes toward adoption of new innovations. This seems to suggest the relevance of farmers' behaviours in any adoption process. Farmers' behaviours need to be understood in order to propel adoption. As such, this chapter of study focuses on the understanding of the adoption process as a concept, farmers' behaviours with respect to new technologies, the adoption of certain soil management technologies in some developing areas, factors affecting the adoption of soil management technologies in sub-Saharan Africa, the role of agricultural extension in the dissemination of soil improvement technologies, and the impact of the innovation orientation and adoption behaviours of farmers on soil erosion development.

3.1. The adoption process as a concept

The adoption process is a basic knowledge every extension practitioner must ensure if there can be adequate extension success in the rural areas. No matter the quality of any new technology, literature findings reveal that adoption has not always been an easy process as would have been predicted. For example, referring to Sumberg (2002), Shelton, Franzel and Peters (2005:198) reported that fodder legumes have not achieved their potential in sub-Saharan Africa despite 70 years of R & D promoting legumes. The following statement of Feder and Slade (1984), as reported in Isabirye, Isabirye and Akol (2010:25), will further buttress the above assertion. According to them, a decision to adopt a technology is a complex process in which a farmer considers several issues that benefit him/ her against the losses and risks associated with the adoption of such a technology.

According to Bembridge (1991:267), adoption is defined as the act of accepting a new idea or technology. In the same vein, the adoption process is defined as a mental process through which an individual goes through from first hearing about a new idea to its final adoption. Commenting further, Bembridge (1991:182-183) stated that new agricultural practice must pass through several mental stages before they are accepted or adopted. This also is supported by Tiwari et al. (2008:210-212). In their argument, individuals pass through various learning and experimenting stages from when they become aware of a problem and its potential solutions and finally deciding whether to adopt or reject the given technology.

Bembridge (1991:182-183), classified the adoption process into five basic stages: awareness, when individuals get knowledge about the existence of the new idea but have little or no information about it; interest, the individual finds interest in the idea and therefore seeks more information about it; evaluation/ comparison, the individual considers the advantages and disadvantages of using the idea; trial, the individual tries the idea, but on a limited scale, to see how it works in practice and to ascertain whether it works and its profitability on the farm; adoption, is, if the individual is satisfied , the idea is then used on a full scale and incorporated into the farming system for continued use.

In the opinion of Rogers and Shoemaker (1971), the adoption stages are divided into four, which looks exactly like that of Bembridge (1991), except for the omission of trial stage: awareness, interest, evaluation, and adoption. Tiwari et al. (2008:210-212) posited that at each stage of adoption, there are various constraints, such as social, economic, physical, or logistical, for different groups of farmers. In other words, the above factors are the deciding factors which confront the farmers at each stage 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 on, or to discontinue afterwards.

The adoption process indicates the role farmers' decision-making processes play in the success or failure of agricultural development interventions. This is why this study explores the role of farmers' innovation orientation and adoption behaviours in the interrelationship of soil erosion and food security in the Upper and Lower Areas of Didimana (study area)

3.2. Farmers' behaviours with respect to innovation for change

According to the rational choice theory, every action is essentially 'rational' in nature, and that individuals calculate the likely costs and benefits of any action before deciding on them (Scott 2000:1). Speaking also along this line, Barungi and Maonga (2011:30) maintained that the behaviour of human beings, whether farmers or non-farmers, is motivated by the possibility of making gains. They went further to affirm that farmers are rational consumers of new technologies and they will only adopt a technology if and only if they presume it will increase their productivity. This means, if the new technology will result to gains for the farmer, as in this case, increased productivity, that is when they will accept such a technology. In Duvel's term, this kind of behaviour (motivation) of famers is what is called goal-oriented movement (Duvel 1990).

The extension officers' understanding of farmers' behaviours and/ or decision-making process is very vital to their success in technological dissemination. A theory that provides a good explanation of human (farmers') behaviour is that by Abraham Maslow in 1970 (Boeree 2006:n.p). According to Maslow, human behaviours are motivated by the desire to satisfy personal needs. Maslow, however, classified this need into five basic categories: physiological, safety (security), affiliation, esteem and self-actualization needs, respectively. In other words, anything that is considered by farmers as being able to meet their needs motivates them towards adoption.

Lewin (1951), as quoted by Shaw and Constanzo (1970), commenting on human behaviour with respect to adoption, said 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.

Another theory to consider in this discourse is the "cognitive dissonance theory" propounded by Leon Festinger in 1957, as cited by Zimbardo and Ebbesen (1970:67-72). According to this theory, humans cannot withstand psychological inconsistency. 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. These are the reasons farmers either adopt or reject adoption. 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. If the new innovation is perceived of as lower in quality, then there is a rejection of the innovation, or an incomplete adoption, and vice versa.

3.3. Farmers' adoption of soil management technologies in some developing countries

Research has shown that poor areas of the world, which incidentally coincides with developing countries, are also the most degraded. For example, Taddese (2001), cited in Pimentel (2006:123), reported that "soil erosion losses are highest in the agroecosystems of Asia, Africa and South America, averaging 30-40 t/ ha/ yr of soil loss". This also is why the Eastern Cape, where this study is conducted, is arguably regarded as the poorest province in South Africa (Sokupa 2004), as well as one of the three most degraded provinces in South Africa (Department of Environmental Affairs, RSA 2007:n.p). Referring to Africa and Asia, The National Academies Press (2008:145), indicated that the long-term use of extractive farming practices are the reasons for the land degradation problems of sub-Saharan Africa and South Asia.

One peculiar challenge associated with the use of land is soil erosion (Bavard, Jolly and Shannon 2006:28). There is therefore a need to sustainably use the land to reduce the undue degradation or depletion of land resources. One of the potent ways of achieving this, and thus enhance agricultural development and improvement, is through the adoption of improved soil management technologies. Usually, every soil management systems aim at the following common objectives: to increase carbon content in soils, enhance water infiltration, ensure the availability of water at the plant-root zone, reduce soil erosion, create a positive nutrient budget, and encourage beneficial micro organisms in soils (The National Academies Press 2008:146). Speaking further, it was said, that due to the regional differences of the soils, climate and socioeconomic conditions in which they co-exist, approaches to soil management are highly situational. This provides a rationale for the different soil management practices adopted in the following developing countries

In Haiti, for example, early efforts to restrict environmental degradation resulting from soil erosion focused on the adoption of mechanical structures, such as the use of rock walls (Bayard et al. 2006:28). The adoption of rock walls was found to be effective in the control of erosion in Haiti. However this result, the diffusion of rock walls throughout Haiti was limited (Bayard et al. 2006:28). It was further said, that when it was adopted, it was not adequately maintained. This emphasizes the power of adoption behaviours of farmers (Lea 1996, cited in Bayard et al. 2006:28).

In East Africa, in order to improve yield of crops, innovative and indigenous technologies have been applied to the soil (Mati 2006:1). According to Ndakidemi et al. (1999, in Mati 2006:1), these consist a wide variety of interventions, ranging from integrated soil fertility management. Others according to Mati (2006:1) include soil and water conservation, rainwater and runoff harvesting systems, integrated pest management, tillage and soil management systems, improved seeds, and innovative agronomic practices.

Specifically in Kenya, the more common soil technologies are: terracing; vegetative barriers, conservation tillage, runoff harvesting and innovative technologies that trap and retain soil, improve its fertility or facilitate soil-moisture conservation and storage. These take different forms and techniques, according to Thomas (1997) and Critchley et al. (1994), as reported by Mati (2006:9). Similarly in Tanzania, the main interventions have included the tapping of runoff from roads, diversion of surface runoff from rocky areas, footpaths, conservation tillage, pitting systems, bunded basins, ridging, terracing and various types of runoff farming systems (McCall 1994, in Mati (2006:9). In Uganda also in East Africa, due to the application of poor soil management practices, it was stated that there is widespread evidence of land degradation which led to an introduction of a soil management technology called "below-ground biodiversity technologies (BGBD)" (Isabirye, Isabirye and Ako 2010:24)

In southern African region, Ajayi, Akinnifesi, Sileshi and Chakeredza (2007:306) indicated the problem of fertility decline in most part of the region due to two primary factors. One is increase in population, and secondly is the fact that many smallholder farmers continues to cultivate crops without the use of fertilizer or low use as the case may be. The main technology that was found prominent is what is called "renewable soil fertility replenishment (RSFR)" technologies, with particular reference to nitrogen fixing legumes.

In another study in central and southern Malawi, Chirwa and Quinion (2012:59) indicated that farmers in the area used a combination of one or more of the following soil fertility replenishment (SFR) technologies: intercropping, relay cropping, improved fallow, and biomass transfer. It was discovered that the use of agroforestry measures, specifically integrated soil fertility replenishment technologies have the capacity to increase crop production and provide additional income for the farmer.
A further study done by Barungi and Maonga (2011:29) in Malawi, suggested that due to the incidence of soil degradation, especially by soil erosion in Malawi, one of the ways progress has been made in curbing the problem is through the use of government policies, like the land resources conservation policy of the mid-1990s. Through this effort, there was a massive campaign by the government which has led to farmers' adoption of various soil management practices in the area. Examples of such are: planting vetiver grass (*Vetiveria zizanioides/Vetiveria nigritana*) and/ or elephant grass, constructing contour bunds, contour and box ridges, making ridges, terraces, and adding manure into the soil.

The need for a sustainable use of the soil cannot be overemphasized. Commenting on the potentials of adequate soil management practices, which are the only way soils can be preserved, Lal (2009) indicated 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) opined 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. These all imply the all-important role of sustainability in soil conservation and/ or management.

3.4. Factors responsible for soil technologies adoption in Sub-Saharan Africa

According to Barungi and Maonga (2011:30), although technology profit is necessary prerequisite for technology adoption, there are however several other factors that influence adoption (of soil technologies). Examples are socioeconomic, technological and land related factors. In this section, factors responsible for the adoption of soil management technologies in certain sub-Saharan African countries will be considered.

A first country to consider is Uganda in East Africa. Due to the application of poor soil management practices, it was stated that there is widespread evidence of land degradation which led to the introduction of soil management technology called “below-ground biodiversity technologies (BGBD)” (Isabirye, Isabirye and Ako 2010:24). Factors which were found responsible for farmers adoption of the innovation according to Isabirye et al. (2010) are farm size, labour, household size, age and wealth status of the house, farm location, gender of household head, primary occupation, soil and water conservation technologies training, land tenure, and social capital.

A study done by Kalineza, Mdoe and Mlozi (1999:76) in a town called Gairo in Tanzania in East Africa also show that factors responsible why farmers adopted soil conservation practices are technology related factors such as labour requirement and perceived technology benefits. As it was stated, farmers who obtained knowledge on soil conservation through extension/ training seminars, as well as farmers with secure land ownership will likely adopt soil conservation technologies.

In a study done by Ajayi, Akinnifesi, Sileshi and Chakeredza (2007:306) in southern African region on the rate of adoption of renewable soil fertility replenishment (RSFR) technologies, with particular reference to nitrogen fixing legumes, certain factors were found responsible for farmers adoption of the RSFR technology. These are grouped into the following: technology-specific (e.g. soil type, management regime), household-specific (e.g. farmer perceptions, resource endowment, household size), policy and institutions context within which RSFR is transferred (inputs and output prices, land tenure and property rights), and geo-spatial (performance of species across different bio-physical conditions, location of village).

Diederen, van Meijl and Wolters (2002:3), in their study on “modernization in agriculture: what makes a farmer adopt an innovation?” citing Stoneman (1983), said that two major classes of models have been put forward to describe adoption behaviour. One of them is the population models of diffusion, which describes innovation as driven by internal process information propagation. In the same vein, the second model is the decision theoretic models, of which the probit model is most prominent. According to the probit model of adoption the assumption is that decision of farmers to adopt or not to adopt an innovation at any specific moment in time is the outcome of profit maximizing behaviour.

3.5. The role of agricultural extension in soil improvement innovation dissemination

The role of agricultural extension in technological advancement and overall agricultural development cannot be overemphasized. In the words of Bembridge (1991:18), “agricultural extension can be seen as an educational task consisting of communicating to farmers and helping farmers to adapt their farming methods to take full advantage of proven and acceptable technology”. This therefore stipulates that effective and efficient extension is a key element required to overcome food insecurity and obtain substantial agricultural progress. According to Onweremadu and Matthews-Njoku (2007:39) the agricultural extension officer’s efficacy is judged by the magnitude of mass adoption and spread of modern scientific technologies among farmers in the rural areas.

Bembridge (1991:25-26), in his study, classified agricultural extension functions in farming communities into the following:

1. As change agents. In this regard, agric extension assists farmers in developing and adopting an attitude conducive to the acceptance of technological change.

2. As a middle man. In this also, agricultural extension disseminates to farmers results of research and as well as transfer farmers’ problems back to such research organizations.

3. Capacity building. In this function, agricultural extension assists farmers gain managerial skills to operate in a commercial economy through the provision of training and guidance in problem-solving and decision-making.

4. Protection of environmental resources. In this function, agricultural extension plays the role of promoting among farmers the conservation and best use practice of natural resources, especially soil, vegetation and water, and to inculcate a conservation consciousness among farmers.

Christoplos (2010) definition of extension is all-encompassing. It is defined as systems that should facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agri-business, and other management skills and practices. According to this definition, extension is seen as a system which works together among farmers. In fact, Christoplos (2010) further indicated that the role of extension has widened to include varieties of issues that extend beyond agriculture in rural areas. Such issues include:

dissemination of information about technologies, new research, markets, input and financial services, and climate and weather: training and advice for individual farmers, groups of farmers, farmer organizations, cooperatives and other agribusiness along the market chain; testing and practical adaptation of new technologies and practices on-farm; development of business management skills among smallholder farmers and other local entrepreneurs; facilitation of linkages among market actors (including financial and non-financial inputs, processing and trading) including brokering collaboration and promoting social learning among them; linking smallholder farmers, rural entrepreneurs, and other members of the agricultural community with institutions offering training and education in fields relevant to the agricultural sector.

The above descriptions reveal extension roles in agricultural development, especially in rural areas. One obvious issue here is that extension messages have broadened greatly, to include such information such as climate change. Hence, extension practitioners must be well informed on farmers' contributory roles to climate change, and what they can do to resolve the problem.

3.6. Impact of innovation orientation and adoption on soil erosion development

The adoption behaviour of farmers is one of the most important factors influencing the spread or dissemination of innovations in agriculture (Toborn 2011:3-4). Duvel (1991:73) argues that agricultural problems are often the result of none or poor adoption of improved or more appropriate agricultural technology for change. Careful consideration of the adoption behaviour of farmers is therefore an important aspect of assessing and interpreting the dissemination of innovations – in this case the use of improved soil management technology to sustain food security.

New soil management technologies are continuously been developed to combat or eradicate soil erosion. It is, however, still an important question whether soil erosion is perceived by farmers as a threat to the food security position of rural households. Paudel and Thapa (2004), as reported in Tiwari et al. (2008:210) commenting on a similar issue in the mountains of Nepal, indicated that 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. This idea seems to be the view of Giller, Witter, Corbeels and Tittonell (2009:24), citing Tittonell et al. (2008), that in Sub-Saharan Africa, we often see that options for soil management that show great potential gain little foothold in real practice. The finding of Ajayi et al. (2007:307) study in Southern Africa, citing Ajayi and Kwesiga (2003), is a further support to the above assertion. It was stated, that despite the potential of renewable soil fertility replenishment (RSFR) technologies in Southern Africa, the adoption and spread among smallholder farmers in the region has generally lagged behind scientific and technological advances thereby reducing their impact.

Garcia (2001), as cited by Tiwari et al. (2008:212), also postulates that farmers' adoption of improved soil conservation technology (ISCT) is influenced by interactive effects of household socio economic characteristics, resource availability, physical characteristics of the land and institutional support provided by the public or NGO sector.

It is expected that farmers will, in the adoption decision making process compare the advantages and appropriateness of different soil conservation technologies, based on the available resources at their disposal and their opportunity for profit (Tiwari et al. 2008:212). In this assertion, the factors of available capital and potential profit/ gain to the farmer are basic variables determining levels of adoption. Commenting on the subject, Ervin and Ervin (1982) stated that adoption behaviour is difficult and often requires a blend of income, profit, and institutional support. Arguing on factors which make innovations spread or the adoption process, Robinson (2009:1) commented that, in terms of innovation spread, it is not individuals who change, but the innovations themselves. According to him, the adoption process theory is unlike most other theories of change; instead of focusing on persuading individuals to change, it sees change as being mainly about the evolution or 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:n.p). It was suggested 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. Other factors in the adoption process, according to King and Rollins are information sources used in the educational process (citing Sulaiman, Baggett and Yoder 1993) and supply and demand considerations, which explain expected profits from an innovation (also citing Mansfield 1979).

Appropriate adoption plays a pivotal role in any developmental process. For example, Dethier and Effenberger (2011:13-14) maintained that in Asia, agricultural yields increased at an average rate of 2.8% between 1961 and 2004, an outcome largely explained by the adoption of high-yielding varieties and the intensive use of fertilizer. This is to reinforce the appropriate innovation adoption behaviour of farmers.

The importance of appropriate innovation adoption behaviour was also emphasized by Barham et al. (1995), explaining that continuous research is undertaken on the adoption behaviour of small farmers. Indications are that new technologies play a significant role in raising the income of smallholder farmers.

In the opinion of De Franco and Godoy (1993), as reported in Godoy, Franks and Claudio (1998:n.p), appropriate adoption behaviour does not only benefit farmers but it also produces substantial equitable benefits to the community at large. This implies therefore that appropriate adoption behaviour, or rejection or even inappropriate adoption for that matter, not only influences the situation of farmers but also that of the community.

Conversely, the impact of adoption behaviour of individuals/ farmers is also very significant. For instance, Brown and Shrestha (2000:221) argued that the continuous use of crop intensification without due conservation measures, as found in conventional cultivation methods, accelerates soil erosion and nutrient depletion.

Research suggests that the main human activity contributing to the occurrence of soil erosion the world over is agriculture (Pimentel 2006:122-123). The truth is, no matter the amount of soil management practices operated on the land, there is bound to be some level of degradation caused to the soil after every use of land by humans, as in agricultural production. If this is the case, how much more is expected when poor practices is utilized. Out of the world's cropland and grazing land, cropland has been rated as the most susceptible to erosion (Pimentel 2006:123). Two reasons were suggested for this, namely frequent cultivation and deforestation before cultivation of crops. In fact, Myers (1993), cited by Pimentel (2006:123) estimated that erosion on agricultural land is about 75 times greater than on natural forest environment.

Lal (1994), cited by Pimentel (2006:123), suggests that about 2 billion ha of arable land has been abandoned since farming began. This according to him is almost equal in area to the nearly 1.5 billion ha now under cultivation. It seems as if there are no recent studies quantifying the present amount of arable land that erosion has seized from production.

The adoption of conservation technology is generally considered as a means to an end. In this sense inappropriate adoption also often creates problems. In this sense Sombatpanit et al. (1996), cited by Tiwari et al (2008:211-212), suggests that the adoption of conservation innovations should not be regarded as an end in itself, but rather as a continuous decision-making process. A complicating factor in this regard is the difficulty experienced in the introduction of technological/ technical innovations for erosion control. This is mainly due to the often perceived incompatibility of such innovations with farmers' current agricultural practices, scales of operations, income levels (Anderson and Thampallai, 1990).

3.7. Conclusion

This section provided an exhaustive analysis of authors' views on the adoption behaviour of farmers and its impact on soil erosion development. According to findings, the adoption process is a mental process through which an individual goes through from first hearing about a new idea to its final acceptance and adaptation. The adoption process of farmers is very important because it tells if farmers will accept or reject agricultural innovations for change. The literature also reveal that various improved agricultural technologies abounds, but the problem is that farmers' none or inappropriate adoption of such innovations are the reasons for most agricultural problems like soil erosion. Hence, great responsibility rest with the extension agents to be able to make the messages of improved technologies appealing to farmers. This is necessary because agricultural messages that will easily attract farmers' interest must be seen as being able to meet their needs, agree with their perceptions, as well as their residual knowledge, otherwise they either reject the idea out rightly or adopt it inappropriately. This is the reason for the persistence of agricultural problems.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.0. Introduction

Brynard and Hanekom (2006:35) describe “Research methodology as the ‘how’ of collecting data, and the processing thereof within the framework of the research process”. In other words, it is the method of data collection, and the way the data is analysed and interpreted to improve knowledge about and contribute to solving the problem that initiated the research. Having dealt with basic concepts related to soil erosion, food security measures, innovation adoption processes and their corresponding linkages in chapters two and three, this chapter focuses on the various processes and methods associated with the execution of the data collection and processing methodology in order to complete the research process. In order to purposefully engage in such methodology, an understanding of the study area, the various sources of data and data collection methods, population and sample size, sampling technique, data analysis, presentation and interpretation, as well as a model for testing relationship among certain variables is essential.

4.1. The study area

The Upper and Lower Didimana Areas consist of Upper Didimana, Lower Didimana and Romanslaagte villages respectively. All the areas are located in Ward three of the Tsowana Local Municipality in the Chris Hani District Municipality of the Eastern Cape of South Africa. They are between one to three kilometres apart. In the light of this study, they will henceforth be called the “study area”. The study area is located on latitude $32^{0}06^{/}00^{//}$S and longitude $26^{0}34^{/}59^{//}$E respectively.

Information on the study area is presented in this section as reported in the Chris Hani District Municipality Integrated Development Plan (IDP) Review (2011-2012) and the Tsolwana Local Municipality Integrated Development Plan (IDP) Review (2010/ 2011).

4.1.1. Socio-economic characteristics

Socio-economic characteristics relate to social and economic factors of the study area such as poverty, household income distribution, and unemployment.

4.1.1.1. Poverty

According to the Chris Hani District Municipality IDP Review (2011-2012:20-25), the following is said of the poverty status of the study area. It is estimated that 56.6% of people in the area live in poverty. It was also indicated that the area has a very high level of malnutrition and hunger index: chronic malnutrition is said to be 1.16, children underweight is

16.0, while acute malnutrition is 0.04 respectively. In addition, it is maintained that the study area has the second highest concentration of hungry people when compared with other parts of the Chris Hani District Municipality. Due to the problem of acute concentrations of hunger, poor households are said to be compelled to spend the greatest percentage of their income on food.

In terms of household income distribution, the Tsolwana Local Municipality IDP Review (2010/11:37) suggested that approximately 23% of households in the study area earn a gross income of no more than R1500 monthly, while another 16% earn between R1500 and R2500 monthly. As reported, the implication of this is that almost 40% of households could be regarded as poor in the study area.

4.1.1.2. Unemployment

With respect to unemployment level of the study area, the Chris Hani District Municipality IDP Review (2011-2012:24) has the following to say. Firstly, it says that unemployment is a major problem in the area, with current unemployment levels of about 57%, which is significantly higher than both the national level of 37% and the provincial level of 51% respectively. Secondly, it states that the majority of people in the study area (of about 51%) are employed in the community services sector, with trade sector the second largest employer of labour in the area. More so it is stated that due to the high rate of unemployment in the study area, there is a high rate of dependence on grants and remittances as main sources of household incomes, especially in the poorer areas.

4.1.1.3. Agriculture/ land use

In terms of agricultural production in the study area, the Chris Hani District Municipality IDP Review (2011-2012:34) indicated that livestock farming is an important source of income for people in the study area. However, it was said that the greatest challenge of improving the industry remains that of low skills, access to land, poor veldt and livestock management, limited access to market and limited access to finance and credit by emerging farmers due, in part, to insecure land tenure. Other challenges are limited mentoring and information from the Department of Agriculture and dilapidated and insufficient infrastructure such as roads, fencing, stock dams and dipping tanks. In the area, dry land cropping is said to be feasible in very small parts. Crops grown in the area are maize and beans, and its winter crop is wheat (The data of Reclamation and Settlement of Lower Didimana Location, No 4, District of Whittlesea 1966).

According to the view of Statistics South Africa (2002), the main land use of the area is sheep farming, even though there are other animal production systems also being practiced.

4.1.2. Geomorphology of study area

Basic aspects to consider under this section are the topography and relief, as well as the geology and soils of the study area.

According to the Tsolwana Local Municipality IDP Review (2010/ 11:43-45) , the study area is made up of rolling and undulating hilly to very steep areas within the valleys. The altitude varies from 1280.2 to 1463.0 meters (The data of Reclamation and Settlement of Lower Didimana Location, No 4, District of Whittlesea 1966)

In terms of geology and soils of the area, the Tsolwana Local Municipality IDP Review indicated that the area consists mostly of Beaufort sediments intruded by dolerite. These are said to comprise of shale, mudstone and sandstone. More so, the soils are said to be mainly derived from the Beaufort and Molteno series of the Karoo sequence, and that the soils are poorly developed, shallow or rocky, which are not suitable for crop production. The red shale is particularly susceptible to donga and sheet erosion, and the data of Reclamation and Settlement of Lower Didimana Location, No 4, District of Whittlesea (1966) stated that erosion has played havoc in some of the areas.

4.1.3. Climate and vegetation

According to Agricultural Development Programme for the Eastern Cape (1986), as cited by the Tsolwana Local Municipality IDP Review (2010/ 11:43), the climate of study area varies from arid to very cold high veldt and falls mainly into two climatic zones, which are the arid and semi-arid moderate midlands, and arid and semi-arid cold high lying land.

4.1.3.1. Rainfall

In terms of rainfall of the study area, the Tsolwana Local Municipality IDP Review (2010/ 11:43) maintained that the mean annual precipitation is between 301 millimetres and 600 millimetres. Rainfall distribution is said to be poor and dry spells occur frequently. This is a summer rainfall area with 70% to 80% of precipitation during the summer months and 20% to 30% during the winter months. Since rainfall in the study area falls within the summer rainfall area, most of the rains fall between October and April annually (The data of Reclamation and Settlement of Lower Didimana Location, No 4, District of Whittlesea 1966).

4.1.3.2. Temperatures

In terms of temperature, the Tsolwana Local Municipality IDP Review (2010/ 11:44) also said that temperatures are coolest in the northern sections of the area, and becoming warmer to the south and eastern part. Maximum temperature in some areas ranges from 19.3^0 C to 25.3^0 C while average minimum ranges from 4.1^0 C to 10.2^0 C. More so, overall the area has an average maximum temperature of 22.3^{0} C and an average minimum of up to 8.9^{0} C respectively.

4.1.3.3. Prevailing winds

Speaking in terms of prevailing winds, the Tsolwana Local Municipality IDP Review (2010/ 11:44) stated that during the summer months, prevalent wind direction in the area is north – westerly (berg winds), whereas south – easterly to south – westerly winds prevail during the winter months.

4.1.3.4. Evaporation

Evaporation in the study area is said to be approximately 2,146mm per annum, which actually is higher than its average yearly rainfall (Tsolwana Local Municipality IDP Review 2010/ 11:44).

4.1.3.5. Vegetation

Also, citing the Chris Hani state of the Environment report (2004), the Tsolwana Local Municipality IDP Review (2010/ 11:44) stated that the vegetation type of the study area comprises of the South – Eastern Mountain Grassland, the Sub-arid Thorn Bushveld, Eastern Mixed Nama Karoo and Moist Upland.

4.1.4. Soil erosion status of the area

According to the Tsolwana Local Municipality IDP Review (2010/ 11:46) the study area is said to have some of the most erodible soils in the entire region of Chris Hani District Municipality.

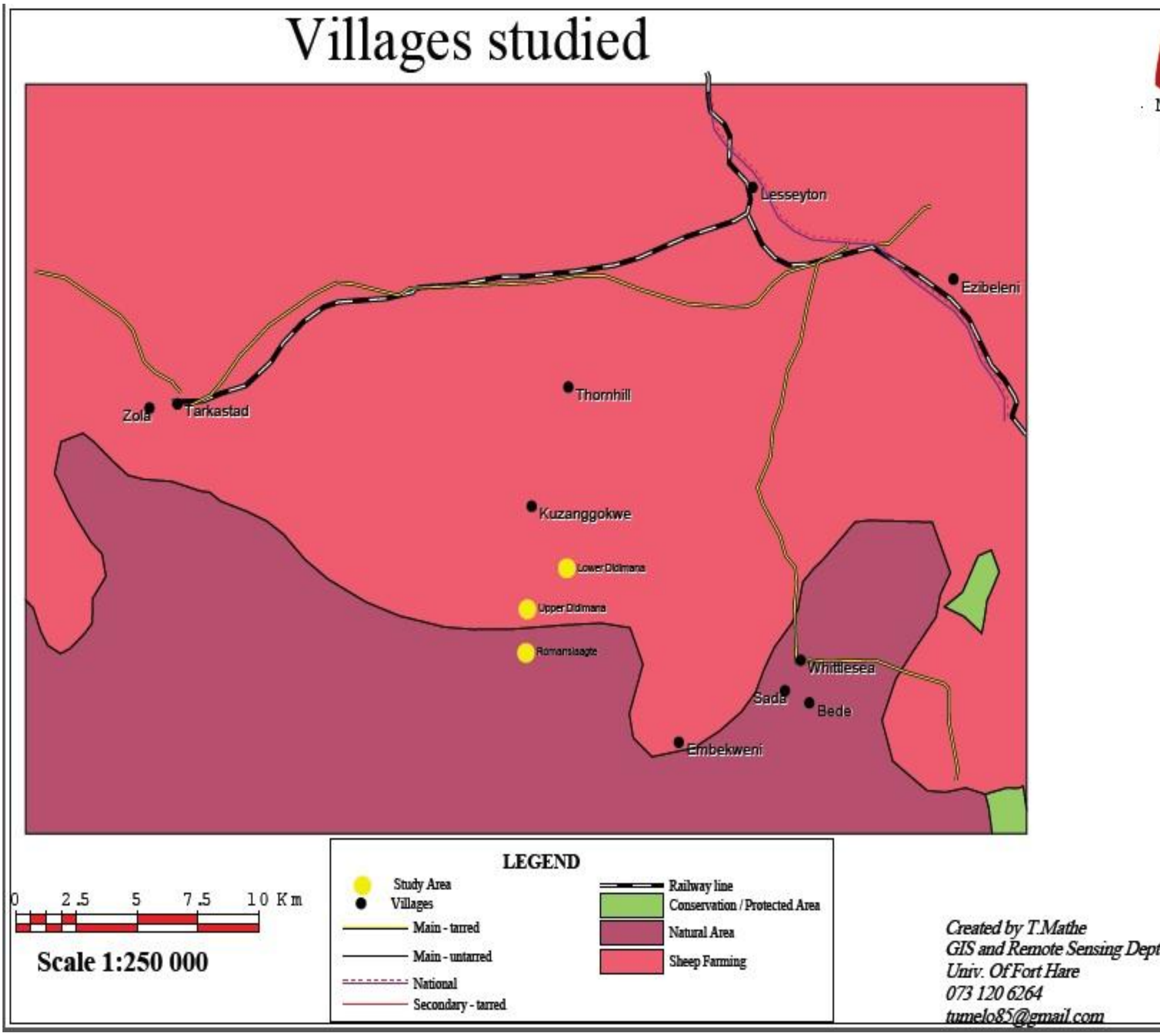

Figure 4. 1: A map of study area

4.2. Information needs and data collection

According to the conceptual framework of this study (the Duvel 1991 model, Duvel 1991:77), the independent variables which are more of demographic characteristics of farmers are linked up with dependent variables (i.e. farmers practices and results of their practices) by mediating variables which constitute more of farmers' perceptions, according to the line of thought of this study, even though farmers' needs and knowledge also play a part (figure 4.2). Based on this, the data organization and collection was outlined in this order, focusing first on demographic variables of farmers, then farmers' perceptions on soil erosion, their innovation adoption behaviours, as well as the results of behaviour which relate to levels of food security in the area.

The role of accurate and suitable data collection cannot be overemphasized in any research endeavour like this. According to Durosaro (n.d:3), accurate data collection is stated as one of the three factors necessary for the success of any educational system. It was also stated that poor data collection, analysis and storage could result to recording of fiction instead of facts, which could distort sound decision- making.

With regards to this study, basic information needs centre around demographic characters like gender, age, marital status, highest education, farm size, farming system and composition, sources of income and number of years involved in farming. For the mediating variables, information on farmers' perception on soil erosion and its activities are sought. On farmers' practices and behaviours, information such as farmers' innovation orientation and adoption are required, while on results of farmers' behaviours, information relating to farm yield, product quality, sustainability, profitability, accessibility and availability of food are required.

4.2.1. Sources of data

Based on the foregoing, data for this study were carefully selected to meet up with the desired objectives. As in every research endeavour, two main sources of data are available: primary and secondary data sources or both as the case may be. In this study, the primary and secondary means of data collection were harmoniously utilized. Durosaro (n.d:1) defined 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) commented that the actual research study begins with data collection, 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. The primary data source includes field observation, interviews and questionnaire administration. The secondary data sources include published and unpublished works, such as books, journals, articles, seminar papers, photographs, past projects, lecture notes.

4.3. Method of data collection

The following are the various ways in which the above two methods of data collection are utilized in this research.

4.3.1. Primary data sources

According to California State University (2012:n.p), "Primary data sources are the first hand evidence left behind by participants or observers at the time of events". Examples offered are: autobiographies, memoirs, diaries, emails, oral histories, letters, correspondences, eyewitnesses accounts, first-hand newspaper and magazine accounts of events, legal cases, 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 main importance of primary data source is that it provides first-hand testimony concerning a subject under investigation (California State University 2012:n.p).

In the light of this study, primary data sources are information gathered from farmers in the study area through the use of questionnaires. Other primary data from the study area were through a personal observation of soil erosion activities in the area, as well as photographs of specific sites of erosion. The following processes were the various ways primary data were gathered from the study area.

- A reconnaissance survey of Upper and Lower Didimana areas was done on the 5th of April, 2011. In this survey the researcher ensured an observation of the study area, taking note of damages on soil by erosion and the locations of the study villages with respect to sites of erosion. This was needed to have a firsthand knowledge of the study area and an understanding of erosion activities in the area. Also this was needed to have a rough mental map of the area with respect to the operation of soil erosion as a problem in the area.

- Following this first contact, with the help of the extension department in the study area, appropriate and formal interview appointments were fixed with the farmers to collect the relevant data. As part of data collection processes, photographs of specific soil erosion sites were also taken (appendix 2). These photographs serve to support the objectives, research process and findings of the study.

- Farmers in the study area were interviewed with the aid of structured questionnaires. These questionnaires were structured to extract information on various issues about the erosion development, how this has impacted on the food security measures/ capacity of the study area, and the role farmers' innovation adoption behaviours have played in the interaction.

4.3.2 Secondary data sources

Secondary data sources are materials or resources that digest, analyze, evaluate and interpret information from primary sources or other secondary sources (California State University 2012:n.p). In other words, they are information obtained from sources/ persons that are not direct observers or participants of the events under study. Some examples 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:n.p).

With respect to this study, secondary data were obtained from various sources, namely published works such as Duvel (1991) study, Le Roux, Newby and Sumner (2007), and unpublished literature such as Ighodaro (2007) and (2010) dissertations, Ighodaro and Lategan (2012) study, books on the subject, such as contemporary issues in environmental studies by Jimoh and Ifabiyi (2000). The map of the study area (Upper and Lower Didimana) was also obtained from the GIS department, University of Fort Hare, Alice, to be able to identify and define the study area accurately.

4.4. Interviewing procedure

Data collection dates were fixed with the farmers in the study area. The different dates were 1st, 12th and 26th of June, 2012 respectively. One-on-one interviews with the farmers were conducted in the study area for the data collection process. In this process, the researcher employed and trained five survey assistants, who understand and speak the local vernacular sufficient to convey the questions and accurately record the responses of respondents. Preparatory training meetings were held on the different questions in the questionnaires and to describe the objectives and the intentions of the survey.

Enumerators were trained to employ specific protocol to establish rapport and encourage respondents to cooperate and give honest and unbiased answers (Mukarumbwa 2009:31).

One of the main challenges encountered in the course of data collection of this sort is farmers' conservatism and reluctance to discuss matters. This is why survey assistants, who speak the same local dialect of respondents, were employed. This process, apart from helping to overcome the aforementioned problem, also does help to ensure consistency and reliability in the data collection exercise.

4.5. Selection of variables of analysis

Due to the particular relevance of the Duvel (1991:77) model, an adaptation of its concept and its application for study questionnaire design and possible variables of analysis was developed and is presented in this section.

Suitable dependent and independent variables were identified and their role and impact through the influences of mediating variables on the perceived food security position of respondents were the topic of this investigation.

It is generally accepted that agricultural problems are the results of no or inappropriate application of improved agricultural production technologies. In other words, adoption behaviours of farmers could be regarded as major cause of agricultural problems like soil erosion. A new technology can be rejected at any stage of adoption, even though it is more when the five stages of adoption (Rogers 2003, cited by Sahin 2006:15-17) are not complete. Similarly, when the knowledge of use of a new technology is not adequate, inappropriate adoption can occur, according to Duvel (1991:70-86). With regards to this study, these are the basic reasons for agricultural problems.

Table 4.1 is a schematic illustration of the different interrelationships influencing the agricultural development process according to this study. Important interactions between the human and environmental factors as reflected in the adopted agricultural production practices provide the basis from where the role of perception, knowledge, aspirations and needs may be assessed.

Although there are several human or anthropogenic factors responsible for soil erosion, the main human factor focused on here relates to farmers’ adoption behaviours and decision making processes, which is assumed as the main reason for agricultural problems like soil erosion.

As focus for this study, the perceived impact of the outcomes of applied cultivation practices on the productivity of soil and its associated impact on food security will provide the area of analysis. Variables and interview strategy were therefore deployed to gain understanding of the perceived impact of this set of interrelationships on farmers’ food security position.

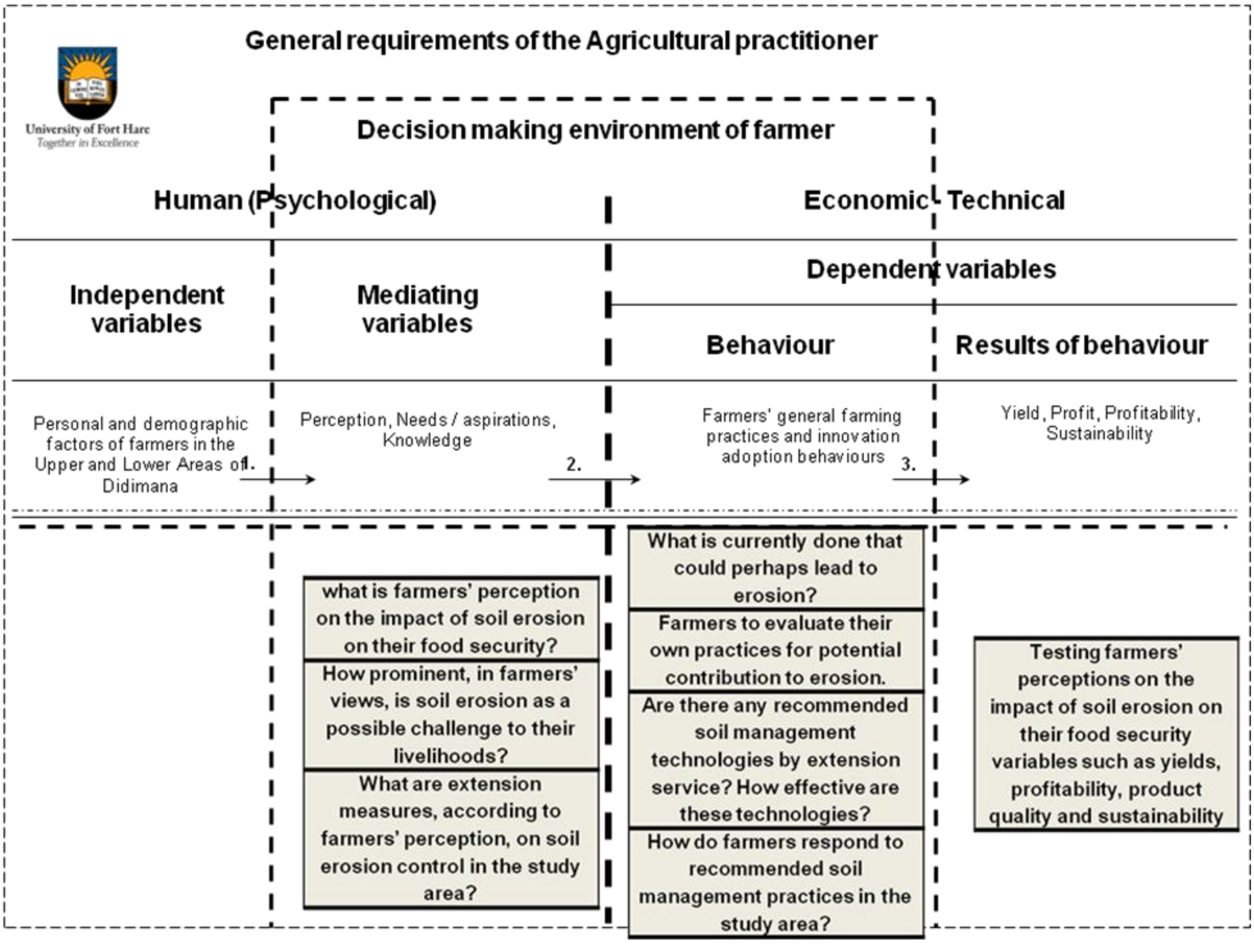

Figure 4. 2: An adapted Duvel (1991:77) model for the study of impact of soil erosion on food security in the Upper and Lower Areas of Didimana

4.5.1 The independent variables

Sequel to the model adoption of this study, the personal and demographic characteristics of farmers is the independent variables. Examples are age, gender and education of farmers. These determine the needs, perception and knowledge (mediating variables) of farmers, which are the direct precursor of whatever adoption behaviour they demonstrate, which ultimately lead to farming problems or otherwise farming efficiency.

Taking gender for an example, sexes of individuals most times determine the type of behaviour they portray. In fact, Espinosa and Garett (1987:101-117) argued that gender as a basic character of farmers is a very important element to consider in the development and spread of agricultural innovations. This was why Bembridge (1991: 207) maintained that an understanding of a character like gender helps to understand why men and women behave differently, and why women take certain decisions different from their male counterpart in relation to farming in rural environments.

Probing into specific indirect causes of farmers' behaviours in the study area, the following variables were the focus of interest: age, gender, marital status, educational status, farming system, farming composition and production levels, farm size, sources of income, and farming experience (age).

4.5.2. The mediating variables

In trying to assess the influence of specific relationships responsible for erosion development and their potential influences on food security, three research questions were put forward in this study, namely:

- What is the perceived role of innovation orientation and adoption of farmers with respect to soil erosion development in the Upper and Lower Areas of Didimana, Eastern Cape of South Africa?

Emphasis here is in finding out from farmers' views what soil management technologies are available in the study area, and farmers' behaviours toward their use.

- What is farmers' perception on the impact of soil erosion on their food security?

Also, emphasis of study here is finding out farmers' perception of soil erosion as a problem in their area, and how this is impacting on their level of food production.

- What are extension measures on soil erosion control in the study area?

Similarly, this area views farmers' perception on basic recommendations by extension officers on mitigating measures of soil erosion in their area.

4.5.3. Behavioural variables

In this aspect, the influence of farmers' production behaviour on soil erosion development was conceptualized through the following:

- What is currently being done that could perhaps lead to soil erosion? An open-ended question was provided for farmers.

- Farmers' evaluation of their own practices for potential contribution to erosion. An open-ended question was also provided for respondents.

- Are there any recommended soil management technologies by agricultural extension service in the area, and how effective are they? Emphasis was on finding out any soil management practices, traditional or recommended. Effectiveness was assessed with the aid of a Likert scale.

- What is farmers' response to recommended soil management practices in their area? Farmers' use of extension advices and recommended practices were the focus in this section, and it was tested with the aid of a Likert scale.

4.5.4. Results of behaviour or effects variables

In assessing the perceived level of food security, the focus was on testing farmers' views on the potential impact of soil erosion on their food security measures, such as, farm yield, quality of produce, sustainability, profitability, accessibility and food availability.

- **Farm yield:** According to Sheaffer and Moncada (2012: 207), "yield is a complex quantitative trait that has been improved by selection for disease and insect resistance, competitiveness, and drought resistance". Yield in this study is measured in terms of quantity of produce.

- **Product quality:** product quality is defined as the ability of a product to fulfil the customer's needs and expectations (United Nations Industrial Development Organization 2006:1). The defining parameters for food was said to include the taste of the food, nutritional properties, texture, shelf life and so on.

- **Sustainability:** Sustainability is from the word "sustain". According to the Oxford Dictionary of Contemporary English (2003), sustain means to maintain or to cause something to continue to exist. In other word, sustainability will therefore refer to the ability for the farmer to continue farming for a long time unhindered. This can be determined in terms of length of time for the farmer to continue farming without any decrease in yield or profit. Examples of indicators for agricultural sustainability according to Woodhouse, Howlett and Rigby (2000:21), citing Gomez et al (1996), are yield, profit, frequency of crop failure, soil depth, organic carbon and permanent ground cover.

- **Profitability:** According to Johnson, Lessley and Hanson (1998:1), even though profit and profitability are sometimes used interchangeably, they are however somewhat different. They said, in the discussion of profitability, a consideration should be made of the relationship of net farm profit to issues of farmland, labour and management skills invested in the farm business. Elaborating on the differences of the two terms: profit and profitability, Anonymous (n.d: 237) emphasized that profit is an absolute concept, whereas profitability is relative; profit is the total income earned by an enterprise within a certain period, while profitability refers to the operating efficiency of the enterprise. It was further said that profitability is the ability of the enterprise to make profit on sales; it is also the ability of the enterprise to get sufficient return on the capital and employees used in the business operation (Anonymous n.d:237).

- **Food accessibility:** Food access is defined as a situation where a person has sufficient resources to obtain appropriate foods for a nutritious diet (World Health Organization 2012:n.p). Accessibility is determined by factors such as income, employment, purchasing power, private transfers, transportation and market infrastructures, and socio-cultural contexts (Kinabo 2008:5).

- **Food availability:** World Health Organization (2012:n.p) speaks of food availability as sufficient amount of food on a consistent basis. Food availability can be determined by continuous supply of food, input and output market condition, as well as production capabilities of the agricultural sector (Department of Agriculture, Republic of South Africa 2002:16)

4.6. Sampling technique

It is not always feasible to study an entire population, except where the population is small. This is why sampling is important. It provides a means of gaining information about the character of a population without the need to examine the population in its entirety (National Audit Office, Statistical and Technical Team 1992:4). There are several reasons for sampling. One of them is that with samples, one can be able to draw inferences across an entire population, and secondly, it assist in drawing illustrative examples of certain kinds of behaviour (National Audit Office, Statistical and Technical Team 1992:4).

In consonant with this study, certain potential pitfalls in sampling are kept in view. Three of such pitfalls are posited by the National Audit Office, Statistical and Technical Team (1992:4). One of them is that, although sampling is capable of providing a valid, defensible methodology, however it is important to match the type of sample needed with the type of analysis required. Another caution is that the user must take care to check the quality of the information from which the sample is to be drawn. Finally, the user of samples must know that if the quality of the sample in question is poor, sampling may not be justified.

The sampling technique chosen for the execution of this study was the simple random sampling method. The simple random sampling is a process whereby elements of a population are chosen from the population with every individual having an equal chance of being chosen. Through the extension officers in the study area, the researcher was able to obtain a list of farmers in the area.

Table 4. 1: A conceptual framework suitable for the information needs of assessing the perceived impact of soil erosion on food security

How does soil erosion influence or change the production environment of farmers in the study area? (Dependent variables)							
	Decision making environment of farmers	**Yield**	**Product quality**	**Sustainability**	**Profitability**	**Access**	**Availability**
Independent variables	1. Innovation orientation and adoption of farmers in study area	What method of planting do farmers engage? Is there any recommended soil technologies in the area? How do farmers relate with them? How does innovation orientation of farmers affect their produce?	How does innovation orientation of farmers affect the quality of their produce?	How does innovation orientation of farmers affect the sustainability of farmers in study area?	How does innovation orientation of farmers affect the profitability of farmers in study area?	How does innovation orientation of farmers affect food accessibility in study area?	How does innovation orientation of farmers affect availability of food in study area?
	2. Perceived impact of soil erosion	How does soil erosion impact on the farmers' yield?	How does soil erosion impact on the quality of produce of farmers?	How does soil erosion impact on sustainability of farmer?	How does soil erosion impact on profitability of the farmer?	How does soil erosion impact on food accessibility in study area?	How does soil erosion impact on food availability in study area?
	3. The perceived influence of agricultural extension in study area?	How does perceived extension effectiveness affect farmers' produce in study area?	How does perceived extension effectiveness affect quality of produce in the study area?	How does perceived extension effectiveness affect sustainability of farming in study area?	How does perceived extension effectiveness affect profitability of farmers in study area?	How does perceived extension effectiveness affect food accessibility in study area?	How does perceived extension effectiveness affect food availability in study area?

4.7. Data analysis and interpretation

Data analysis of this study was done with the aid of SPSS statistical package, and the interpretation and presentation was with the use of basic descriptive and inferential statistical measures such as frequencies, percentages, means, bar and pie charts, as well as the "Multiple Linear Regression" model.

According to Annor-Frempong and Duvel (2009:62), 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 Duvel 2009:62-63).

4.7.1 The multiple regression modelling

According to Jain (2008:3), the following are definition of terms relating to the simple linear regression model:

1. Regression model predicts an answer for a given set of predictor variable.
2. Response variable is regarded as the estimated variable.
3. Predictor variables are called predictors or factors. They are used to predict the response.
4. Linear regression models are models used when the response is a linear function of predictors.
5. Simple linear regression models is used when there is only one predictor variable.

According to Gujarati (1992), cited by Melusi (2012:56), multiple regression modelling is defined as a statistical technique that allows the user the opportunity to be able to predict the result of a dependent variable based on the scores of several other variables which are called the independent variables. The multiple regression models usually take the form of:

$y=\alpha + \beta X + \varepsilon$ .... (1)

Where y= the perceived food security of farmers in study area after soil erosion impact.

X= Exogenous input data of food security (independent variables) α (intercept of y) and β (partial regression coefficient)= Parameters to be estimated

Ɛ = the stochastic error term

In relation to this study, the regression model for the perceived food security of the study area will rather be modelled as:

Z= A + BX + Ɛ .... (2)

According to table 4.1, four main variables are compared, in relation to the study objectives: perceived food security (Z), perceived soil erosion (M), the perceived innovation orientation and adoption of farmers (N), and extension effectiveness (H). Therefore, the regression model will be computed as follows.

4.7.1.1. Perceived food security regression modelling

Perceived food security (Z) is measured in this study by farm yield (Y), product quality (PQ), sustainability (S), profitability (P), accessibility (A) and availability (Av). This means that there has to be a regression calculation for all the food security variables.

Z= f(Y) + f(PQ) + f(S) + f(P) + f(A) + f(Av)...(3)

Incorporating the demographic characters (as Duvel 1991 indicated) of farmers into the model, the expected perceived food security will be:

A= Age of farmers

G= Gender

M= Marital status

E= Education levels

Y= Yield

PQ= Product quality

S= Sustainability

P= Profitability

A= Accessibility

Av= Availability

Z= f(A) + f(G) + f(M) + f(E) + f(Y) + f(PQ) + f(S) + f(P) + f(A) + f(Av)..................(4)

4.7.1.2. Regression model of farmer's innovation orientation, soil erosion impact, extension effectiveness and food security in the study area

In this computation, perceived food security is regarded as dependent on perceived innovation orientation of farmers (N), perceived soil erosion impact (M) and perceived extension effectiveness (H) as represented in the table 4.2 and 4.3 below:

Table 4. 2: A concise relationship of dependent and independent variables of study

Dependent variables	Independent variables
Perceived innovation orientation of famers (N)	Food security variables (Z)
Perceived impact of soil erosion in study area (M)	Food security variables (Z)
Perceived extension effectiveness (H)	Food security variables (Z)

Table 4. 3: Regression models for the relationship of perceived food security, perceived innovation orientation of farmers, perceived soil erosion impact and the perceived extension effectiveness in the study area

Outcome variables	Input variables (independent variables)
N	f(A) + f(G) + f(M) + f(E) + (Y) + f(PQ) + f(S) + f(P) + f(A) + f(Av)..............(3)
M	f(A) + f(G) + f(M) + f(E) + (Y) + f(PQ) + f(S) + f(P) + f(A) + f(Av)...............(4)
H	f(A) + f(G) + f(M) + f(E) + (Y) + f(PQ) + f(S) + f(P) + f(A) + f(Av)...............(5)

4.8 Expected variables

Table 4. 4: Variables used in the variable relationships in the study area

Independent variables	Types of measurement	Priori expectations (+/-)
Age of farmers	Continuous	+/-
Gender of farmers	Dummy	+/-
Marital status of farmers	Dummy	+
Education levels of farmers	Continuous	+
Perceived farm yield	Dummy	+
Perceived product quality	Dummy	+
Perceived sustainability of farmers	Dummy	+
Perceived profitability of farmers	Dummy	+
Perceived accessibility of food	Dummy	+
Perceived availability	Dummy	+

4.8.1 Explanation of variables and their possible expectations

This aspect of the methodology is needed to explain the variables compared in the study and their expected direction as revealed in the literature. The proposed variables here are envisaged to, in one way or the other; influence the way farmers adopt or reject innovations, behaviour which impacts on soil erosion. Also they are thought to influence on soil erosion and extension messages in terms of whether they are open or conservative to change.

4.8.1.1 Age of farmers

In this study, the age of farmers is expected to impact positively or negatively on farmers' behaviour in the study area with respect to the adoption of recommended soil management technologies. This is because the older people are, the more they are unwilling to take risk, as such, they will prefer their old methods despite the improved soil technologies from extension officers in their area. On the other hand, the older a person is, the more experience he/ she becomes due to much knowledge acquired through long practice. As such, he/ she tends to deal with the soil with caution. This seems to be the view of Bonabana-Wabbi (2002:30). For example, citing Adesina and Baidu-Forson (1995), Bonabana-Wabbi (2002:30) said that in Burkina Faso, age was discovered to influence adoption of sorghum positively. However, he also said that age has been found to be either negatively correlated with adoption, or rather not significant in farmers' adoption decision making process.

Similarly, Odendo, Obare and Salasya (2010:7), reporting Abdulai and Huffman (2005), maintained that older farmers are more likely to adopt a technology because of their accumulated knowledge, capital and experience. However, they also said that young farmers are more ready to take risk, and being at an earlier phase of life cycle, are more likely to adopt certain new technologies, buttressing positive and negative role of age in adoption.

4.8.1.2 Gender of farmers

Gender difference is not expected to impact significantly on adoption of soil technologies or adherence to extension advice, 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 (2002:32), 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.

4.8.1.3 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 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.

4.8.1.4 Education levels of farmers

Similarly education is expected to impact positively on the level of adoption of appropriate soil technologies in the study area. According to Bonabana-Wabbi (2002:31), 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.

4.8.1.5 Perceived farm yield

Anticipated high farm yields and income thereof may increase the probability of the adoption of improve soil management technologies (Melusi 2012:63), because a more farm yields mean more food reliance and income for the farmer. As such, he/ she is thought to be more open to extension advice and as well have enough money to buy better technologies in the case when he/ she has to pay. In other words, farm yield is expected to be positive.

4.8.1.6 Perceived product quality

The quality of farmers' produce is expected to be positive because good quality means people will be willing to pay for the produce, which will mean more income for the farmer. As such, he/ she will have more money to buy better improve technologies that are more soil friendly to enhance his/ her farming.

4.8.1.7 Perceived sustainability of farmers

Citing the definition by the World Commission on Environment and Development (WCED), Spangenberg (2002:1) maintained that the ability of an individual to meet the needs of the present without compromising the ability of future generations to meet their own is called sustainability. This variable is expected to be positive, all things being equal, in the study area, because the more sustainable a farmer is, the more his/ her ability to continue in the business of farming for a long time, which indirectly reveal his/ her level of use of appropriate soil management technologies or yielding to extension advices.

4.8.1.8 Perceived profitability of farmers

According to Johnson, Lessley and Hanson (1998:1), profitability speaks of a consideration of the relationship of net farm profit to issues of farmland, labour and management skills invested in the farm business. In other words profitability is more than just issues of profit. This variable is expected to be positive because the more profitable a farmer is the more profit he/ she has, as such willing to buy and use more soil friendly technologies.

4.8.1.9 Perceived accessibility of food

Accessibility of food refers to a situation where a person has sufficient resources to obtain appropriate foods for a nutritious diet (World Health Organization 2012:n.p). This variable also is expected to be positive in the study area because the more accessible farmers' produce are to buyers, the more profit they make, and as such more income which helps them buy more improve technologies as the case may be.

4.8.1.10 Perceived availability of food

World Health Organization (2012:n.p) speaks of food availability as sufficient amount of food on a consistent basis. The more food is available to farmers, the more food reliant and profitable they tend to be, and the more they are open to change. As such, this variable is expected to be positive in the study area.

4.9 Conclusion

Research methodology is expected to provide an understanding of the processes of executing the research, which involve the various sources through which data for the study was collected, the technique of data collection, as well as processes of analysing and interpreting the data. In this study, the primary sources of data were collected with the aid of a structured questionnaire, personal observation and photographs of specific sites of erosion. Secondary sources were from published and unpublished literature. The simple random sampling was the sampling technique, while a one-on-one process was adopted for the data collection process.

The Duvel (1991) model was the model for conceptualization, where the independent variables (which according to this study are more of demographic characteristics of farmers) impact indirectly on farmers' innovation adoption behaviours through the mediating variables. The mediating variables, which are more of perception of farmers (even though their needs and knowledge also play a part) are considered as the most immanent determinants of farmers' behaviours. This leads to agricultural problems like soil erosion, which ultimately result to food insecurity.

While the basic descriptive statistics like frequencies, percentages, means, bar and pie charts were used to provide basic understanding of variables in the study, a more inferential statistic was conducted to test for the relationships which exist between variables in the study. The chapter that follows give a clear description of the data analysis and interpretation as relating to the initial objective that led to the study.

CHAPTER FIVE

PRESENTATION AND INTERPRETATION OF FINDINGS

5.0. Introduction

This study was specifically aimed at ascertaining how soil erosion impacts on food security in the Upper and Lower Areas of Didimana, in the Eastern Cape of South Africa, and the role farmers' innovation orientation and adoption behaviours play in the interaction. The study was informed based on the prevalence situation of soil erosion problems in the Eastern Cape, and so seeks to provide solutions to outlined objectives in the study. Therefore in this chapter, effort is made to present the discussion of findings as discovered in the study area using basic descriptive statistics, as well as the simple regression model. The chapter begins with a discussion of some demographic characteristics of farmers, and thereafter proceeded to the discussion of findings in line with the stipulated objectives of study. These are (1) to establish farmers' perceptions on the impact of soil erosion on food security of the study area; (2) to establish farmers' innovation adoption behaviour with respect to soil erosion control in the study area; and (3) to establish farmers' perceptions on the impact of extension activities with respect to soil erosion-control in the study area. The chapter then closes with a comparison of relationships among certain variables of the study using the simple linear regression model.

5.1. Basic personal and demographic characteristics of respondents

According to the Duvel (1991:77) model, there are certain indirect (independent) factors which play a role in farmers' behaviours. These are the personal and demographic characteristics of respondents. Bradmore (2004) defines them as variables such as age, gender, income level, marital status, educational level. They are very important because they help to indicate behavioural patterns of respondents (Shaw & Constanzo 1970:122-125). Lategan and Van Niekerk (2007:257-265) also posited that the interpretation of such behavioural patterns of individuals may as well act as a vehicle of understanding of the decision making processes of the population under study and their resultant production activities. Similarly, in a study conducted by Sebadieta (2006:iv), findings indicate that intervening variables are the determinants of farmers behavioural change, and the influence of the independent variables is manifested through them. Sebadieta (2006) also established that age, education and farm size seem to have an impact on adoption of technologies.

5.1.1. Age of respondents

Age of respondents is one viable basic character in a research. This is because age is one of the indicators that indicate the level of experience of the respondents and as well the reliability of their perceptions, all things being equal. According to the definition of Mayhew (2004), age structure is the composition of a nation by age groups. Arguing further on the relevance of age structure to a research, Mayhew (2004) maintained that age structure has a profound effect on the future of any nation. For example, Europe, with more than $15^0/_0$ of the population over 60 years, suffers from “age dependency”, while South Asia, with 45-$55^0/_0$ of its population under 16, is concerned to limit population growth. As such, farmers in the study area were required to indicate their actual age as at the time of interview, which thereafter was classified as in figure 5.1.

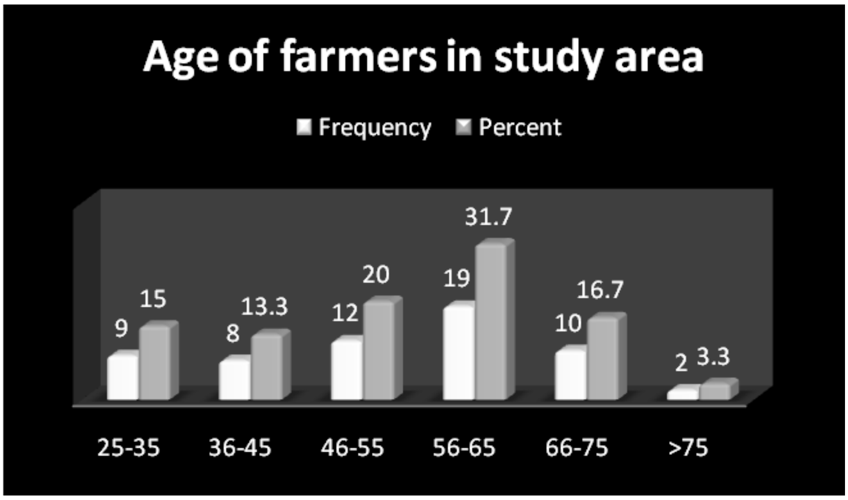

Figure 5. 1: Age of farmers in Upper and Lower Didimana

As the figure illustrates, the population of farmers in the study area consists of older people, as representation of young people less than 35 years (which is the maximum age of youth in South Africa- Rural Urban Consultant 2001) is only 15%. Apart from the 15%, which are youth, all the other 85% of farmers are in the older people’s age group, where about 52% are in the age group of those who are social grant (old people) recipients, while about 33% are in the age group 36 to 55 years.

As revealed in this analysis, the age constitution of farmers in the study area leaves very little to be desired in terms of farming and food security in the area and South Africa as a whole. This is because decisions about farming is left in the hands of older people, who are less educated, innovative, traditional and very conservative in terms of technological spread and adoption. This is not however unusual in most developing rural communities, due to the problem of rural-urban migration of youth to cities and towns, in search of better life and living, which largely is occasioned by the gap in development between the rural and urban areas.

5.1.2. Gender of respondents

From the views of the World Bank Group (2011), the definition of gender could be viewed from two angles: socially and biologically. From its social consideration, gender refers to the socially-constructed differences between men and women, while the differences in sex refer to its biological consideration. According to Espinosa and Garett (1987:101-117), gender as a basic character of farmers is a very important element to consider in the development and spread of agricultural innovations, which happens to be the core value of extension.

In a rural setting, usually roles and responsibilities are different for both men and women. Hence an understanding of a character like gender helps to understand why men and women behave differently, and why women take certain decisions different from their male counterpart in relation to farming in rural environments (Bembridge 1991:207).

Table 5. 1: Gender of respondents

Gender of Respondents	Frequency	Percent
Male	32	53.3
Female	28	46.7
Total	60	100.0

Source: Fieldwork 2012

As the table 5.1 indicates, a total of 60 farmers were interviewed in the entire study area. Findings indicate that the percentage ratio of male to female farmers is 53.3 to 46.7. As indicated, the gap between males and females with respect to farming in the study area is not very significant. This is unlike most rural communities where farming is more in the hands of males than the females. A factor which may have contributed to the above could be that the dividends of the global cry for gender equality, in which South Africa seems to be one of the foremost adherers, is gradually yielding. Another reason that may have contributed may be because farming, as discovered in the study area, is much more of homestead gardens which do not require too much effort as compared to other farming types, hence females may have found it very easy to compete with their male counterpart.

5.1.3 Marital status of respondents

The role of marital status to a research endeavour cannot be undermined. It offers to individuals different behavioural tendencies (Ighodaro 2010). According to Duvel (1991:70-86), one of the independent variables which plays a part in the behaviours of farmers or individuals is the personal characteristics of the individual, which includes marital status. This goes to show the relevance of marital status to a study like this. Quoting Berkman and

Syme (1979), Frank (1998:1) argued that “research has shown that married persons have lower death rates than single and unmarried individuals”. In an explanation of factors responsible for this, citing Goldman (1993a, 1993b) and Kisker and Goldman (1987), Frank (1998) indicated that the presumed factors underlying this differential involve the integrative and protective effects of married life and the obligations the married role entails for the individual on the one hand, and the possible contribution of health selection into marriage, on the other. Without gainsaying whether psychologically, socially and economically, marriage life offer some form of protection to the married, which ultimately impacts on their decision making. Supporting this view, Wood et al. (2007) stated that 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.

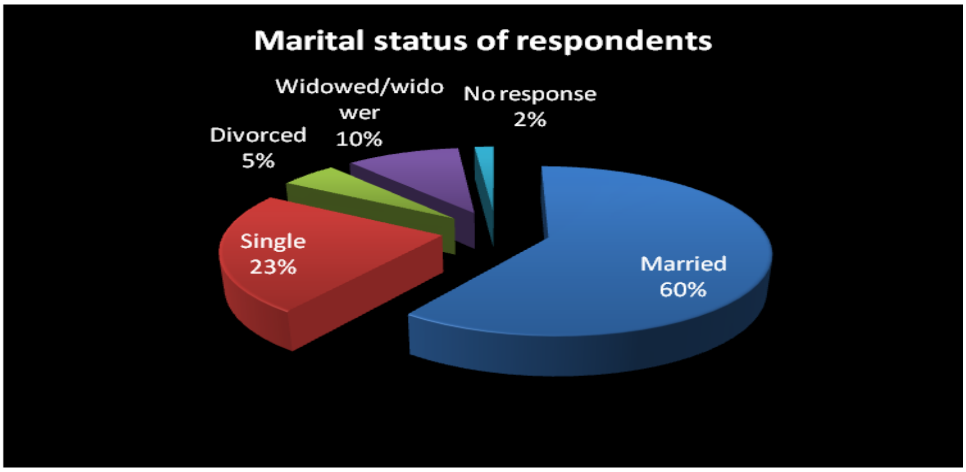

Figure 5. 2: Marital status of farmers in Upper and Lower Didimana

According to the figure 5.2, the percentage of married people in the study area is 60%, while that of the unmarried (singles, divorced and widowed/ widower) add up to 40%. If all things were deemed equal, the positive effect of marital status according to literature would have been very significant. This also would have led to appropriate farming decisions that reduce soil erosion or degradation, and which ultimately lead to food security. However, due to some other factors prevailing in the study area, such as inadequate education and level of poverty, amongst others, this supposedly positive effect of marital status is rather ineffective.

5.1.4 Highest level of education of respondents

According to a popular saying, “education is the best legacy that can be bequeathed to a child”. At a glance, this quotation seems to explain the all-important role of education to an individual and the entire society at large. The finding of Goel (2007:2) is an appropriate support to this: the quality of human resource found in any nation or country is easily judged by the number of literate population living within it. He further emphasized that the above assertion is the reason why rich and developed nations of the world are composed of very high literacy rate and productive human resource. Therefore an understanding of the education level of respondents in a research is another very potent personal characteristic of respondents. It prevails indirectly on the intermediate variables (farmers' perceptions, needs and knowledge), which according to Duvel (1991), are the direct precursors or determinants of farmers' behaviours and decision making process.

Table 5. 2: Education status of respondents

Education levels of respondents	Frequency	Percent
No formal education	1	1.7
Grade 1-6yrs	16	26.7
Grade 7-10yrs	16	26.7
Grade 11-12yrs	23	38.3
Diploma certificate	1	1.7
Agricultural degree	2	3.3
No response	1	1.7
Total	60	100.0

Source: Fieldwork 2012

Judging from the table 5.2, the level of education of farmers in the study area is very poor. As revealed, the percentage of farmers' population with at most a grade 12 certificate is 93.4%, while only five percent (5%) have a tertiary education. Findings here is however not different from other literature findings on rural education in the Eastern Cape. For example, in a similar study done by Ighodaro (2010) in a village called Sheshegu also in the Eastern Cape, findings indicate that only 6% had a tertiary education. Education, especially in rural areas of the Eastern Cape seems to be at a very low level, which indeed is alarming. To show the importance of education in the development of any country, President Barack Obama of the United States of America, with a bid to encourage students on the importance of education, said "what you are learning in school today will determine whether we as a nation can meet our greatest challenges in the future" (Obama 2009:n.p).

In a nutshell, findings in this section are good explanations why the Eastern Cape Province is presently ranked as one of the three poorest, as well as one of the three most degraded provinces in South Africa (Le Roux, Newby and Sumner 2007:333-329). The reason is because, available evidence proves that poverty and inadequate education or illiteracy are two key characteristics which impact on farmers' poor farming decisions which, as in this case, lead to soil erosion (Pender and Hazell 2000).

5.1.5 Respondent's farm size

According to Diao, Hazell, Resnick and Thurlow (2007: 7), one of the yardsticks for classifying farms into family farms and commercial agriculture is the size of farm holding (size of farm) of the farmer. It was said that the average size of farm of family farms is about 5-10 hectares, while that of commercial agriculture may exceed 100 hectares. Based on this, the nature of farm holding of farmers give an indication of the particular type of farming they practice.

Table 5. 3: Respondent's farm sizes

Farm sizes (m^2) of respondents (grouped)	Frequency	Percent
<200	44	73.3
201-300	6	10
301-400	6	10
401-500	1	1.7
>500	2	3.3
No response	1	1.7
Total	60	100

Source: Fieldwork 2012

As the table 5.3 indicates, over 70% of farmers in the study area occupy farm holdings which is less than 200 meters squared. This in itself speaks of the nature of farms cultivated in the study area. Compared to the classification of Diao et al. (2007), 200m^2 is an equivalent of about 0.02 ha, which is nothing compared to the family farms classification of Diao et al (2007). In fact, the survey discovered, according to the farmers, that they have actually stopped active farming in the area since around 1996. Some of the reasons that were given are the incidence of soil erosion, the topography of the area (mountainous), lack of irrigation and dams' facilities. As such, what most of the people currently practice in the area is what is called "homestead garden", which is basically meant to support the basic food needs of the farmer and his or her household.

Findings here speak volume. It shows an emergency situation in terms of food security goal of the South African government in general and the Eastern Cape in particular. In fact, the situation of farming as discovered in this study is a slap on the vision of the Integrated Food Security Strategy (IFSS) of the South African government, which is to attain a universal food security for all South Africans as defined by the Food and Agriculture Organization of the United Nations (FAO) (Department of Agriculture, Republic of South Africa 2002).

5.1.6 Respondents' current farming system and their production levels

Farming system as used in this section refers to the types of farming practiced by the farmer. On the other hand, the production levels of the farmer and his or farm refers to the potential contribution of the type of farming system to the security of food for the farmer. According to FAO (2001), farming systems in Sub-Saharan Africa is classified into 15 different categories, which when closely examined are either livestock or crops, even though these two broad categories were mixed in different forms.

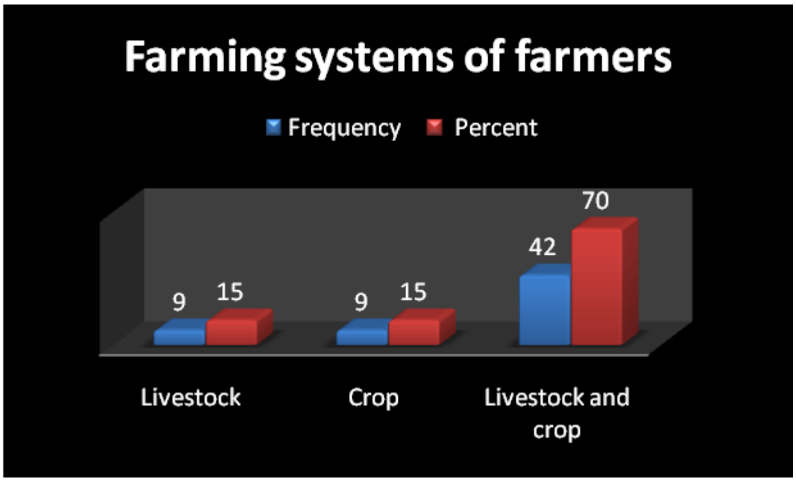

Figure 5. 3: Current farming systems of farmers in Upper and Lower Didimana

As the figure 5.3 stipulates, the percentage of farmers who practice livestock is 15%, those who practice crop farming is also 15%, while those who practice livestock and crop farming is 70%. Apparently farming in the study area is more of mixed farming system where crop and livestock farming are done together. Rota and Sperandini (2010:2), reporting Van Keulen and Schiere (2004), commented that in an integrated system of farming (i.e. mixed farming), livestock and crops are produced within a coordinated framework. Mixed farming as discovered in this study is said to be relevant for both poor and wealthy countries around the world (Schiere et al. 2006:2). They further indicated that the inclusion of crops in livestock systems is of great benefit. It helps to provide feed for animals in low input systems and as well recycle excess nutrients in high input systems. Supporting also, Rota and Sperandini (2010:2) also said that one of the benefits of mixed farming is that the waste products of one component becomes a viable resource for the other component.

Similarly, table 5.4 is a representation of the perceived levels of production of each farming system practiced by the farmer in the study area. Comparing the two systems, there seems to be no conclusive evidence on which farming system is seen to be more productive for the farmer. However, a remarkable observation is the level of perceptions on how much of their livestock or crops that are sold, either on limited sales or large sales. The percentage is very small, which is not however surprising. Most rural farmers from developing countries produce on a subsistence level, especially because of poverty, inadequate education, and perhaps a lack of technical know-how. According to StatsSA and NDA 2000, the main reason why subsistence farmers engage in production is for the purpose of own consumption. Three main characters were offered as basic characters associated with this kind of production. They are low production, risk and uncertainty. In fact, an analysis of the former homeland areas in South Africa reveals that the Eastern Cape took the lead in the list of subsistence farmers (StatsSA & NDA 2000). This further supports the findings that farmers in the study area are subsistence in nature.

Table 5. 4: Production levels of respondent's farming systems

Production levels of farming system	Livestock		Crop	
	Frequency	Percent	Frequency	Percent
Insufficient for own consumption	24	40	17	28.3
Just enough for own consumption	17	28.3	29	48.4
Just enough for own consumption and ceremonial	11	18.4	5	8.3
Sufficient excess for limited sales	5	8.3	5	8.3
Sufficient excess for large sales	3	5	4	6.7
Total	60	100	60	100

Source: Fieldwork 2012

5.1.7 Sources of income and their relative contribution to total income for the farmer

This section aims at unravelling the different sources of income for the farmer in the study area, and as well measuring the perceived relative contribution of the different income sources to the total income of the farmer. These are needed for several reasons. One is to understand the general nature of farming in the area; two also is to establish the standard of living of farmers in the area; and three is to understand the most activity engaged by people in the area, which indirectly reveals the main activity that is responsible for the problem under study: soil erosion.

As the table 5.5 unfolds, the main source of income for the farmer in the study area is from non-agricultural source, followed by livestock farming, and then crop farming which is the last. A truth that was discovered from the study is that, most of these non-agricultural sources of income are from government social grants: old peoples' grant, which took the lead, as seen from the group of 12501-15000 Rand, where 38.3% (the highest percentage) of the population of farmers get their income. Looking closely, this category of grant could be that of old age pension grant, care dependency grant, and disability grant (of about R14400 per annum); other categories of grants are the child support and foster care grants (Kane 2009:6). The next highest source of farmers' income is livestock farming, followed by crop farming, which is the lowest.

Table 5. 5: Sources of income for the farmer

INCOME/ANNUM (RAND)	NON-AGRICULTURAL		CROPS		LIVESTOCK	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Zero income	19	31.6	57	95	37	61.7
<2500	1	1.7	3	5	7	11.7
2500-5000	1	1.7			11	18.3
5001-7500	9	15			2	3.3
7501-10000					2	3.3
10001-12500	1	1.7				
12501-15000	23	38.3			1	1.7
15001-17500	1	1.7				
17501-20000	1	1.7				
20001-40000	3	5				
>40000	1	1.7				
Total	60	100	60	100	60	100

Source: Fieldwork 2012

In terms of relative contribution to total income of farmers, farmers were requested to indicate the relative contribution of the various sources of income to their total income. As table 5.6 indicates, 70% of the farming population said that non-agricultural sources of income contribute between 61-100% of their total income sources. On the other hand, findings indicate that only about 1.7% of farmers said that income from crop farming contributes between 61-100% of their total income. In the same vein, only 16.6% of total farmers said income from livestock contributes between 61-100% of their total income. Findings here seem to agree with the report by the Chris Hani District Municipality, Draft Integrated Development Plan Review (2010/ 2011:52), which suggests that farming is not a main source of food in the study area.

Another variable worth considering in this section is the average income of the farmer in the study area. This was calculated by summing the averages of the three sources of income: non-agricultural, livestock and crop farming respectively. The median as a means of central tendency was used in the calculation to avoid problem of over skewedness. For non-agricultural income source, the value gave R13750.50; from livestock also, the value gave R3750.00, while that from crops gave R1250.00, summing up to a total of R18750.50 per annum. When this is determined on a monthly basis, it yields R1562.54 (US$178, dollar rate as at 15th October, 2012) per month. When considered on a daily basis, this becomes about US$6 per day, which is far above the international poverty line of US$1.25 per day (United Nations 2009:47). However when compared to the poverty line of South Africa according to Ronnie (2002), which is R2400 per month, a R1562.54 monthly income is below the line. Hence the study area can be considered poor. The poverty state of study area can be further buttressed when the average income is compared with the minimum wage of the following service sectors in South Africa. Findings show that average income of study area is far lesser. For example, consider the minimum wage of hospitality workers, who are ranked amongst the lowest income earners in South Africa, for the period of 1st July, 2010 to 30th June, 2011, it was R1981.48 to R2209. Also, that of civil engineers, for the period of 1st December, 2010 to 30th November, 2011, stood at R4183.2 to R8880 per month (Labour research service 2011).

Table 5. 6: Relative contribution of income sources to total income

Income contribution (%)	Non-agricultural		Crop		Livestock	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Zero income	15	25	50	83.3	31	51.7
<20	1	1.7	3	5	10	16.7
20-40	2	3.3	5	8.3	7	11.7
41-60			1	1.7	2	3.3
61-80	9	15			2	3.3
81-90	6	10				
91-100	27	45	1	1.7	8	13.3
Total	60	100	60	100	60	100

Source: Fieldwork 2012

There are several implications of this data. One of them is that farmers' perception indicates that the area is poor. Another is that, it becomes worrisome when income of farmers in the study area comes more from social grants, which spells doom for the overall economy of South Africa, because majority of the people in the area are social grant-dependents. Another issue of great concern is that level of crop farming is so low that only about 5% of farmers actually have a little to sell, because the people have left active farming and now mainly practicing homestead gardens which can barely feed the farmer and his family. A last point to note, which is however nothing different from the Census data of 2002 (Statistics South Africa 2002), is that livestock farming could be considered as one of the main human activities responsible for soil erosion in the study area, because it seems to be the main source of income apart from social grants.

5.1.8 Farmer's number of years in farming

An understanding of the number of years of a famer is also very important in a research, because it gives an indication of the farmers' experience, as well as the reliability and credibility of his/ her responses. Also, it indicates farming efficiency, reasons for some farming decisions, as well as the adoption or rejection of certain agricultural innovation for change.

As the figure 5.4 indicates, the farming experience for farmers in the study area can be said to be low, because the larger part of the population of farmers have been in farming for a period less than 10 years. The truth is, adequate experience in any business endeavour cannot be overemphasized, even as Bean (2010) highlighted:"experience plays a significant role in the business world".

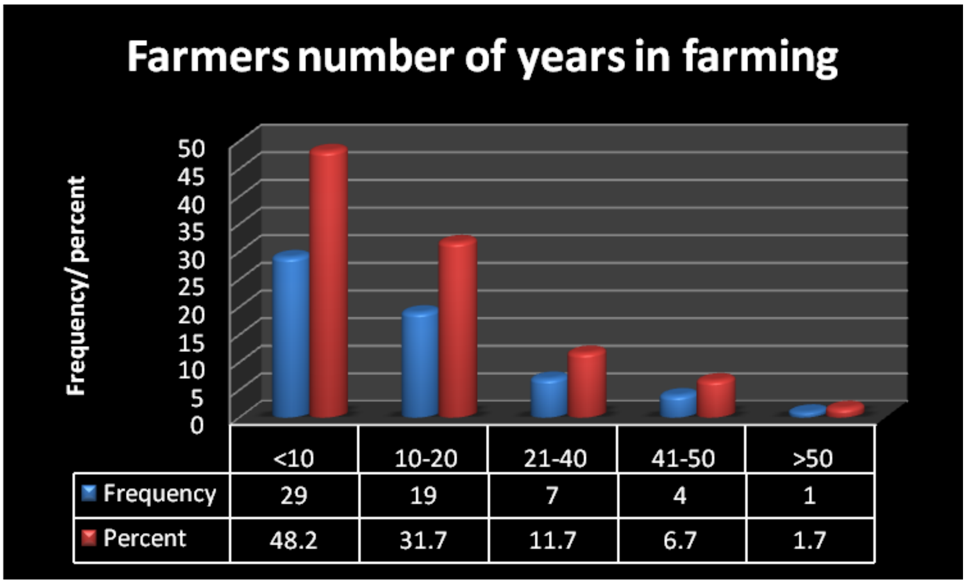

Figure 5. 4: Farmers' number of years in farming

The role that experience play in any production processes like farming is reflected better in the following statements by Barkai and Levhari (1973:56). Firstly, it was stated that "it is an accepted proposition that there is a positive association between efficiency and experience in production". Secondly is that any learning that is associated with cumulative experience, contributes to production. Lastly, they said that the acquisition of experience requires time. As made clear in the above statements, time and experience are directly proportional. Another thing that can be deduced from the above is that production is enhanced through experience acquired through time, and finally, much experience breeds efficiency. And efficiency here could refer to competence, doing things right, or applying recommended practices. However, as findings indicate in this study, with the larger part of the population of farmers being in farming for a period of less than 10 years, experience can be said to be low in the study area.

5.2. Farmers' perception on the impact of soil erosion on food security in their area

According to the goal of this study, the core aspect is this section: the perceived impact of soil erosion on food security of the Upper and Lower Areas of Didimana. As it were, soil erosion impacts food security through its impact on the agricultural productivity of an area via the soil. Reporting Sanchez et al. (1997), Odendo, Obare and Salasya (2010: 2) indicated that soil fertility degradation, which also results from soil erosion, on small farm holdings has been cited as the fundamental biophysical root cause of food insecurity and poverty in sub-Saharan Africa. The truth is that anything that negatively affects agricultural production breeds food insecurity. In the study of Barungi and Maonga (2011: 28), it was stressed that land degradation resulting from soil erosion and other processes, such as leaching and salinity, is a serious environmental threat to agricultural sustainability.

As such, this section focuses on how soil erosion impacts on the food security measures of the study area. It begins by providing an understanding of the various food security measures utilized for the study, and thereafter considers the various ways soil erosion is affecting them.

5.2.1. Measures of food security in the study area

Food security is a dynamic subject. As such its measures are variable. According Clay (2002: 1), food security is a flexible and multidimensional concept. In fact, it was said that this flexibility is reflected in the many attempts of its definition in research and policy usage. However, the most common pillars of food security definition as found in the literafture are food avaialblity, accessibility, sustainability, profitability and quality of produce (Koc and MacRae 2001: 8). Based on the above, this study is pleased to measure food security in the study area with the following measures: farm yield, product quality, sustainability, profitability, accessibility and availability of food. In this section, each of these food security measures have been carefully considered in their lowest terms in the best language understood by farmers in the study area.

5.2.1.1. Crops planted and time of planting

A total of about 19 different types of crops were found cultivated in the study area. These range from cereals, vegetables, hay/feed, to fruits such as apple and pineapple. As table 5.10 depicts, the five most common crops, in order of importance, are maize, spinach, potatoes, pumpkin, and beans. Other crops also are carrot, onion, cabbage, and beetroot. Findings here seem to be in consonant with literature. For example it was stated by

Musunda et al. (2012) that maize is the most important summer crop cultivated in smallholder farming areas of the Eastern Cape. Also, according to the data of Reclamation and Settlement of Lower Didimana Location, No 4, District of Whittlesea (1966), crops grown in the area are maize and beans.

Table 5. 7: Crops planted in the study area

Crops planted	Frequency	Crops planted	Frequency
Potato	27	Beans	22
Pea	12	Tomatoes	6
Cabbage	18	Lettuce	4
Spinach	32	Green pepper	2
Onion	19	Peanut	1
Beetroot	13	Wheat	4
Carrot	20	Apple	1
Maize	43	Pineapple	1
Pumpkin	24	Hay/feed	4
Butternut	8		

Source: Fieldwork 2012

Table 5. 8: Time of year crops are planted

Time crops are planted	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Potato	3	1	4	2	2	2	1	1	8	10	12	4
Pea	2	3	3	4	2	2	1	1	2	3	1	
Cabbage	2	1	2	2	4	6	2	4	2	3	5	3
Spinach	7	6	10	6	6	8	4	8	5	6	5	5
Onion	3	3	4	4	2	5	1	4	2	3	3	3
Beetroot	2	1	2	1	2	5	2	4	2	3	4	3
Carrot	1	2	7	4	3	2	2	7	5	3	2	3
Maize	2	1	1						8	23	18	7
Pumpkin	2	1	1					1	3	14	12	5
Butternut	1								2	4	4	4
Beans	1				1	3	2	1	4	9	13	3
Tomatoes	1	1	3	1	1			1	1	1	2	
Lettuce			1	2						1		
Green pepper		1								1		
Peanut										1		
Wheat					1	2	2	2	2	2	2	2
Apple										1		
Pineapple											1	
Hay/feed		1		1	1			1				
Other crops	1											

Source: Fieldwork 2012

The period of the year when these crops are planted was another focus of the research. With respect to table 5.8, considering the five most common crops planted in the area, majority of the people indicated that they plant maize in September, October, November and December. From all indications, spinach seems to be favourable throughout the months of the year from January to December. Similarly, potato seems to be well favoured for September, October and November, as majority of the farmers said they plant the crop in the aforesaid months. In the same vein, pumpkin is said to be planted in the months of October, November and December, while beans seem to be more favoured in the months of September, October and November.

One basic importance of the findings above is that it informs stakeholders in the development of agriculture in South Africa and the Eastern Cape in particular, to know how to build up programmes for the development of crop farming in the area around already established periods where particular crops are most suited, in order to optimize production and beef up food security.

5.2.1.2. Decision on which crop to plant

The decision on which crop to plant is determined by a range of factors. According to Talawar and Rhoades (1998), as cited by Raynborg and Rubiano (2001: 115), “many studies provide evidence of farmers’ detailed knowledge of their soils and of their ability to draw agronomic management implications from this knowledge”. From another view, factors responsible for farmers’ decision with respect to crop planting are classified into what is called price and non-price factors (Rajasekaran 1993: 2-3). In this regard, price factors can be that of inputs or outputs, while non-price factors can be environmental, political, as the case may be. This variable is important in a research like this because it assists the understanding of basic factors which informs farmers in the study area, or what factors form the basis of their selection of a type of crop to be planted during the course of the year. Table 5.9 is a reflection of data to this effect.

As the table reveals, majority of farmers in the area are informed on which crop to plant during the year through an understanding of the weather or crop seasons, with a farmers’ response of 85%. A finding like this is worthy of note. Although this is not however strange in most developing rural communities because, most knowledge like farming knowledge are passed from generation to generation informally through traditions of the ancestors and fore-parents, which is mastered by experience. As supported by Museveni (2008), the President of the Republic of Uganda, during the opening of the 5th Pan-Commonwealth Forum on Open and Distance Learning, traditional livelihoods were sustained through informal education system and passed from one generation to another. He further said that large pockets of the rural population of the Commonwealth of States are still fully or partially sustained through informal education system.

Table 5. 9: Farmers' decision on crops to plant during the year

Basis of crop planting decisions	Frequency	Percent
Through education	4	6.6
Availability of resources	1	1.7
Through extension officers' advice	3	5.0
An understanding of weather/crop seasons	51	85.0
No response	1	1.7
Total	60	100

Source: Fieldwork 2012

Other bases of crop planting decisions as indicated by farmers in the study area are through education (maybe in a formal or informal setting), extension officers' advices and level of resources available to the farmer.

5.2.1.3. Level of farmers' satisfaction with their yield and product quality

According to literature, agriculture remains the main factor upon which rural livelihoods depend (Bishop-Sambrook 2005) in many parts of the world. This implies that an understanding of farmers' satisfaction with farming endeavours or means of livelihood is an indication of some level of food security. In the opinion of Ridaura et al., (2002), as quoted by Minh Duc (2008: 525), the satisfaction of farmers is regarded as an important measure of sustainability, and it has become the leading goal of scientific investigation and policy agenda. As such, in the study area, a 5-point Likert scale was used in testing certain aspects of various farming expectations of farmers in the study area as represented in table 5.10. In the scale, one represents "totally dissatisfied", while five represents "highly satisfied".

In the table 5.10, two farming expectations of farmers were evaluated. The first row of measurement is on the level of farmer's satisfaction with the quality of his/ her plants. By plants here is meant plants/ crops without its fruits for fruit-bearing crops. But for vegetables like spinach, plants can be the same as fruits, because there is no mark differentiation between its plants and fruits. The second row measures the level of farmers' satisfaction with their crop quality. In this case, emphasis is on the crops/ fruits without the plant. Also the third row focuses on farmers' satisfaction with the quantity of harvest. Emphasis here is on farm yield.

As the table reveals, in each categories of measurement, less than half the population of farmers in the study area indicated that they are satisfied without any problem.

Table 5. 10: Level of satisfaction with various farming expectations

Farmer's satisfaction with various farm expectations	Totally dissatisfied	A little dissatisfied	Moderately satisfied	Satisfied	Highly satisfied	Total
Level of satisfaction with plant quality	3	16	13	20	8	60
Level of satisfaction with crop quality	6	11	15	23	5	60
Level of satisfaction with quantity of harvest	7	13	18	17	5	60

Source: Fieldwork 2012

According to this section plant and crop quality is a measure of product quality while quantity of harvest is a measure of crop yield. The expectation of these variables is that, all things being equal, plant and crop quality should be positively related with food security, because a plant or crop that does not have any sign of infection should produce good fruits which presuppose good income for the farmer. In the same vein, quantity of harvest is expected to be positively related to food security because abundant harvest presupposes more income for the farmer. In this view, the reverse is also the case. Poor quality or quantity of crops will result to poor productivity and food insecurity for the farmer. Supporting this, Pimentel (2006: 126) citing Lal and Stewart (1990), said that when soil erosion depletes nutrient resources, plant growth becomes stunted and overall productivity reduces.

5.2.1.4. Percentage of crops sold for profit

Percentage of crops sold for profit here relates to the variable of yield in food security measures chosen by this study. One of the best ways of determining food security is to find out whether there is any extra produce sold for profit by farmers, and perhaps how much of these extras are sold. This is because ideally it is the farmer who is food self-sufficient that thinks of sales, all things being equal. Based on this, farmers in the study area were with a 6-point Likert scale measured, where "one" represents 0% crop sales, while "six" represent 80% crop sales and above. The figure 5.5 represents information in this regard.

According to figure 5.5, over 78% of the population of farmers sell less than 41% of their crops. One peculiarity about this finding is that over half the population of farmers (53.3%) actually do not sell their produce, which means all their produce are meant for personal consumption which indeed is one main character of subsistence farmers (StatsSA and NDA 2000). Giving some characteristics of subsistence farming, Balinta and Wobst (n.d: 3) said that subsistence farming is a type of farming associated with low agricultural marketed output, low productivity and poverty.

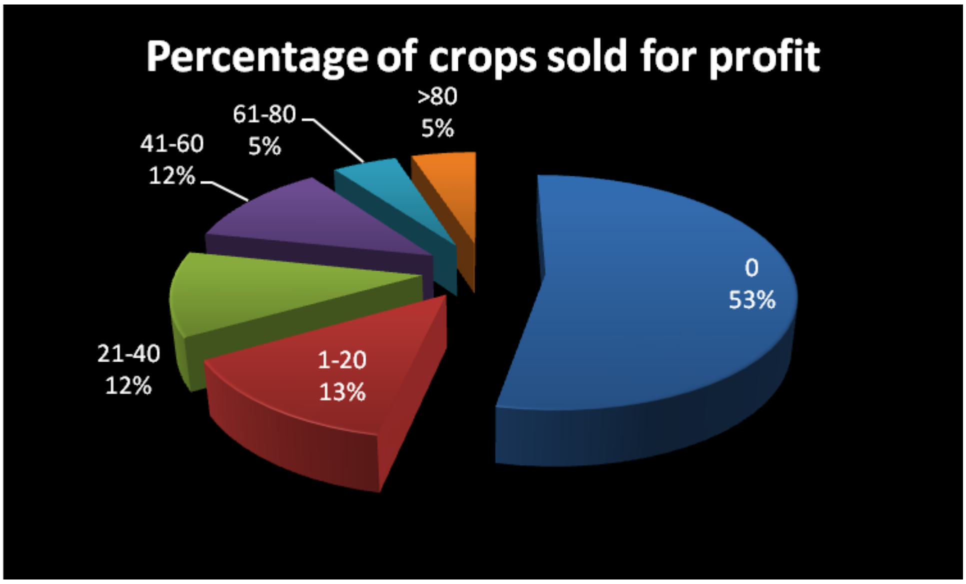

Figure 5. 5: Percentage of farmers' crops sold for profit

5.2.1.5. Difficulty associated with farmers selling their crops

In this study, the difficulty of farmers selling of produce relates to the factor of food accessibility. The more difficult it is for farmers to sell their crops in the study area, the more food is inaccessible in the area, which breeds food insecurity. Therefore the idea is that this variable is expected to be positively related with food security in the study area.

In figure 5.6, 26.7% which is the largest percentage of farmers said selling their produce is difficult. Reasons given for this vary from competition among farmers, lack of ready market, poor yield of crops, apparently due to erosion problem and other reasons such as proximity of farmers' village to town.

If the larger part of the population of farmers said it is difficult to sell their crops, this calls for worry, because one measure of food security is accessibility (Department of Africulture, Republic of South Africa 2002: 16). Inaccessibility of food is food insecurity in disguised, and access to quality and adequate food is a basic human right. In fact, Adeyemi et al. (2009) posited that, since it started, the United Nations stated among all other human rights, that access to adequate food is both an individual right and a collective responsibility.

Finding here seems to explain one of the reasons why access to quality and affordable food is still a problem in many parts of Africa. Vrieling, de Beurs and Brown (2011) speaking on the subject posited that despite the impact of globalization and food trade, access to food remains a major challenge in major parts of the population of Sub-Sahara Africa.

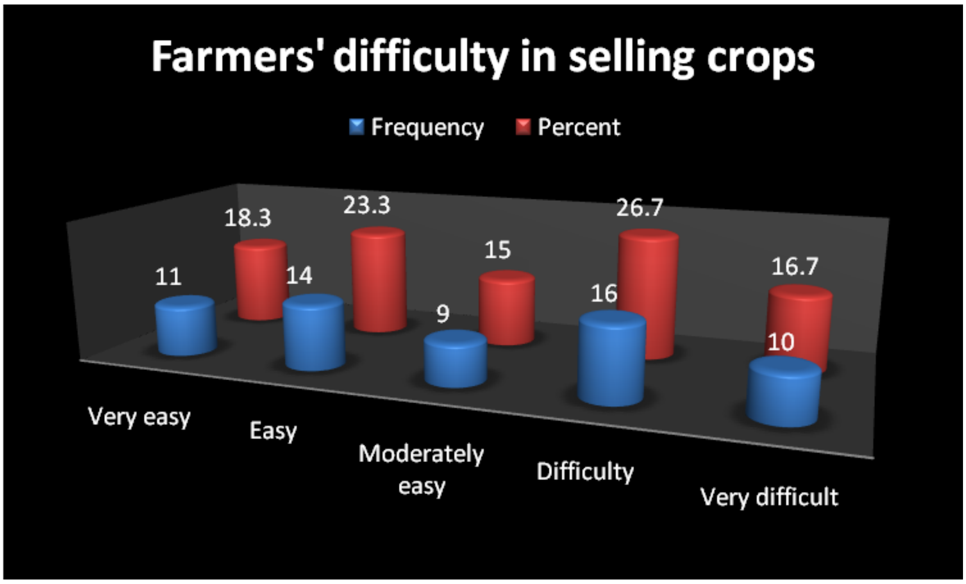

Figure 5. 6: Farmers' difficulty in selling crops

5.2.1.6. Members of community that always have enough food for their households

Another main area farmers perceptions were measured is on the number of families in their area that always have enough food for members of their households. This variable is aimed at measuring the food availability aspect of food security. The expectation is that food availability is that the more food is available to households in the study area, the more food status is secure. Table 5.11 is pictorial of findings.

Table 5. 11: Number of households that always have enough food for their homes

Food security characters of study area	None at all	Very few of the families	About half of the families	More than half of the families	All the people	Total
Always have enough food for the family	4	27	14	12	3	60

Source: Fieldwork 2012

In a community where only very few of the families always have enough food for their families, this show nothing but some levels of food insecurity. And food insecurity is defined as limited or uncertain availability of nutritionally adequate and safe food or the inability to acquire food in socially acceptable ways (Hlanganise 2010:2).

5.2.1.7. Food security status of the farmer

Farmers' right perception is of immense benefit in social science research because it helps to explain farmers' problems in their own context. According to Mercer (1971), human satisfaction, which is more of perception, is becoming increasingly common as a goal of planning in many different contexts. As such, farmers' perception was also sought on their food security status. Figure 5.7 depicts findings.

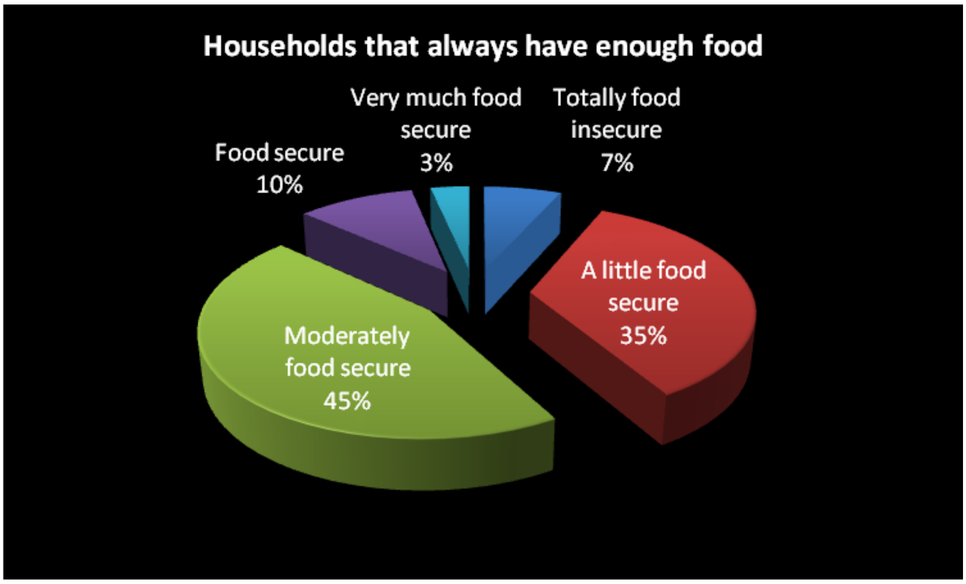

Figure 5. 7: Number of families that always have enough food their households

As shown in the figure 5.7, only 10% indicated that they are food secure, while 3% consider themselves to be very much food secure. 86.7% of the total population of farmers perceive themselves as food insecure at different degrees.

5.2.1.8. Production levels of farmers' crops

Part of the proceeds from the World Food Summit in Rome, in 1996, was the right of everyone to have undenied access to a safe, nutritious and adequate food (FAO 1998). This therefore presupposes that quantity of food is one measure of food security. Hence in this section, effort was made to assess the production levels of individual farmer and his/ her crops in the study area. Each farmer (whether they sell their produce or not) was required to indicate, after a crop harvest, how much each crop produces. For farmers who do not sell their crops, they were to estimate. The mean of findings were later calculated and represented as in the table 5.12.

Firstly, one remarkable thing about findings of this table (table 5.12) is that not all crops are cultivated by all farmers, and secondly, some crops were found more favourable for cultivation by the majority. For example, maize is found more favourable for cultivation by almost all farmers in the community, followed by spinach and potato, in order.

Also, the average production levels of crops with respect to growers are as follows: maize is about 12 bags per person, spinach is about 13 bunches per person, potato is about 10 bags per person, cabbage is about 8 bags per person, onion is about 8 bunches per person, butternut is about 17 bags per person, and beans is about 25 bags per person.

Findings here leaves very little to be desired. It again reiterates the level of farming practice in the area, which is basically homestead garden where majority of the farmers cultivate less than 0.02 ha of land (section 5.1.5), as well as the level of food security in the study area, which is poor or below average.

The findings of Musunda et al. (2012) on crop production in the Eastern Cape revealed that maize is the most important summer crop grown by smallholder farmers in the Eastern Cape. It was stated further that its productivity is very low with average yields of less than 1 t ha^{-1}. Low and variable rainfall was said to be a major factor limiting the production of maize in the area. Although this is remarkable, it will be difficult if compared with the production rate in the study area. This is because the area under crop production is just too small to be significant.

Table 5. 12: Production levels of crops cultivated in the study area

Crops cultivated	Frequency	Mean of crop production
Potato	22	9.991
Pea	1	1
Cabbage	21	8.2857
Spinach	27	12.4815
Onion	17	7.8235
Beetroot	1	2
Carrot	4	18.75
Maize	39	11.6667
Pumpkin	7	14.1429
Butternut	11	17
Beans	4	25.125
Lettuce	1	0.5
Wheat	2	8
Hay	1	0
Other crops	1	2

Source: Fieldwork 2012

5.2.1.9. Sustainability level of farm enterprise

Sustainability is a measure of how much the farmer in a farming enterprise can continue in the business of farming for a long time unhindered. Quoting the definition by the World Commission on Environment and Development (WCED), Spangenberg (2002: 1) indicated that "sustainability is an ability of an individual to meet the needs of the present without compromising the ability of future generations to meet their own needs". In order to understand this variable in the study area, farmers were required to provide responses to a

4-point Likert scale, where "one" represents "unsustainable", while four represent "sustainable without support".

Table 5. 13: Sustainability level of farm enterprise

Farming sustainability	Frequency	Percent
Unsustainable	11	18.3
Sustainable with major support	16	26.7
Sustainable with minor support	20	33.3
Sustainable without support	13	21.7
Total	60	100

Source: Fieldwork 2012

In the table 5.13, findings indicate that only 21.7% of the population of farmers perceived their farming endeavours as sustainable without any form of support. All others were either unsustainable or sustainable with one form of support or the other. This again gives a level of food insecurity in the area. This is because unsustainable food supply as a result of unsustainable farming breeds hunger, lack of food access and availability, which all are measures of food security.

5.2.1.10. Farming profitability of the farmer

Table 5. 14: Perceived farm profitability by farmers

Farming profitability	Frequency	Percent
Very unprofitable	11	18.3
A little profitable	16	26.7
Moderately profitable	15	25
Profitable	10	16.7
Very profitable	8	13.3
Total	60	100

Source: Fieldwork 2012

Profitability is another very potent measure of food security in any place. It is one major driving force in farmers' adoption behavioural tendencies. This is because, according to Barungi and Maonga (2011: 30), the behaviour of human beings, whether farmers or non-farmers, is motivated by the possibility of making gains, which has to do with profit. This means profitability is expected to be positively related to farmers' adoption behaviours because the more profitable the farm business is, the more the farmer is willing to accept any new thing that will enhance more profit; to food security because the more profitable a farmer is, the more access he can have to food and other basic necessities of the home; and to soil erosion because the more profitable a farmer is, the power he has to access better technologies that reduce erosion. In line with this, farmers were required to provide response to a 5-point Likert scale, where “one” represents “very unprofitable”, while “five” represents “very profitable”. Findings are represented in the table 5.14.

According to the table, only about 30% of total population of farmers suggested that their farming enterprise was profitable. All others indicated that their farm work is unprofitable with varying degrees. For example, 18.3% said they are very unprofitable, 26.7%, which also is the largest response, said they are a little profitable, while 25% said they are only moderately profitable.

Findings here could be adduced as one indicator why soil erosion is still evident in the study area. Perceptions reveal that majority of the farmers are unprofitable, which could be why they are not adopting recommended practices or using extension advices on appropriate soil management in the area.

5.2.2. Impact of soil erosion on food security in the study area

According to literature, one main impact of soil erosion is nutrient (plant food) depletion (Pimentel 2006: 126). Usually when erosion occurs, the topsoil, which is the nutrient-carrying part of the soil is washed away. In fact, Le Roux, Newby and Sumner (2007: 329) maintained that throughout South Africa, the loss of topsoil is one of the main soil degradation problems confronting agriculture. Hence in this section, effort is made to understand how soil erosion impacts on the level of food production (yield), product quality, sustainability, profitability, accessibility and availability of food in the study area.

5.2.2.1. Impact of soil erosion on crop planning decisions

Crop planning decisions speak of how the farmer takes decisions on which crop to plant during the course of the year, and at what time. Therefore this section seeks to know how soil erosion has affected this important farming variable. With an open-ended question farmers were required to provide their perceptions along this line. Table 5.15 is an indication of findings.

From the table 5.15, although there were many classifications of farmers’ views, the most significant response in line with the objective of this study is that soil erosion impacts on their weather conditions or is changing their planting sequence, which scored 20% of farmers’ response. This is actually one of the ways that soil erosion impacts on climate change and variability. According to the farmers, this occurs through a shift in time of rain, and thus gradually changing the time of planting/cropping in the area. The impact of climate change is usually dire.

Table 5. 15: Impact of soil erosion on crop planning decisions

Impact of soil erosion on crop planning decisions	Frequency	Percent
Direct impact on weather/changes in planting sequence	12	20
Soil degradation problems	6	10
Poor crop yield/quality	7	11.7
Increase in cost of production	1	1.7
Other impacts	14	23.3
No much impact/no impact at all	20	33.3
Total	60	100

Source: Fieldwork 2012

Climate change impact according to Parson et al. (2003: 11) "is the change caused by a projected change in climate..." One of its effects, according to Hertel and Rosch (2010: 15-16), is that adverse effect of climate change reduces food availability and causes higher food prices. It was also posited by Hertel and Rosch that adverse effect of climate change on productivity will reduce farm earnings (profitability). To farmers in the study area, this is quite remarkable and calls for urgent attention if the food security goals of South African government can be actualized.

5.2.2.2. Impact of soil erosion on livelihoods of farmers

One of the main impacts of soil erosion is on the livelihoods of smallholder famers. Odendo, Obare and Salasya (2010: 2), citing Sanchez et al. (1997), said that soil fertility degradation on smallholder farms (which is mostly caused by soil erosion) is reported as the primary biophysical root cause of food insecurity and poverty in sub-Saharan Africa, where most people live in rural areas and obtain their livelihoods from farming. In relation to this, farmers were also interviewed and findings are represented in table 5.19.

Table 5. 16: Perceived impact of soil erosion on livelihoods of farmers

Soil erosion impact on livelihoods	Frequency	Percent
Household feeding	9	15
Impact on crops and livestock	24	40
Destruction of infractures/properties	8	13.3
Other impacts	12	20
No impact at all	5	8.3
No response	2	3.3
Total	60	100

Source: Fieldwork 2012

According to findings of table 5.16, the three most significant perceived impact of soil erosion on farmers livelihoods are (1) negative impacts on crops and livestock; (2) other impacts which reflect in the form of increase in cost of production, loss of usable land, negative impact on human lives, climate change problems, negative impact on farmer's occupation, and creation of gullies; and (3) impact on household feeding of farmers.

Considering the above, findings seem to concur with literature. For example earlier findings of this study (section 5.1.7) indicated that farmers in the study area were more engaged in livestock farming than in crops. This is also supported by the population census data of 2002 (Statistics South Africa 2002) that the main land use of the Eastern Cape where this study is conducted is sheep farming even though other livestock are also reared.

5.2.2.3. Percentage of crop losses due to soil erosion

Crop loss is a factor of profitability. The idea is that if crop losses are much, then it is an indication that the impact of soil erosion is much in the area. The reason is that one on-site impact of soil erosion is loss of crops. This could be either through nutrient depletion or physical damage as the case may be. This is why Pimentel (2006: 126), reporting Langdale et al. (1992), suggested that nutrient deficient soils produce 15 to 30% lower crop yields than uneroded soils.

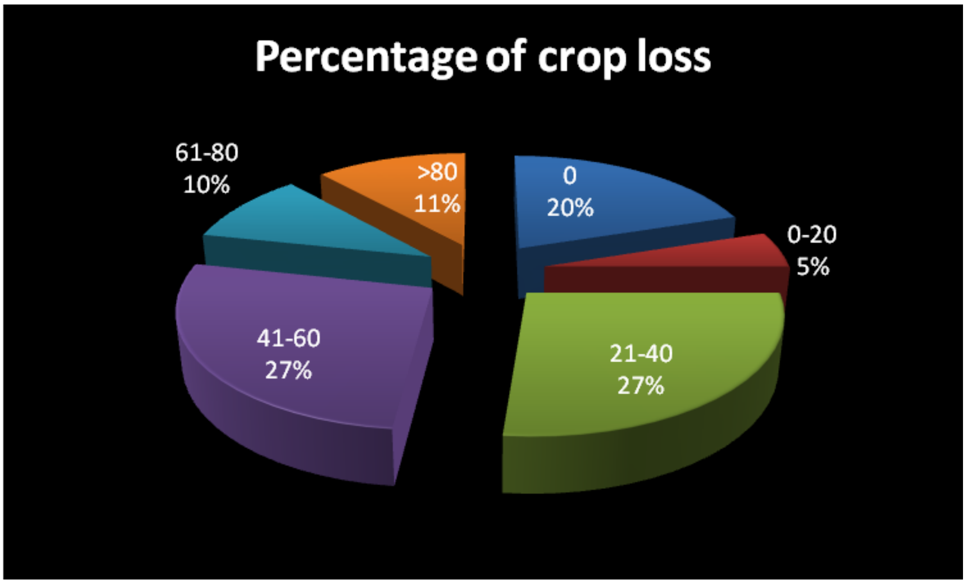

Figure 5. 8: Perceived percentage of crop loss by farmers

In figure 5.8, the data reveal that up to a total of about 53.4% of farmers said they lose well between 21-60% of crops due to soil erosion. The most remarkable aspect of the finding is that 20% of the farmers said they do not lose any crop due to soil erosion. Three reasons may be adduced for this. One of such may be the effect of those who do not farm on crops. Another reason may also be the effect of the nature of farming currently practiced in the area which is homestead garden, whose size is relatively too small for the impact of soil erosion to really be significant. A third reason may as well be the effect of those farmers who do not sell their crops.

5.2.2.4. Frequency of change in crop planting due to soil erosion

Table 5. 17: Change in crop planting due to soil erosion

Change in crop planting due to soil erosion	Frequency	Percent
I'm actually planting less every year	22	36.7
Once in a year	11	18.3
Every two years	10	16.7
More than two years	3	5.0
Have never changed despite soil erosion	14	23.3
Total	60	100

Source: Fieldwork 2012

Soil erosion impacts on both the farmer, his/ her farm, as well as on the environment of the farmer. It causes reduction in crop yield, farm income, and propels various forms of changes by the farmer in order to overcome the problem. Based on this, farmers were required to indicate their perceptions on how they might have changed their crop planting because of soil erosion. This also indicates the severity of the soil erosion on their farms. The table 5.17 is a representation of findings.

As findings indicate, two are particularly of note. One of them is that the largest percentage (36.7%) said they actually plant fewer crops every year due to soil erosion problem. This is quite remarkable, which indeed agree with literature findings on the trend of soil erosion in the world. As maintained by Radford (2004), each year experts estimate that more than 10m hectares (25m acres) of crop land are degraded or lost as a result of soil erosion. One deduction from the above is that farming sustainability, profitability and livelihoods are at great risk.

Another point of note is the percentage of farmers (23.3%) which said they have never changed their crop planting style because of erosion. This might be because they are able to manage the effects of soil erosion alongside their farming or may be because their farm is too small for the effect of soil erosion to be significant.

5.2.2.5. Severity of current soil erosion on sustainability

Sustainability is how much the farmer is able to remain in farming for a long time. How much the perception of farmers' sustainability is a reflection also of the severity of soil erosion in their area. This was also measured with a Likert scale of 1-5, where "one" represents "very severe", while "five" represent "not limiting at all".

Table 5. 18: Severity of current soil erosion on sustainability

Severity of erosion on sustainability	Frequency	Percent
Very severe	17	28.3
Severe	15	25.0
Moderately severe	7	11.7
A little severe	13	21.7
Not limiting at all	8	13.3
Total	60	100

Source: Fieldwork 2012

As table 5.18 suggest, over 50% of farmers' perception reveal that the impact of current soil erosion on their sustainability is severe (refer to appendix 2). This indeed is alarming, because farming is the main source of livelihoods in most developing countries worldwide. According to Mati (2006: 1), agriculture is the main occupation of people in sub-Saharan Africa, supporting over 67% of the population.

5.2.2.6. Perceived impact of soil erosion on amount of food available for the households

Amount of food available for the household relates to the factor of availability of food. It is positively related to food security because the more food people have the more food secure they are and vice versa. This therefore means that anything the hinders production of food will no doubt hinder food security. This is why this study is very relevant. Farmers were thus interviewed on the level of food that is available to their homes. Figure 5.9 is a representation of findings.

According to findings, a total of 71.7% of farmers said that the impact of soil erosion is significant on the amount of available food for their households. This again is worrisome because adequate and available food for the home is a basic requirement for food security. For example, the Parliamentary Office of Science and Technology (2006: 1) defined food security as a situation when all people at all times have physical and economic access to sufficient, safe and nutritious food for a healthy and active life.

Findings here are remarkable. Firstly, it provides an understanding of the level of the impact of soil erosion on farmers' livelihoods in the study area. Secondly, it gives an indication of the level of food insecurity in the area, because, if the impact of soil erosion on the amount of household food is much, then this is unarguably a sign of food insecurity.

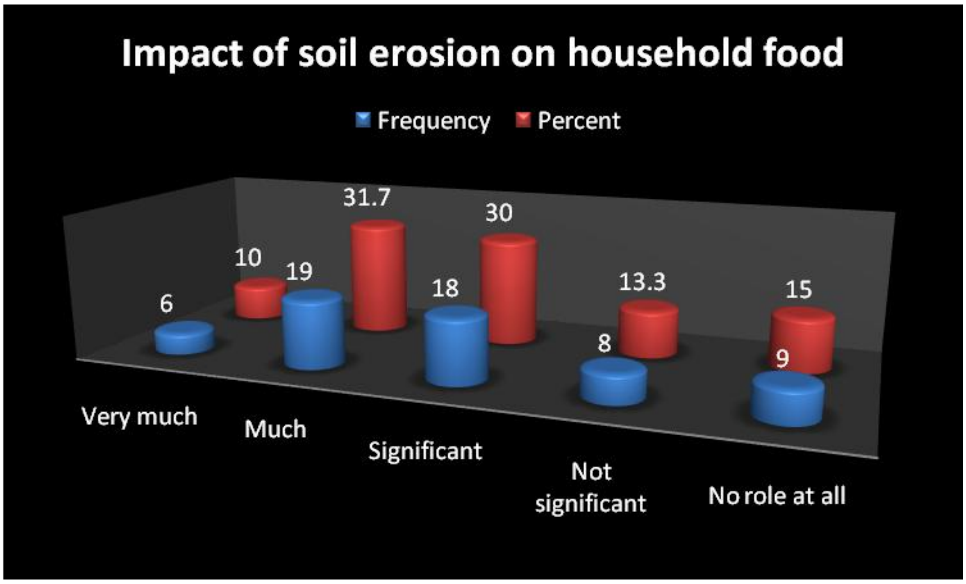

Figure 5. 9: Impact of soil erosion on amount of food available for the home

5.3. Farmers' innovation adoption behaviour concerning erosion control in the study area

In this section, the first emphasis will be to provide an understanding of possible soil management technologies or practices, whether recommended or traditional, in the study area. The second aspect will then be an establishment of farmers' innovation adoption behaviour in the area.

5.3.1. Possible soil conservation measures in the study area.

One of the most effective ways of curbing soil erosion activities is the use of appropriate soil conservation measures. These are highly proven and improved soil management measures that reduce too much strain on the soils. Inappropriate and unimproved dealings with the soil have grave consequences not just for the soil, but for the environment as a whole. According to Pimentel (2006: 121), the extensive removal of vegetation for crops and livestock rearing is usually followed by extensive soil erosion. It therefore means that adequate caution has to be given in the way humans deal with soil. This may be through adequate soil management measures. As such, farmers in the study area were interviewed to know the level of recommended soil management practices available to them.

5.3.1.1. Perception on recommended soil management practices for soil preparation

One of the major ways of dealing with soil erosion problem is the use of appropriate soil management practices for preparing the soil before planting. In this section, farmers are required with an open-ended question to provide any recommended soil management practices, if there are, for soil preparation in their area. Table 5.19 represents findings.

Table 5. 19: Perception on recommended soil management practices for soil preparation

Recommended soil management practices for soil preparation	Frequency	Percent
Soil tillage	7	11.7
Contour farming	6	10
Use of manure/fertilizer	7	11.7
Planting layered crops/trees	6	10
Construction of furrows	8	13.3
Others	26	43.3
Total	60	100

Source: Fieldwork 2012

According to Donovan and Casey (1998: 6-16), a list of possible soil management practices that could improve soil fertility was provided. Examples are the use of mineral fertilizer, rock phosphate, limestone, gypsum, legumes, integrating crops and livestock, and crop residues.

From the table 5.19, apart from the “others ” variable, farmers’ perception reveals that the three most frequently used soil management practices are construction of furrows/ drainage; use of manure/ fertilizer; and soil tillage. Considering the table also, the use of soil tillage is quite questionable. This is because undue tillage is one of the easiest ways through which soils are open to erosion. In fact, Ighodaro and Lategan (2012) emphasized that tillage cropping is one of the inappropriate agricultural practices leading to soil erosion in the Eastern Cape.

5.3.1.2. Perception on recommended soil management practices for crop planting

Table 5. 20: Use of recommended soil management practices for crop planting

Recommended soil management practices for crop planting	Frequency	Percent
Use of intercropping	5	8.3
Construction of furrows	5	8.3
Use of appropriate spacing	7	11.7
Planting of trees	5	8.3
Ridging	5	8.3
Use of crop rotation	5	8.3
Others	28	46.8
Total	60	100

Source: Fieldwork 2012

According to the Benson Agriculture and Food Institute (2004: n.p), “few management decisions are as important in successful crop production as those made at planting time”. One of those decisions relates to soil management.

In the study area, farmers were also required to indicate their basic soil management practices for crop planting. Table 5.20 is a representation of findings. From the table, farmers seem to employ the use of appropriate spacing of crops, which scored 11.7% of total respondents. Other practices also includes: use of intercropping, construction of furrows, planting of trees, ridging and crop rotation.

As reflected, appropriate spacing topped the list of farmers' response. This is quite promising because appropriate spacing is one of the management decisions that enhances crop yield. Speaking on this, the Benson Agriculture and Food Institute (2004: n.p) indicated that the objective of spacing of crop plants is to achieve the maximum yield on a unit area of land without sacrificing quality of products.

5.3.2. Farmers' innovation adoption behaviours in the study area

According to Duvel (1991: 73), the basic reason for agricultural problems like soil erosion in rural areas is because of farmers' none adoption or inappropriate adoption of improved innovations for change. Literature findings show a great positive relationship between farmers' behaviours, technology adoption and dissemination. For example in Botswana, poor adoption rate was one of the factors pointed out as constraints against extension effectiveness and delivery system (Kimaro, Mukandiwa and Mario 2010: 5). Also in Haiti, Bayard et al. (2006: 28) reported that despite the effectiveness of rock walls in controlling soil erosion and the expected high returns of using it, its diffusion among Haitian people was limited. Citing Lea (1996), it was also reported that in the case when it was adopted, the structures were not maintained adequately, which seems to supported Duvel's idea as well as the central argument of this study which has to do with adoption behaviour of farmers, that soil erosion problem in the study area is because of farmers' none adoption or inappropriate adoption of improved soil management practices.

Therefore, this section focuses on identifying some of those variables that indicate farmers' behaviours toward agricultural innovations relating to soil erosion control and bearers of agricultural innovations (extension officers) in the study area.

5.3.2.1. Perceived frequency of using extension advices

As figure 5.10 indicates, the largest percentage of farmers of about 41.7% maintained that they do not use extension advices at all. This is quite remarkable. Several reasons can be attributed for this. One is that it could be that extension services are ineffective in the study area. Also it might be that extension advices are incompatible with farmers' needs, perception and knowledge, according to Duvel (1991: 80-81), or it could even be the impact of certain demographic variables like age and education. As findings of this study reveal that over 50% of farmers in the area are in the older people's group and only 5% have any tertiary education. According to Bonabana-Wabbi (2002: 31), citing Waller et al. (1998) and Caswell et al. (2001), education creates a favourable mental attitude for the adoption of new technologies especially those that requries information-intensive and management-intensive practices.

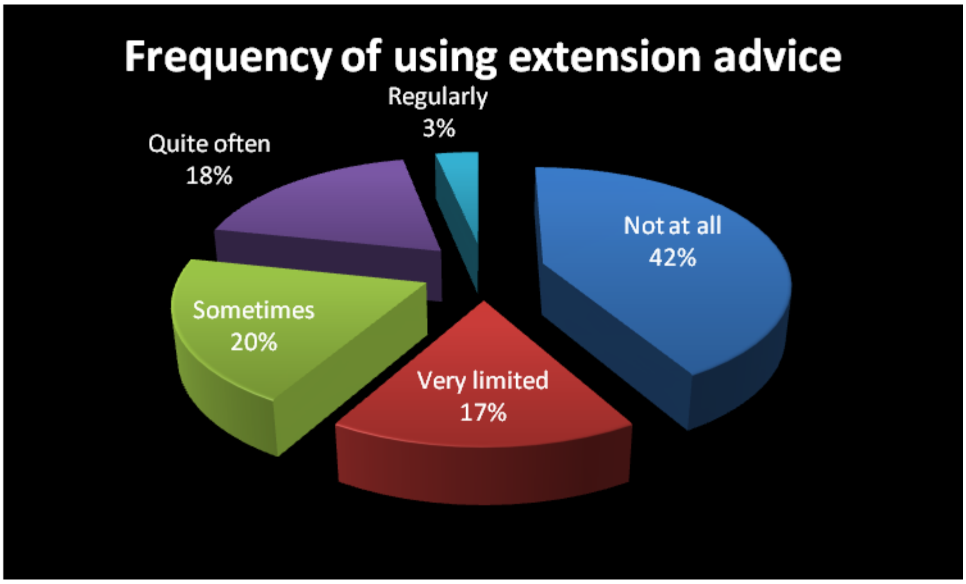

Figure 5. 10: Frequency of farmers' use of agricultural extension advice

5.3.2.2. Level of use of recommended soil management practices

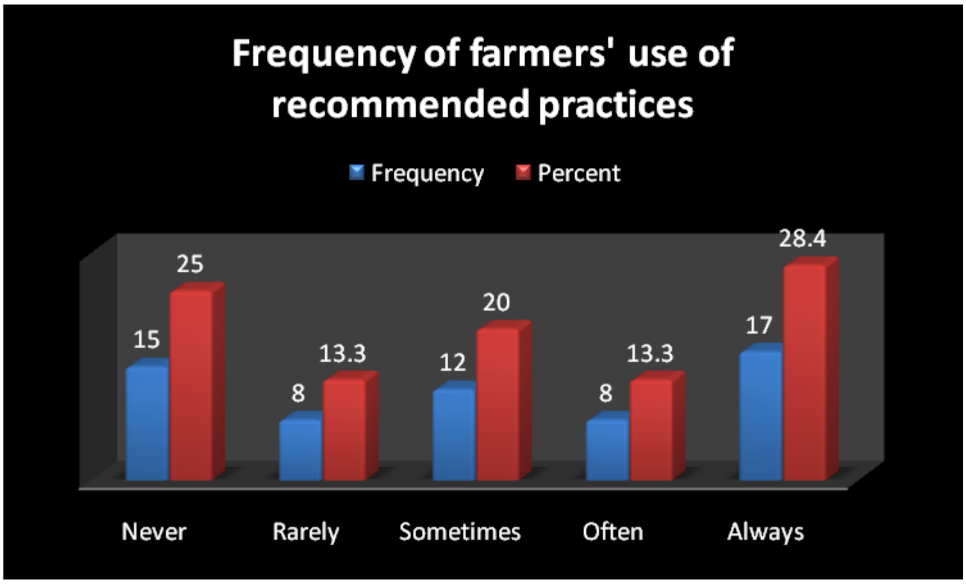

Figure 5. 11: Frequency of farmers' use of recommended soil management practices

Apart from use of general extension advices, in terms of the objectives of the study, effort was also focused on finding out farmers' behaviours with respect to basic recommended soil management technologies in the area. As in the previous section, the expectation is that frequent use of recommended practices should positively impact on soil erosion and ultimately on food security in the study area. As a matter of fact, recommended practices are the result of tried and tested research. Toborn (2011: 10) posited that recommended practices have gone through transformative and communicative stages. As such, farmers were required to rate with a Likert scale of 1-5, where “one” represents “never”, while “five” represent “always”.

According to the figure 5.11, a total of about 58.3% of farmers have one problem or the other with using the recommended soil management practices available in their area. In fact, 25% said they do not use them at all, 13.3% said they rarely use them, while 20% said they only use them sometimes. Finding here is remarkable because, it goes to suggest a reason for soil erosion in the study area: farmers’ non-use or inappropriate use of recommended practices for soil erosion control.

As in the previous section, several factors can be attributed to this behaviour of famers. However, no matter the factors, the underlying point is that farmers either are not using the recommended practices for soil erosion control in their area or they only use them partially. This seems to agree with the thesis argument of this study that soil erosion problem in the study area is because of farmers’ none adoption or inappropriate adoption of recommended soil management technologies in the area.

5.3.2.3. Level of farmers’ satisfaction with recommended soil management practices

Figure 5. 12: Farmers’ satisfaction with recommended soil management practices

According to the previous section, over half the population of farmers in this study have a problem with the recommended soil management practices that is available in their area.

Hence in this section, effort is made to establish farmers' satisfaction with the various practices. The expectation is that, from all indication, farmers' satisfaction is supposed to be positively related with their level of adoption. In the opinion of Ridaura et al. (2002), as quoted by Minh Duc (2008: 525), the satisfaction of farmers is regarded as an important measure of sustainability, and it has become the leading goal of scientific investigation and policy agenda.

Based on this, farmers were tested with a Likert scale of 1-5, where "one" represents "unsatisfied", while "five" represent "very satisfied". Findings are displayed in figure 5.12.

In the figure, the perception of farmers reveal a total of about 56.6% that are not totally satisfied with the recommended practices. In fact, 23.3% said they are unsatisfied, 13.3% said they are a little satisfied, while 20% said they are just satisfied moderately.

Findings of this section seem to agree with that of the previous two sections. As revealed, in both sections, over half the population of farmers do not use agricultural extension advice or recommended soil management practices in their area. Finding here is an indication of one of the reasons why farmers are refusing or adopting inappropriately the soil technologies in their area from agricultural extension service or by any other body in the study area.

5.4. Farmers' perceptions on the impact of agricultural extension services with respect to soil erosion-control in the study area.

Agricultural extension as defined by Ozor and Nnaji (2011: 43), citing Leeuwis (2006), is a series of embedded communicative interventions meant to develop and induce innovations which is expected to solve human problems. Speaking on the relevance of extension to agricultural development, Kimaro, Mukandiwa and Mario (2010: iii) suggested that agricultural sustainability and productivity worldwide depends on the quality and effectiveness of extension services among other things. Therefore in this section, the focus is on establishing farmers' perception on the impact or effectiveness of agricultural extension with respect to soil erosion control in the study area. Various variables have been chosen to measure this as provided in the following subsections.

5.4.1. Extension "talk" on soil erosion control

The frequency of agricultural extension officers' talk on soil erosion and its control is very relevant in understanding the effectiveness of extension services with respect to soil erosion control. This is because, if extension' perception on the level of impact of soil erosion in the study area is equal to that of farmers, it will reflect as one of the central themes during their visits. The idea is that extension talk is expected to be positively related to soil erosion impact in the study area.

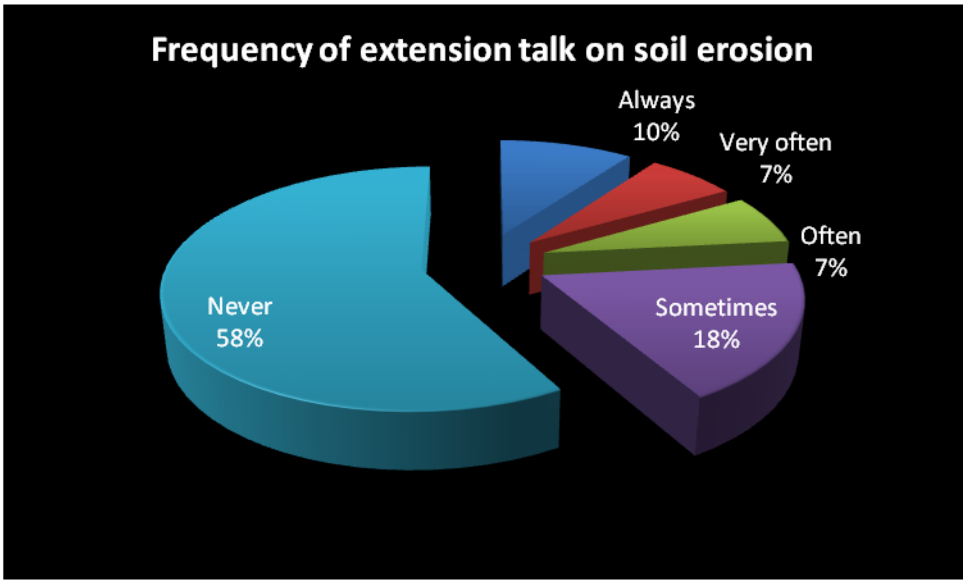

Figure 5. 13: Frequency of agricultural extension talk on soil erosion control

However findings of figure 5.13 appear very shocking, as only about 24% of farmers said that extension officers discuss issues of soil erosion during their visits, while a total of 58% said they never speak about soil erosion at all, while 18% said they only do sometimes. As it were, extension is to provide adequate information on best practices or new technologies for farmer's development. According to Oladele and Tekena (2010: 91), reporting Agbamu (2002), agricultural extension is the most important source of information to farmers in most African countries. Citing Van den Ban and Hawkins (1998), Oladele and Tekena further said that agricultural extension plays significant roles in influencing farmers' adoption behaviours.

The above findings indicate some level of ineffectiveness on the part of extension. This is because the role of extension is to provide farmers enough information to solve their farm problems. If therefore extension service in the study area is not addressing a farm problem like soil erosion, then indeed there is a big gap.

However, reasons that can be attributed to the above finding might be many. One of them could be the problem of inadequate training to face such environmental problems. Apart from training, other factors may be the problem of how well equipped extension people are to do their jobs. Another factor may as well be the problem of farmers' resistance to change

5.4.2. Farmers' perceptions on the effectiveness of extension advices

Agricultural extension advices here represent all general extension services in the study area. The aim is to know how highly esteemed extension people and their advices are viewed by farmers. The idea also is that farmers' perception is expected to be positively related to their level of adoption of recommended practices from extension agents. This also was measured with a Likert scale of 1-5, with "one" representing "ineffective", while "five" represent "very effective".

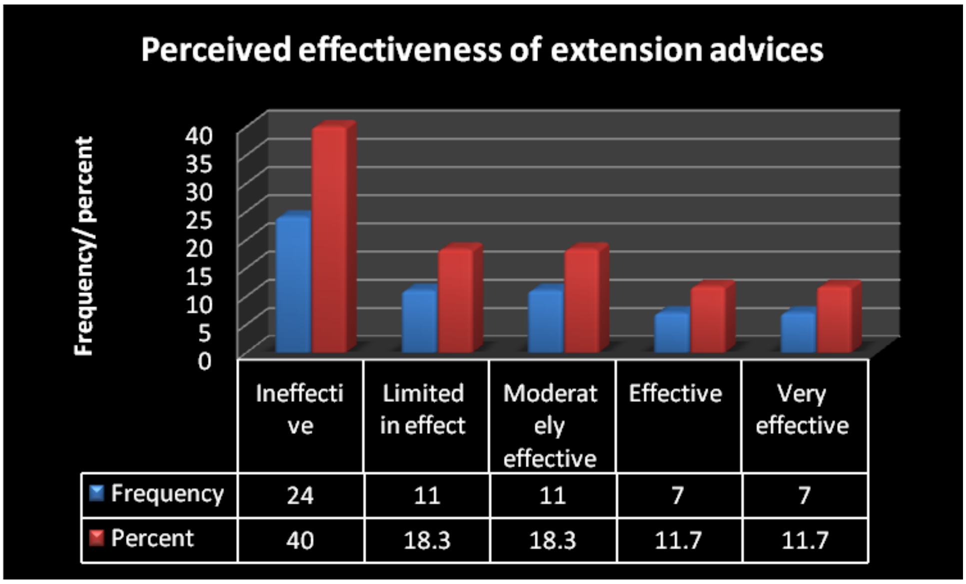

Figure 5. 14: Farmers' perception on the effectiveness of extension advices

As findings indicate (figure 5.14), only about 23.4% of farmers perceive extension advices to be effective. Farmers' perception is considered very relevant in the adoption process. Emphasizing the role of perception in adoption, Pankratz, Hallfors and Cho (2002: 315), reporting Rogers (1995), posited that literature has found out that the way targeted adopters perceive the attributes of an innovation is very critical and that these perceptions account for up to 49-87% of the variance in whether they will eventually adopt the innovation or not. So, if farmers' perception here is of low quality, this could be the reason why they shy away from adopting recommended practices by extension people which seems to support the central argument of this study that soil erosion in the study area is as a result of farmers' none or inappropriate adoption of recommended soil management technologies in the area.

5.4.3. Extension versus traditional methods on erosion control

Traditional method of soil erosion control was also measured against extension recommendations. The reason is because all over the world rural people have their own local ways of dealing with agricultural problems. In the study area, farmers were required with a Likert scale of 1-5, to compare their local methods of erosion control against the recommendations by extension officers. Findings are expressed in the table 5.21.

According to findings, a total of 53.4% of farmers said that their methods were perceived of higher effect than extension methods. This again provides the understanding why farmers are not accepting extension advices, which can be a reason why soil erosion is still evident in the area.

Table 5. 21: Perceived effectiveness of traditional versus extension methods of erosion control

Traditional versus extension methods	Frequency	Percent
Not effective at all	5	8.3
Less effective	13	21.7
Moderately effective	10	16.7
Effective	16	26.7
More effective	16	26.7
Total	60	100

Source: Fieldwork 2012

Findings of table 5.21 seem to support literature views on the subject. For example, Rogers (1995), as cited by Pankratz, Hallfors and Cho (2002: 315), indicated that if farmers perceive the relative advantages of the incoming innovation of lower quality to what they have been using, usually they shy away from adoption. This also is support by Duvel (1991: 80-81). However, in Duvel's consideration, the relative advantage of Rogers (1995), as cited by Pankratz et al. (2002: 315), is called insufficient prominence.

5.4.4. Perception on level of extension equipment

Extension equipment here speaks about how well equipped extension people are in carrying out their duties in the study area. This could be in the form of number of extension officers, means of mobility, communication equipment, and adequate funds from government. As the figure 5.15 indicates, farmers' perception on level of agricultural extension officers' equipment to succeed in their job seems inadequate, as only about 28.3% of farmers said extension officers are well equipped, while the other 71.6% said extension is inadequately equipped.

This indeed is remarkable. It shows therefore that there are myriads of factors militating against the effectiveness of agricultural extension services in the study area. This seems to true these days in many developing countries of the world. As a case study, in Botswana for example, the First National Conference on Agricultural Extension in 1995 identified five primary classes of problems militating against the success of the extension delivery system (Kimaro, Mukandiwa and Mario 2010: 4-5). One of them is what was called physical problems relating to natural occurrences, limited market for products, and inadequate transport and communication facilities. A second one was called administrative or management problems. This one has to do with inadequate residential and office accommodation, low morale among extension workers, extension agents attending to administrative and emergencies instead of extension duties. Another problem that was identified was related to training problems. This refers to problems such as shortage of specialized trained personnel and inadequate in-service training. The fourth category of problem was called farmer problems. This has to do with problems like lack of credit facilities, absentee farmers, poor adoption rate due to negative attitudes, shortage of drought power and shortage of farm labour. The last category that was classified was called general problems, which have to do with poor coordination among sister departments, inadequate research extension linkages, extension officers/ farmer ratio too high, and extension areas too wide for one officer.

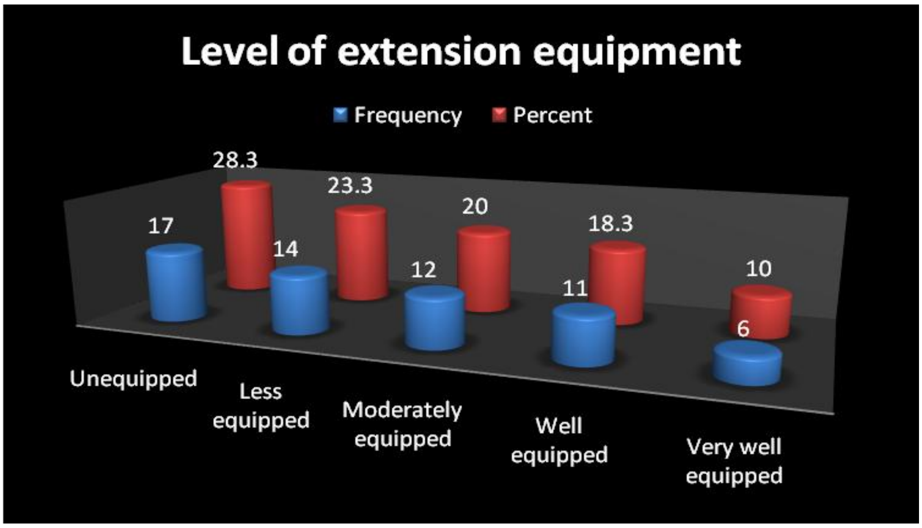

Figure 5. 15: Perception on level of agricultural extension equipment

5.4.5. Adequacy of extension officers in their job

Farmers' perception on the adequacy of extension officers in their job was also measured in the study area. According to figure 5.16, perception seems to indicate that extension officers are inadequate, as only 21.7% of farmers said extension officers are adequate. Various reasons that were offered for their view, in order of preference, were:

1. Agricultural extension people are unreliable. According to farmers, they make promises which they do not keep;
2. they hardly or never visit their area;

3. other reasons, such as their being unconcerned for subsistence farmers, and undue focus on cooperatives;
4. communication problems; and
5. they pay less attention to crop farming. In other words, extension services are more tilted toward livestock farming in the area.

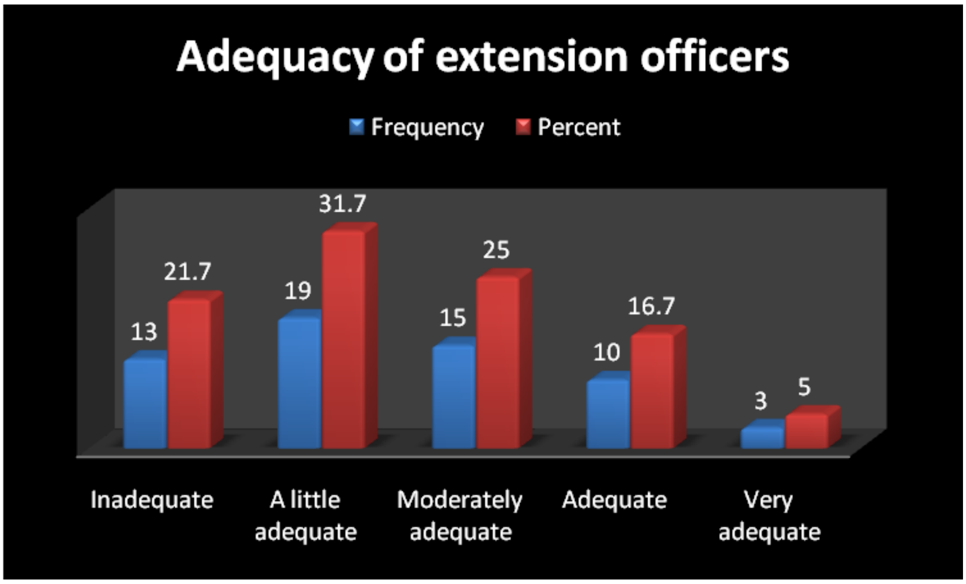

Figure 5. 16: Perception on level of agricultural extension adequacy in their job

5.5. Testing for relationships or associations among variables in the study area

One major focus of chapter four of this study was on defining basic variables with respect to the objectives of the study. A spectacular thrust of any research is finding out how variables relate in nature. Variables usually do not stand in isolation. As such, research studies want to know why things are the way they are: if variables A, B, C and D are found in a study, the questions therefore are, how does A stand in relation to B? How does B stand in relation to C? As such in this chapter, specific effort is geared towards knowing the kind of relationship that exists between chosen variables of study. This will be achieved through the presentation of results of linear regression test statistics.

5.5.1. Results of the linear regression model

Table 5. 22: Presentation of the results of test of relationships in the study area

Variables	Perceived innovation orientation		Perceived soil erosion impact		Perceived extension effectiveness	
	β	Sig.	β	Sig.	β	Sig.
Age	0.048	0.724	0.333	0.024**	0.164	0.224
Gender	-0.081	0.536	-0.105	0.444	0.135	0.297
Marriage	-0.021	0.874	0.042	0.766	0.088	0.508
Education	0.143	0.301	0.133	0.360	0.223	0.107
Yield	0.343	0.021**	0.044	0.772	-0.301	0.043**
Product quality	0.064	0.657	0.285	0.065*	0.191	0.189
Sustainability	0.193	0.205	-0.290	0.074*	0.160	0.290
Profitability	0.071	0.642	0.031	0.845	-0.477	0.003***
Accessibility	0.292	0.027**	0.063	0.637	-0.076	0.550
Availability	0.049	0.710	-0.156	0.261	0.208	0.115
	R=0.597		R=0.537		R= 0.615	

*** 1% significance level ($P < 0.01$) ** 5% significance level ($P < 0.05$) * 10% significance level ($P < 0.10$)

5.5.2. Discussion of results

5.5.2.1. Relationship between the perceive impact of soil erosion and food security in the study area- age, product quality and sustainability of farmers

As table 5.22 indicates, the age of farmers is found to relate positively with the perceived impact of soil erosion on the agricultural potential of famers in the study area with a statistical significance of 0.024, measured at a p-value of 0.05 (5%) significance level. This is however as partially expected, because as expected, the age of farmers impacts both negatively and positively on adoption. The study of Bonabana-Wabbi (2002:30), citing Adesina and Baidu-Forson (1995), is a good support of this assertion. It was said that in Burkina Faso, for example, age was discovered to influence adoption of sorghum positively. However, he also said that age has been found to be either negatively correlated with adoption, or rather not significant in farmers' adoption decision making process. The above finding seems favourable for a high reduction and control of soil erosion. This is because there is supposedly a high level of adoption of improved soil management practices or use of extension advices in the study area, since the descriptive statistics reveal that over 50% of farmers are old. But this does not seem to be the case.

In the regression model above (table 5.22), the quality of product was also found to relate positively with the impact of soil erosion in the study area with a statistical significance of 0.065, measured at a p-value of 0.10 (10%) level of significance. This is however expected because quality farm product will breed more buyers as well as more income for the famer, which will enhance more capacity for increased productivity, and the buying and use of more improved soil management technologies. As such, soil erosion in the area will be reduced. It seems to agree with findings of the descriptive statistics, as product quality was found to be low. Hence perhaps the low adoption rate of recommended practices in the area. Improved productivity impacts greatly, not only on the farmer's wellbeing, but on the entire economy. In China for example, it was said that the success of crop production has impacted on both global food supply and on natural resource use and availability (Fan, Shen, Yuan, Jiang, Chen, Davies and Zhang 2011:1).

In a similar note, as the table 5.22 reveals, sustainability of farmers is also found to be positively related with the perceived impact of soil erosion in the study area with a statistical significance of 0.074, measured at a p-value of 0.10 (10%) level of significance. This again is expected to be true/ positive because sustainability means the farmer is able to continue in the business of farming for a long time unhindered (World Commission on Environment and Development (WCED), cited by Spangenberg 2002:1). And the fact that the value is positive presuppose that the farmer will ensure a sustainable means of production, which in this case is recommended soil management technologies, to farm. This seems also to agree with findings of the descriptive statistics. As discovered, sustainability of the farmers was found to be low, hence perhaps the low adoption of recommended soil management technologies.

5.5.2.2. Relationship between perceived innovation orientation of farmers and the perceived soil erosion impact on agricultural production in the study area- education, yield and accessibility

According to the expectation of this study, as literature reveals, a variable like education is supposed to be positively related with innovation orientation and adoption behaviour of farmers. This also is as supported by Bonabana-Wabbi (2002:31), citing Waller et al. (1998) and Caswell et al. (2001), that education create a favourable mental attitude for the adoption of new technologies especially of information-intensive and management-intensive practices. However, with respect to this study, as result of the regression analysis indicates (table 5.22), the relationship between education and the perceived innovation orientation and adoption of farmers is not statistically significant. This is somewhat different from the view of descriptive statistics of the study. As discovered, education level of farmers in the study area is low, which is presumed to be impacting negatively high on their farming decisions in the area.

Although this is the case, this does not altogether mean that there is no form of relationship between the two variables in the study, it is just that the relationship is not statistically significant. Perhaps there might have been other factors that may have been impacting on this finding. It may be that the soil technologies being introduced in the study area does not require much educational knowledge to operate.

As the table 5.22 indicates, the yield of farmers relates positively with the perceived innovation orientation and adoption behaviours of farmers in the study area with a statistical significance of 0.021, measured at a p-value of 0.05 (5%). This is however remarkable and it concurs with findings of the descriptive statistics as the yield of farmers was perceived low, hence adoption rate of recommended practices. For example, it is expected that the more the yield of farmers' farm, the more income they get. And profit is one of the main factors that propel any business endeavour. This also is why they will like to adopt more soil management practices that help them overcome soil degradation problems like soil erosion. As Tiwari et al. (2008:212) puts it, it is expected that farmers will, in the adoption decision making process compare the advantages and appropriateness of different soil conservation technologies, based on the available resources at their disposal and their opportunity for profit (Tiwari et al. 2008: 212).

Similarly, in terms of the relationship between food accessibility of farmers and their level of innovation orientation and adoption, the food accessibility of farmers was found to be positively related with their level of innovation orientation and adoption at 0.027 statistical significance, measured at a p-value of 0.05 (5%) significance level. This also is remarkable because, as expected, the more accessible farmers are to food, the more economically and socially empowered they become. As such, they would like to adopt more soil management technologies to access more of the gains of improved production and social status. This is because, hunger is one of the socioeconomic factors which can lead to poverty and disease, and ultimately to food insecurity, as well as to slow economic growth of society. In fact, the Parliamentary Office of Science and Technology (2006:2) maintained that "hunger, poverty and disease are interlinked, with each contributing to the occurrence of the other two". Findings here also concur with findings of the descriptive statistics. As discovered, selling of crops which is one measure of accessibility in the area was found to be difficult, as such the low adoption rate of recommended practices.

5.5.2.3. Relationship between extension effectiveness and innovation orientation and adoption in the study area- farm yield and profitability of farmers

As the regression model (table 5.22) reveals, perceived extension effectiveness is positively related with the farm yield of farmers in the study area with a statistical significance of 0.043, measured at a p-value of 0.05 (5%) level of significance. This finding is actually expected to be positive because agricultural extension officers are the bearers of new technologies for change, and like in this study, recommended soil management technologies. The fact it is positive at 5% means that the more the yield of farmers, the more they are likely to adopt recommended soil management technologies or agricultural extension advices relating to soil erosion. Drawing inferences from literature, the rational choice theory propounded that every action is essentially ‘rational’ in nature, and that individuals calculate the likely costs and benefits of any action before deciding on them (Scott 2000: 1). Speaking also along this line, Barungi and Maonga (2011:30) maintained that the behaviour of human beings, whether farmers or non-farmers, is motivated by the possibility of making gains. In all, the indication is that farmers will be very happy to adopt recommended soil management technologies or extension advice relating to soil erosion control in their area when they perceive that it will increase greatly their yield. This seems to rhyme also with findings of the descriptive statistics. As discovered, farm yield is low and majority of farmers do not use extension advices in the area.

The perceived agricultural extension effectiveness was also found to be negatively related with the profitability of farmers in the study area with a statistical significance of 0.003, measured at a p-value of 0.01 (1%) level of significance. The regression coefficient was -0.477. This finding is very significant, especially at a 1% level of significance, and with a partial coefficient of profitability being -0.477. This seems to disagree with findings of the descriptive statistics, which indicated that farming in study area is just only 30% profitable without any problem. It also seems to disagree with literature findings on relationship of profitability of the farmer and effective extension service. As expected, the more farmers are profitable, the more they accept extension messages and vice versa. For example, citing Roberts, English and Mahajanashetti (2000), Roberts, English and Larson (2002) indicated that the key to farmers’ adoption of site-specific farming (and perhaps other technology) is the profitability of the technology. This means that profitability propels adoption tendency. And moreover, citing Romani (2003) and Evenson and Mwabu (1998), Muyanga and Jayne (2006: 1) suggested that there is a general view that extension services, if well designed and implemented, improve agricultural productivity. This also indicates a positive relationship between agricultural extension and farm productivity.

The statistical test finding of the negative relationship of farmers’ profitability and extension effectiveness may have been occasioned by several factors. Drawing inference from findings of the descriptive statistics, one of them could be because the farm size of most farmers in the study area is just too small (less than $200m^2$ or 0.02 ha) to really feel the impact of soil erosion, as such they may not be too bothered about extension service on soil management technologies. Also, the factor of subsistence farming may be at work. This is because most of the farmers in the study area farm only to provide extra food for the home, not really for profit. As such, the long term gains of employing soil technologies may not be deemed necessary, as a result, they may not be too bothered about extension and their messages. Moreover, the descriptive statistics reveal that most farmers in the study area are old and not well educate. And it is a general belief that older and uneducated people are more closed to change and very conservative, traditional and less innovative, as such they may not be too concerned about extension services on soil erosion control.

5.6. Conclusion

One of the aims of this chapter was to present and discuss the findings of primary data collected at the Upper and Lower Areas of Didimana, in the Eastern Cape of South Africa using basic descriptive statistics such as frequency, percentages, mean, bar charts and pie charts. In line with the main objective of the study, findings seem to indicate that the food security level of farmers in the study area is low, and the impact of soil erosion on food security and the livelihoods of the farmers seems to be high. Similarly, farmers' perception seems to indicate that the impact of farmers' innovation orientation and adoption behaviour with respect to soil erosion control in the study area is high, as most farmers do not use agricultural extension advice and recommendations, as well as most of them perceive the relative advantage of their traditional methods of more importance than that of extension. Finally, findings indicate that farmers' perception on the impact of agricultural extension activities on soil erosion control in the study area seems to be low, as farmers perception indicates that they are inadequately equipped, their services are ineffective and they are also considered inadequate in their job as it relates to soil erosion control in their area.

According to findings of the linear regression model test staticstics, innovation adoption orientation and adoption behaviour of farmers was found to be positively related with farm yield and food accessibility. Therefore, extension service and all those involved in agricultural development should take great advantage of this opportunity. That is by ensuring that everything that will increase yield and remove all factors militating against the accessibility of food should be their greatest concern. This is because these factors are found to increase the probability of farmers adopting innovations for change.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.0. Introduction

This chapter consist of three major aspects. The first part deals with summary of findings, where the basic discoveries of the study are expressed in their lowest terms. The second aspect is the conclusion. In this section, effort is geared towards the wrapping up of the study, while the third aspect deals with a provision of some suitable recommendations as applied to the study area.

6.1. Summary of findings

The basic aim of this study was to ascertain the perceived impact of soil erosion on the food security of Upper and Lower Areas of Didimana, in the Eastern Cape of South Africa, and the role farmers innovation adoption behaviour plays in the interaction. The central argument of this study was that soil erosion which is an agricultural problem is the result of non-adoption or inappropriate adoption of improved and recommended soil management technologies by farmers in the study area. The Duvel (1991) model was the model that provided the scaffold of reasoning, where the relevance of individual demographic characters is stressed in the determination of farmers' behaviours. Hence this section begins with a summary of the demographic characters of farmers in the study area.

6.1.1. Demographic variables

6.1.1.1. The population of farmers in the study area consist of older people which leaves very little to be desired. In other words, farming decisions are left in the hands of older people, who are less educated, less innovative, traditional and very conservative in terms of technological spread and adoption.

6.1.1.2. Findings indicate that the percentage ratio of male to female farmers is 53.3 to 46.7, which show that the gap between males and females with respect to farming in the study area is not very significant. A factor which may have contributed to the above could be that the dividends of the global cry for gender equality, in which South Africa seems to be one of the foremost adherers, is gradually yielding.

6.1.1.3. Findings also indicate that the percentage of married people in the study area is 60%, while that of the unmarried (singles, divorced and widowed/ widower) add up to 40%. According to literature, the positive effect of marital status would have reflected in the form of appropriate farming decisions that reduce soil erosion or degradation, but the effect of some other variables like inadequate education and level of poverty in the area may have rendered these ineffective.

6.1.1.4. More so, findings reveal that the education level of farmers in the study area is poor, as only 5% of farmers' population had a tertiary education. Finding here is a good explanation why the Eastern Cape Province is presently ranked as one of the three poorest, as well as one of the three most degraded provinces in South Africa The reason is because, available evidence proves that poverty and inadequate education or illiteracy are two key characteristics which impact on farmers' poor farming decisions which, as in this case, lead to soil erosion.

6.1.1.5. It was also discovered that over 70% of farmers in the study area occupy farm holdings which is less than 200 meters squared (0.02 ha). Finding here indicates an emergency situation in terms of food security goal of the South African government in general and the Eastern Cape in particular. In fact, the situation of farming as discovered in this study is a slap on the vision of the Integrated Food Security Strategy (IFSS) of the South African government, which is to attain a universal food security for all South Africans as defined by the Food and Agriculture Organization of the United Nations.

6.1.1.6. The perception of farmers further reveals that farming in the study area is more of mixed farming, with a percentage of 70%, while those who practiced livestock only is 15% and those who practiced crop farming only is also 15%.

6.1.1.7. Findings also indicate that the major source of income for the farmer in the study area is from the government social welfare scheme, wherein the old people constitute the largest percentage. Apart from the social grant scheme, findings indicate that livestock farming is the main income source for the farmers, which seem to indicate the most human activity responsible for the erosion problem. Crop farming constitutes the lowest in terms of income generation for farmers in the study area, with only 5% farmers' perception.

6.1.1.8. Furthermore, farming experience for farmers in the study area can be said to be low, because the larger part of the population of farmers have been in farming for a period less than 10 years.

6.1.2. Findings on farmers' perceptions on the perceived impact of soil erosion on food security of the study area

This section consists of two aspects. First it considers the various measures used by the study to assess food security in the study area, while the second aspect views farmers' perceptions on the impact of soil erosion on food security in the study area.

6.1.2.1. Measures of food security in the study area

6.1.2.1.1. In terms of crops planted, a total of about 19 different types of crops were found cultivated in the study area. The five most common ones, in order of importance, are maize, spinach, potatoes, pumpkin, and beans.

The period of the year when these crops were planted was another focus of the research. Considering the five most common crops planted in the area, majority of the people indicated that they plant maize in September, October, November and December. From all indications, spinach seems to be favourable throughout the months of the year from January to December. Similarly, potato seems to be well favoured for September, October and November, as majority of the farmers said they plant the crop in the aforesaid months. In the same vein, pumpkin is said to be planted in the months of October, November and December, while beans seem to be more favoured in the months of September, October and November.

6.1.2.1.2. Perceptions of farmers also indicate that the decision on which crop to plant during the year is determined by a range of factors. The most significant one is that farmers in the area are informed on which crop to plant during the year through an understanding of the weather or crop seasons, with a farmers' response of 85%.

6.1.2.1.3. In terms of farmers' satisfaction with crop quality and quantity, farmers' perception indicate that, in each categories of measurement, less than half the population of farmers in the study area indicated that they are satisfied without any problem. This means that the majority are not satisfied.

6.1.2.1.4. In terms of percentage of crops sold for profit, the study revealed that the largest population of farmers of over 78% sell less than 41% of their crops. In fact, it was found out that over half the population of farmers (53.3%) actually do not sell their produce, which means all their produce are meant for personal consumption which indeed is one main character of subsistence farmers

6.1.2.1.5. In terms of accessibility of food in the study area, the largest population of farmers said selling their produce is difficult. Reasons given for this vary from competition among farmers, lack of ready market, poor yield of crops, apparently due to erosion problem and other reasons such as proximity of farmers' village to town.

6.1.2.1.6. In terms of availability of food, farmers' perception reveal that only very few of the families in the area always have enough food for their families, which show nothing but some levels of food insecurity.

6.1.2.1.7. In terms of farmers' perceived food security levels, only 13.3% perceived themselves to be food secure, while the other 86.7% of the population of farmers perceive themselves as food insecure at different degrees.

6.1.2.1.8. In terms of the perception on the average production levels of each crop cultivated, maize produces about 12 bags per person, spinach is about 13 bunches per person, potato is about 10 bags per person, cabbage is about 8 bags per person, onion is about 8 bunches per person, butternut is about 17 bags per person, and beans is about 25 bags per person.

Findings here leaves very little to be desired. It again reiterates the level of farming practice in the area, which is basically homestead garden where majority of the farmers cultivate less than 0.02 ha of land (table 5.3), as well as the level of food security in the study area, which is poor or below average.

6.1.2.1.9. In terms of how sustainable farmers were in the study area, farmers' perception indicates that only 21.7% of the population of farmers perceived their farming endeavours as sustainable without any form of support.

6.1.2.1.10. Profitability of farming in the area was also perceived low, as only 30% perceived their farming to be profitable, while all the others suggested that their farming was unsustainable at varying degrees.

6.1.2.2. Impact of soil erosion on food security in the study area

6.1.2.2.1. In terms of impact of soil erosion on farmers' crop planning decision making, the most significant effect was demonstrated in the form of impact on their weather conditions or a change in their planting sequence due to soil erosion. According to the farmers, this occurs through a shift in time of rain, and thus gradually changing the time of planting/ cropping in the area.

6.1.2.2.2. Similarly, the three most significant perceived impact of soil erosion on farmers livelihoods are reflected in the form of: (1) negative impacts on crops and livestock; (2) other impacts which reflect in the form of increase in cost of production, loss of usable land, negative impact on human lives, climate change problems, negative impact on farmer's occupation, and creation of gullies; and (3) impact on household feeding of farmers.

6.1.2.2.3. Perception of farmers further reveals that in terms of the percentage of crops losses by farmers, findings indicate that about 53.4% of farmers lose well between 21-60% of crops due to soil erosion. The most remarkable aspect of the finding is that 20% of the farmers said they do not lose any crop due to soil erosion. Three reasons may be adduced for this. One of such may be the effect of those who do not farm on crops. Another may also be the effect of the nature of farming currently practiced in the area which is homestead garden, whose size is relatively too small for the impact of soil erosion to really be significant. A third reason may as well be the effect of those farmers who do not sell their crops.

6.1.2.2.4. Moreover, in terms of frequency of change in crop planting as a result of soil erosion, one major point that is of note is that the largest percentage of farmers said they actually plant fewer crops every year due to soil erosion problem, which is an indication of soil erosion severity.

6.1.2.2.5. In terms of impact of soil erosion on sustainability of farmers, findings seem to suggest that over 50% of farmers' said that the impact of current soil erosion on their sustainability is severe. This indeed is alarming, especially due to the fact that farming is the main source of livelihoods in most developing countries worldwide.

6.1.2.2.6. As relating to impact of soil erosion on the amount of food available for the household, a total of 71.7% of farmers' perception seem to suggest that the impact of soil erosion is significant on the amount of available food for their households. This again is worrisome because adequate and available food for the home is a basic requirement for food security.

6.1.3. Findings of farmers' innovation adoption behaviour with respect to soil erosion control in the study area

In this section, the first emphasis will be to summarize findings of possible recommended soil management technologies or practices in the study area as indicated by farmers, while the second aspect will be on impact of farmers' adoption behaviour as it relates to soil erosion control in the study area.

6.1.3.1. Possible soil conservation measures in the study area.

6.1.3.1.1. With respect to possible recommended soil management practices for soil preparation, farmers' perception suggests that the three most frequently used soil management practices are construction of furrows/ drainage; use of manure/ fertilizer; and soil tillage.

6.1.3.1.2. With respect to possible recommended soil management practices for crop planting, farmers' perception seems to suggest the use of appropriate spacing of crops, use of intercropping, construction of furrows, planting of trees, ridging and crop rotation.

6.1.3.2. Farmers' innovation adoption behaviours in the study area

6.1.3.2.1. With regards to frequency of using agricultural extension advices, farmers' perception seem to indicate that majority of the population of farmers do not use extension advices, which is quite remarkable, considering the role of extension in rural areas.

6.1.3.2.2. Apart from use of extension advices, farmers were also interviewed on their use of recommended soil practices. The indication of farmers' perception is that over half the population of farmers in the study area have one problem or the other with recommended soil practices. In fact, 25% said emphatically that they do not use them at all. 13.3% said they rarely use them, while 20% said they only use them sometimes.

The underlying truth in this section is that for whatever reason according to farmers, majority of farmers does not use extension advices or recommended soil management technologies and those who use them, use them sometimes.

6.1.3.2.3. With respect to farmers' satisfaction with recommended soil management practices by extension officers, farmers' perception suggests that a total of about 56.6% of the population of farmers are not satisfied.

6.1.4. Findings on farmers' perceptions on the impact of agricultural extension services with respect to soil erosion-control in the study area.

6.1.4.1. Further findings indicate that the level of extension "talk" on soil erosion and its control during their visits is very shocking. Only 24% of total population of farmers said that extension people talk about soil erosion when they visit them. In fact, 58% said they never talk about soil erosion at all, while 18% said they sometimes do.

6.1.4.2. In terms of how farmers' perceive the effectiveness of extension advices, findings indicate that only 23.4% perceive extension advices to be effective, which seem to suggest why they do not use them.

6.1.4.3. With regards to a comparison of farmers' traditional methods of soil erosion control against agricultural extension recommendations, findings seem to suggest that farmers perceive their local methods of more importance than those from extension officers, as 53.4% said that their methods were more effective than extension methods.

6.1.4.4. In terms of how well equipped extension people are in their communities, findings suggest that only 28.3% of farmers said extension officers are well equipped, while the other 71.6% said extension is inadequately equipped.

6.1.4.5. As regards the adequacy of extension officers in their job, farmers' perception indicated that agricultural extension officers are inadequate in their job. Reasons given for this were: (1) unreliability of extension people, which suggested that they make promises which they do not keep; (2) they hardly or never visit their area; (3) other reasons were also given like extension officers being unconcerned for subsistence farmers, and they also focus more on cooperatives; (4) communication problems; and (5) they pay less attention to crop farming. In other words, extension services are more focused toward livestock farming in the study area.

6.1.5. Testing for variable relationships in the study area (the linear regression model).

6.1.5.1. In terms of relationship between soil erosion and age, product quality and sustainability of farmers, results indicate that age of farmers relate positively with the perceived impact of soil erosion in the study area with a statistical significance of 0.024, at a p-value of 0.05 level of significance. This is partially as expected because age as a factor in adoption impacts both positively and negatively.

6.1.5.2. In the same vein, the quality of product was found to relate positively with the perceived impact of soil erosion in the study area with a statistical significance of 0.065, at a p-value of 0.10 level of significance. This disagrees with findings of the descriptive statistics and literature, because as expected, high impact of soil erosion reduces quality of produce.

6.1.5.3. In a similar note, sustainability of farmers was found to be positively related with the perceived impact of soil erosion in the study area with a statistical significance of 0.074, measured at p-value of 0.10 (10%) level of significance.

6.1.5.4. With regards to the relationship between perceived innovation orientation and adoption of farmers and education levels, farm yield and food accessibility, results indicate that though literature findings suggest that education relates positively with innovation adoption behaviours of farmers, in the study area, their relationship was not significant. Similarly, this result was also found to be different from that of the descriptive statistics which suggested a positive relationship between education and farmers' adoption behaviour.

6.1.5.5. In terms of the relationship between farm yield and farmers' innovation adoption behaviour, results indicate that yield of farmers relates positively with the perceived innovation orientation and adoption behaviours of farmers in the study area with a statistical significance of 0.021, measured at a p-value of 0.05 (5%).

6.1.5.6. Similarly, in terms of the relationship between food accessibility of farmers and their level of innovation orientation and adoption, the food accessibility of farmers was found to be positively related with their level of innovation orientation and adoption at 0.027 statistical significance, measured at a p-value of 0.05 (5%) significance level.

6.1.5.7. In the study, extension effectiveness was also found to be positively related with the farm yield of farmers in the study area with a statistical significance of 0.043, measured at a p-value of 0.05 (5%) level of significance.

6.1.5.8. Furthermore, the perceived agricultural extension effectiveness was found to be negatively related with the profitability of farmers in the study area with a statistical significance of 0.003, measured at a p-value of 0.01 (1%) level of significance. The regression coefficient was -0.477. This finding is very significant, especially at a 1% level of significance, and with a partial coefficient of profitability being -0.477. Finding here seems to disagree with findings of the descriptive statistics of this study, as well as literature findings, which both suggest that the more a farm is profitable, the more he is willing to adopt extension messages.

6.2. Conclusion

The aim of this study was to establish how soil erosion as a phenomenon impacts on food security of the Upper and Lower Areas of Didimana, in the Eastern Cape of South Africa, and to understand the role farmers' innovation adoption behaviours play in the process. For a proper execution, three specific objectives were put forward, vis-à-vis: to establish farmers' perceptions on the impact of soil erosion on food security of the study area; to establish farmers' innovation adoption behaviour with respect to soil erosion control in the study area; and to establish farmers' perceptions on the impact of extension activities with respect to soil erosion-control in the study area. In order to argue properly, a thesis statement was developed. According to the thesis statement, soil erosion, which also is an agricultural problem, is the result of non-adoption or inappropriate adoption of improved and recommended soil conservation technologies by farmers in the study area.

The impact of soil erosion all over the world is usually very grievous especially when uncontrolled. In the study area, farmers' perception suggested that the impact of soil erosion is severe. This severity is demonstrated firstly through climate change, as the time of rain is gradually changing, and thus changing the time of cropping in the area. Similarly the livelihoods of farmers are being affected, as farmers' crops, livestock, and even household feeding are being negatively impacted. More so, findings indicate that most farmers now plant fewer crops and there is an estimation of a lose by most farmers of well between 21-60% of crops every year. Farmers' perception further revealed that due to soil erosion, over 50% of farmers are unsustainable and that 71.7% of farmers said that the amount of food available for their households are being severely affected.

In virtually every spheres of human endeavours improved technologies have been developed to solve human problems. According to the central argument of this study, the main reason there are still problems like soil erosion is because of a lack of adoption or inappropriate adoption of specific recommended technologies. In the study area, the role of farmers' adoption behaviour in soil erosion impact on food security was investigated. Findings indicate that despite the presence of certain recommended soil management technologies in the study area, majority of the farmers do not use them or extension advices, and moreover their satisfaction with those technologies was low, which could be an explanation why they do not use them.

For innovation to be adopted, rejected or used inappropriately largely depends on the effectiveness and performance of agricultural extension, as well as farmers' perception of them. Thus in the study area, farmers' perception on extension effectiveness indicates that extension hardly talk about soil erosion and its control during times of their visits, and their rating for their services and advices was very low. In fact, a comparison of farmers' traditional methods of soil erosion control with extension recommendations indicated that farmers perceive their local methods of more importance than extension methods. Majority of farmers also indicated that extension officers are inadequate in their jobs. Reasons offered range from issues of unreliability, lack of visits, communication problems, less attention for crop farming, and other reasons such as being unconcerned for subsistence farmers as well as the fact that they focus more on cooperatives.

In all, the findings of the descriptive statistics reveal that the impact of soil erosion on food security in the study area is very significant, and the results of the linear regression model of relationships in the study reveal that soil erosion relates positively with age of farmers, their product quality, and their sustainability. In a similar note, the innovation adoption behaviours of farmers was also positively related to farm yield and food accessibility. Thus showing that innovation adoption behaviour of farmers in the interaction of soil erosion and food security in the study area is significant.

6.3. Recommendations

The study of the perceived impact of soil erosion on the food security of the Upper and Lower Areas of Didimana, and the role farmers' innovation adoption behaviour is playing in the process is revealing. It brings to the fore several issues that need the urgent attention of all stakeholders responsible for the agricultural and overall development of the Eastern Cape and beyond. Therefore, in this section, several recommendations are provided according to the findings of this study.

1. In order to discourage the usual urban migration of able-bodied youth from the rural areas to cities, urgent effort is required by the government to speed up the development of rural areas, with such factors that act as pulling factors to youth, as obtainable in the urban centres.

2. Efforts should be made to raise up the education status of farmers in the Eastern Cape, since adequate education is very vital to appropriate decision making. This can be through the establishment of various adult literacy programmes, or adequately empowering the extension officers in this regard to become active agents of change, not just agricultural education, but other areas of learning that can enhance appropriate farming decisions.

3. In order to achieve the food security goals of the Eastern Cape and the study area, effort should be made to change the homestead farming system status quo of the area. This can be by encouraging farmers in the area to take farming as a business, providing soft loans for farmers, encouraging farmers to form co-operatives so that they can stand a better chance of accessing many government and non-government farming facilities. More so, the government should ensure that irrigation facilities should be made available for the area, since inadequate water is one problem of farming in the area.

4. An adequate research is needed into finding out more specifically ways of administering the social grant scheme for people in the area. This is needed because, the people of study area seems to be over-dependent on social grants, as such, the drive to take farming as a business is very weak. So such research will, amongst other things, investigate how the social grant scheme will better operate without de-motivating the agricultural improvement drive of rural people.

5. Since certain crops were found by the study to be well favoured in the study area, as well as the best month of their cultivation, adequate agricultural improvement programmes should be created by the department of agriculture to maximize the production of these crops in the area.

6. Since one of the discoveries of the study was a lack of a ready market, adequate marketing system should be provided for farmers in the study area, so that they can be able to sell their produce whenever they needed to.

7. Due to the technicality of soil erosion and its operation, it is somewhat very different from obvious agricultural problems like crop and animal pest and diseases. As such,

adequate and constant awareness campaign is needed to educate the study area on soil erosion activities and what they need to do to combat it.

8. In order to improve the effectiveness of extension service in the study area, extension officers should continuously be trained and retrained to come to parity with modern day extension service and servicing. Secondly, an outside monitoring body should be inaugurated to serve as a monitoring body for extension service in the study area. This will go a long way to keep extension officers on their toes.

9. One of the areas extension people must focus on in their training and retraining programmes is on farmers' behaviours in rural areas, with particular reference to the study area. For example, findings of this study indicate that farmers view their own actions on erosion control more effective than extension advice. This is why they either reject extension advices out rightly, or they use their advice inappropriately. This is what this study proposed as the main cause of soil erosion problem in the study area.

10. The government should ensure all the necessary materials needed by extension officers for effective extension servicing in the study area should be made readily available to all extension officers. This is because the study revealed that extension people are ill-equipped in their job in the area.

11. As the study indicated, three reasons were projected why extension people are inadequate in their jobs in the study area. In line with these therefore, extension should ensure their visits to the area are regular. They should also ensure that they do not make promises they cannot keep. In fact, these are some of the reasons why farmers' value for extension has been low in the study area. And finally, extension should try and treat all farmers equally in the study area, whether those in cooperatives or not in cooperatives.

12. According to findings of the study, innovation adoption orientation and adoption behaviours of farmers was found to be positively related with farm yield and food accessibility. Therefore, extension service and all those involved in agricultural development should take great advantage of this opportunity. That is by ensuring that everything that will increase yield and remove all factors militating against the accessibility of food in the study area should be their greatest concern. This is because these factors are found to increase the probability of farmers adopting innovations for change.

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Appendix 1

RESEARCH QUESTIONNAIRE

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION, UNIVERSITY OF FORT HARE, ALICE

Questionnaire on extension analysis of impact of soil erosion on food security in the Upper and Lower areas of Didimana, 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). Name of village……………………………………………… [ ] **V1**

2). Gender of respondent: Male = 1; Female =2. [ ] **V2**

3). Age of respondent: ___________________ [ ][ ] **V3**

4). Marital status (fill in the box): [ ] **V4**

Scale: Married =1; Single = 2; Divorced = 3; Widowed/widower = 4

5) What is your highest level of education?(**Mark with an X**). [ ] **V5**

None	**1-6 yrs**	**7-10 yrs**	**11-12 yrs**	**Diploma**	**Any degree**	**Agric degree**
1	2	3	4	5	6	7

6). Indicate the composition and number of your household members living with you: [ ] **V6**

Male <12	**Female <12**	**Male between 12 and 18**	**Female Between 12 and 18**	**Male > 18**	**Female >18**
1=	2=	3=	4=	5=	6=

7) What is the size of your farm? (m^2): _______m X _______m [ ] **V7**

8). Please describe your current farming system and indicate your production levels:

Farming system- (A)	**Composition (%) (B)**	**Insufficient for own consumption**	**Just enough for own consumption**	**Just enough for own consumption and ceremonial**	**Sufficient excess for limited selling**	**Sufficient excess for expanded commercial trading**
		1	2	3	4	5
1). Livestock						
2). Crops						
3). Others						

V8	A1=	**V9**	A2=	**V10**	A3=	**V11**	B1=	**V12**	B2=	**V13**	B3=

9). Indicate the relative contribution of the following sources to **YOUR** total income: (**Total = 100%)**:

Sources of income		**Amount (R)**	**Relative contribution (%)**	
Non-agricultural	**V14**			**V17**
Agricultural crops	**V15**			**V18**
Agricultural livestock	**V16**			**V19**
Total				

10). How many years have you been involved in farming? **V20**

(B) Erosion Characteristics

1). In your opinion, how serious does the problem of soil erosion affect your agricultural enterprise? **V21**

insignificant	A little significant	Moderately		significant	Very significant
1	2	3	4		5

2). Why do you say so? **V22**

----

3). In your opinion, how much has the impact of soil erosion on your agricultural enterprise changed since you started farming here?

V23

insignificant	A little significant	Moderately		significant	Very significant
1	2	3	4		5

4). What would you say would be the two most important reasons for this?

1.____
____ **V24**
____

2.____ **V25**
____
____

5). What do you think are the three most important reasons for this erosion as you see it?

1. ____

2.____

3.____

1=	**V26**	2=	**V27**	3=	**V28**

6). Rank the following potential reasons in terms of their relative importance as you see it.

Reasons for soil erosion	Rank	
Natural causes like rainfall, wind, etc.		**V29**
Human non-agricultural activities		**V30**
Agricultural crop production practices		**V31**
Agricultural livestock production practices		**V32**

(C) Agricultural extension programmes characteristics

1.). How many times per year do agricultural extension officers normally visit this community?

(Mark with an X the months when visits occur; Xs= number times of visit in a month)

Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Xs=	Xs=	Xs=	Xs=	Xs=	Xs=	Xs=	Xs=	Xs=	Xs=	Xs=	Xs=
V33	**V34**	**V35**	**V36**	**37**	**V38**	**V39**	**V40**	**V41**	**V42**	**V43**	**V44**

2). From your experience, how often do extension officers talk to this community about the control of soil erosion in this community? **Mark with an X**:

Always	Very often	Often	Sometimes	Never
1	2	3	4	5

V45

3). What are the two most important recommendations that extension people make to deal with soil erosion in your area?

1=	V46	2=	V47

1. ____________________

2. ____________________

4). What are the two most important activities that this community does to deal with soil erosion in your area?

1=	V48	2=	V49

1. ____________________

2. ____________________

5). How involved are extension officers with these mentioned community efforts to control soil erosion in this community? **Mark with an X**:

V50

Totally absent	Very limited	Sometimes	Quite often	Regularly
1	2	3	4	5

6). How effective or adequate, from your experience, do you think the following are:

Actions against soil erosion	Very effective	Effective	Moderately effective	Limited effective	Ineffective	
	1	2	3	4	5	
The extension officers advice						V51
The community's actions						V52
Your own actions						V53

7). List any traditional methods you have been using to combat soil erosion in your area:

____

____

8). Compared to extension methods, how effective are your traditional methods of erosion control? V54

More effective	Effective	Moderately effective	Less effective	Not effective
1	2	3	4	5

V55

9). How often do you use extension officers' advices?

Not at all	Very limited	Sometimes	Quite often	Regularly
1	2	3	4	5

V56

10). What are the different methods of communication that extension officers use in relaying their messages to you?

workshops	Farmers' days	Group discussions	Cell phones	Mass media, e.g. T.V, Radio	Print media	Others (specify)

11). How effective, from your own opinion, are extension communication methods to you?

Very effective	effective	Somewhat effective	Effective a little	Ineffective
1	2	3	4	5

V58

12).How much do you understand when extension officers relay extension messages to you?

Very much	Much	Somewhat	A little	Not at all
1	2	3	4	5

V59

13). How well equipped (in terms of resources for effective extension service success) are extension officers to fulfil their mission in your area? V60

Very well equipped	Well equipped	Moderate	Less equipped	Unequipped
1	2	3	4	5

14). How adequate do you think extension officers are in their job? V61

Very adequate	Adequate	Moderate	A little adequate	Inadequate
1	2	3	4	5

15). Give some reasons why you think extension officers are inadequate in your area?

____
____
____ V62

(D). Food Security Characteristics

1). Show on a time line when you plant and which crops you plant (**mark the time with an X**):

S/N	Crop	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
1													
2													
3													
4													
5													
6													
7													
8													

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
V63	**V64**	**V65**	**V66**	**V67**	**V68**	**V69**	**V70**	**V71**	**V72**	**V73**	**V74**

2). How do you decide which crops to plant during the year?

____ V75
____
____

3). How does the problem of soil erosion influence your decision making in planning your crops?

____ V76
____
____

4). In which aspect of your livelihood does soil erosion influence you the most? V77

____
____
____

5). What % of your crop do you think you lose as a result of the erosion around you? V78

0%	1-20%	21-40%	41-60%	61-80%	81-100%
0	1	2	3	4	5

6). How often are you forced by soil erosion to change the way you normally plant your crops?

I'm actually losing land – I'm planting less every year	Once a year	Every two years	More than two years	Have never changed, despite soil erosion
1	2	3	4	5

V79

7). Please rate your satisfaction with the following?

	Totally dissatisfied	A little dissatisfied	Moderately satisfied,	Satisfied	Highly satisfied	
	1	2	3	4	5	
Quality of the plants						**V80**

Quality of the crop / harvest						V81
Quantity of the crop / harvest						V82
The prices you get for your crops?						V83
The cost to produce your crop						V84
The amount of food you produce that is available to your family						V85
The productivity of your farm land						V86

8). How serious is current soil erosion on your land limiting your expectations to continue farming for a long time?

Very serious	Serious	Moderately serious	A little serious	Not limiting at all
1	2	3	4	5

V87

9). How can this limitation be removed? (To ensure a longer farming career on this land)

____

____

____

V88

10). What percentage of your crops do you sell for profit? (Enumerator's assessment from respondent's indications)

0%	1-20%	21-40%	41-60%	61-80%	81-100%
0	1	2	3	4	5

89

11). How difficult do you find it to sell your crops?

Very easy	Easy	Moderately easy	Difficult	Very difficult
1	2	3	4	5

V90

12). Why do you think this is so?

____

____

____

V91

13). How does current soil erosion impact on your cost of production?

____

____

____

V92

14). How does soil erosion influence the profit that you make on the food you sell?

____

____

____

V93

15). Identify the different sources of food for your household?
(a). Your farm, (b). The market (e.g. Spar, shoprite, etc.), (c). Government aid, (d). Foreign aid, (e). Others, specify ……………………………………………………………………

V94

16). How much of all the food your household uses do you produce yourself?

< 20%	20 – 40%	41 – 60%	61 – 80%	>80%
1	2	3	4	5

V95

17). How many of the families in your community are in the following position in general?

	None at all	Very few of the families	About half of the families	More than half of the families	All the people	
	1	2	3	4	5	
Always have enough food for the family						V96

Never have enough food for the family						V97
Produce enough food for the family						V98
Never produce enough food for the family						V99

18). Show on a timeline the general abundance or availability of food in your household for every month. Which months of the year are you self sustainable? Use scale 1 – 5; mark with X

Rating		Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Bordering on famine	1												
Insufficient but possible to supplement	2												
Enough with careful planning	3												
Sufficient	4												
Great abundance	5												

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
V100	**V101**	**V102**	**V103**	**V104**	**V105**	**V106**	**V107**	**V108**	**V109**	**V110**	**V111**

19). How much do you believe is soil erosion impacting on the following:

	Very much	**Much**	**Significant**	**Not significant**	**No role at all**	
	1	2	3	4	5	
Amount of food you can sell?						**V112**
Amount of food available for your household?						**V113**
Number of families who are self-sufficient in terms of food						**V114**
Your current way of farming						**V115**

20). How do your current practices of cultivation impact on the possibility to continue farming for the rest of your life?

____
____
____________ **V116**

21). How much (estimate from your farm produce or actual amount) do you and your household consume (in Rands) in a month? **V117**

<R1000	**R1000-R3000**	**R3100-R5000**	**R5100-R10000**	**>R10000**
1	2	3	4	5

22). (a). How many members of your household have suffered any evidence of malnourishment currently or in the past? **V118**

All the members	**More than half**	**Half**	**Few of the members**	**None**
1	2	3	4	5

23). In your own opinion, how food secure are you? **V119**

Totally food insecure	**A little food secure**	**Moderately food secure**	**Food secure**	**Very food secure**
1	2	3	4	5

24). In your own opinion, for each of your crops grown, indicate their production level? (Get only the yield in terms of the crop – bags of cabbages etc)

Crops	maize	Cabbage	Spinach	butternut	cocumber	onions	potatoes	Others (list)
Productions levels								
	120	**121**	**122**	**123**	**124**	**125**	**126**	**127**

25). In a rating scale of 1 to 4, how sustainable is your farming enterprise?

Unsustainable	sustainable with major support	Sustainable with minor support	sustainable without support
1	2	3	4

V128

26). In a rating scale of 1 to 5, how profitable is your farm work?

Very unprofitable	A little profitable	Moderately	profitable	Very profitable
1	2	3	4	5

V129

27) If this soil erosion problem was to be allowed to expand without any control measure, how do you think it will impact on the productivity of land in your community ten years from now**?**

V130

28). Is there any recommended soil management practices, may be by extension officers or any other government or non-government agents, for the following cultivation practices? **(list them):**

(a). Soil preparation: ____ V131

(b). Crop planting: ____ V132

(c). Crop harvesting: ____ V133

29). How often have you been using them? (Q28 above)

V134

Always	Often	Sometimes	Rarely	Never
1	2	3	4	5

30). How satisfied are you with them (Q28 above)?

V135

Very satisfied	Satisfied	Moderately	A little satisfied	Unsatisfied
1	2	3	4	5

31). How difficult was it for you to answer these questions? (cognitive assimilation)

Very difficult	Difficult	Moderately	Easy	Very easy
1	2	3	4	5

V136

Appendix 2

SOME EROSION SITES IN THE STUDY AREA

Appendix plate 1: An example of a degraded gully site in the study area

Appendix plate 2: An example of a degraded gully site in the study area

Appendix plate 3: An example of gully erosion site in the study area