CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Tropical AgriSciences

Farmers' Perception of Land Degradation and the Adaptation Strategies Used to Combat Low Soil Fertility in Tiko Municipality, Cameroon.

MASTERS' THESIS

Prague 2020

Author: Nathalie Asheri Yayu Mbuyeh

Supervisor: Miroslava Bavorova

Co- Supervisor: Nkomoki William

Declaration

I, hereby declare that I have done this thesis entitled *" Farmers' Perception on Land Degradation and the Adaptation Strategies Used to Combat Low Soil Fertility in Tiko Municipality, Cameroon* " independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA

In Prague, May 2020

Nathalie Asheri Yayu Mbuyeh

Acknowledgement

Foremost, I would like to thank my thesis supervisor Miroslava Bavorová. She has been a great mentor, and her support, assistance and expertise help me throughout the writing of my thesis and during my data collection. In the same spirit, I will like to thank Mr. William Nkomoki for his guidance and always creating time to assist me in making corrections on my research.

Additionally, I will like to thank the Sub Delegate of Agriculture in Tiko, Mrs. Ajoacha Dorine and the Chief of Agriculture Post, Mr. Asongwe Prosper for all their knowledge and connections which made it possible for me to meet the farmers for this research. I would also like to extend sincere gratitude to the farmers of Tiko municipality for creating time to participate in this research and providing me with the knowledge they gained throughout their years of farming.

Furthermore, I need to thank my family and friends for their love and guidance throughout the pursuit of my research. Lastly, a special thanks to Mr. Felizardo Armando Muianga for his support and endless inspiration.

Abstract.

Land degradation is recognized as a major issue in developing countries such as Cameroon, but yet there is still a lack of information on the smallholder farmers' perception on land degradation. The objectives of this study were to examine farmers' perception of the causes and indicators of land degradation and to analyze factors which influence their perception of land degradation in Tiko municipality, Cameroon. The data was collected using focus group discussion and semi-structured questionnaires with 122 respondents. Data analysis was done using descriptive statistics and binary logistics regression. The results of this study showed that 89.3% of the farmers were aware of the problem of land degradation on their farms. A significant number of the farmers identified water erosion (50.8%) and low soil nutrients (44.3%) as very serious causes of land degradation on their farms, while wind erosion was the least identified. Most of the farmers identified lower yields (72.2%) and decreased vegetation (36.9%) as the main indicators of land degradation. The binary logistic regression model results indicated that the total household members and lower yields showed the highest likelihood of a farmer perceiving land degradation. However, only wind erosion had a probability of influencing how farmers perceive land degradation. Therefore, attention should be given to such factors to understand better site-specific perceptions and how land management practices can be implemented.

Keyword: Land degradation, Perception, Cameroon, Smallholder Farmers

Table of Contents

List of Tables

List of Figures

List of Abbreviations

BLM Binary Logit Model

CDC Cameroon Development Cooperation

GDP Gross Domestic Product

FAO Food and Agriculture Organization

FGD Focus Group Discussion

IPCC Intergovernmental Panel on Climate Change

OR Odds Ratio

SDG Sustainable Development Goals

SIRDEP Society for Initiatives in Rural Development and Environmental Protection

SPSS Statistical Package for the Social Sciences

UN United Nation

UNCCD United Nations Convention to Combat Desertification

UNDP United Nations Development Programme

1. Introduction and Literature Review

1.1 Introduction

According to Scherr (1999); Yadav (2001); Rosegrant et al. (2005), 'A 2020 Vision for Food, Agriculture, and the Environment' was an initiative of the IFPRI on the future of agriculture and how to supply food globally while reducing poverty and protecting the environment. Amongst all the projections of this initiative, the emphasis was placed on the effect and impact of land degradation in developing countries (Scherr 1999).

Scientists have made numerous efforts to determine the effect and impact of land degradation (Stringer & Reed, 2007). For example, thematic mapper imagery (Ringrose et al. 1999), field assessment (Stocking & Murnaghan 2001a), interviews (Reed & Dougill 2002) and opinions from experts (Oldeman 1990). Nevertheless, these studies on the assessment of land degradation are limited because the focus is placed on the collection of quantitative data without the involvement of the inhabitants of the communities (Stringer & Reed 2007). This is an indication that more research needs to be carried out using both quantitative and participatory approaches.

According to Reimer et al. (2012), these limitations prompted the UNCCD to recognise that the inhabitants of dryland community possess indigenous knowledge that will assist researchers in land degradation assessment. However, some researchers have criticized the use of local knowledge because it is believed that the information they provide for land management is based on unproven assumptions (Stringer & Reed 2007). Understanding how farmers perceive land degradation and the land management practices that they use is an essential strategy in targeting specific communities; this will help in sustaining the benefits of the resources of the environment which will decrease land degradation and make global food security achievable (Tesfahunegn 2018).

On this note, this research aims were to examine farmers' characteristics, their adaptation strategies and their perceptive of the causes and indicators of land degradation and analyze if their socio-demographic, farm attributes, biophysical attributes, and institutional attributes influence how they perceive land degradation

1.2 Literature Review

According to the UN (1994); Vogt et al. (2011) land degradation is;

'*Reduction or loss in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as (i) soil erosion caused by wind and water (ii) deterioration of the physical, chemical and biological or economic properties of soil (iii) long-term loss of natural vegetation.*'

Land degradation will remain a problem of the 21st - century because of its unfavorable effects on the environment, crop production and how it affects global food security and people's wellbeing (Eswaran et al. 2001). Land degradation changes the natural environment (Stocking & Murnaghan 2001a) and causes a decrease of the land's biological and economic production ability (UNCCD 2008). Conacher et al. (1995) indicate that losing the biophysical ecosystem influences the human activities on land, which according to Pacheco et al. (2018) will, in turn, decrease the performance of land because the land management techniques implemented are not sustainable. These unsustainable land management techniques make land degradation a significant problem for the ecological system because it acts as a barrier to achieving long term sustainable goals and occurs globally in all agro-ecological areas and has a long term impact on the environment, the social and economic conditions, and social vulnerability (Israr et al. 2018).

For Johnson & Lewis (2007), land degradation should be viewed as a reduction in both the biological productivity of land and the usefulness of the land for human activities. The writer further explains that a reduction in the biological productivity will decrease land resources and water properties which make up the hydrologic domain and is an significant element in land degradation while a reduction in usefulness refers to the reduction of human activities on land; therefore, even with constant production of biomass, a land might still be viewed as useless to the inhabitants.

According to Delphis & Levia (1999b) land degradation occurs when there is a linkage between the environment and its inhabitants. The writer further claims that this can occur

at the local, regional, national, or global scales. At the local scale, land degradation is due to the need for natural resources to produce, while on the regional scale, land degradation might occur when a country is undergoing a political instability. This will makes land degradation a social problem because it will directly affect labor product, technology, and the capital put into the production (Blaikie & Brookfield 2015). Blaikie (2016) also claims that land degradation will impact the society and the economy because it will lead to high usage of synthetic fertilizers for a continual sustainable productivity but will have a negative impact on individuals who will have to abandon their degraded lands and move to another production land.

Land degradation can be manifested in different forms, and for Vogt et al. (2011) this occurs when there is a scarcity of vegetation used for fuel and feeding, when water sources become dry and cause fertile lands to be dominated by thorny weeds, and lastly, when soils become thinner and rocky, and pavement gets flooded by the rain. The inquirer also claims that land degradation can manifest itself as a loss of a land production capacity or environmental management. The manifestation of land degradation can either be permanent (irreversible destruction of the biological and environmental potential of the land over an extended time) as seen in severe gullying and advanced salinization or it can be temporal and reversed by adding nutrients to nutrient-depleted soils and the reestablishment of vegetation and buffering of the soil acidity (Yadav 2001).

Furthermore, Bojö (1991) reveals that land degradation causes the absence of productive land through waterlogging, erosion, salinization, nutrient reduction, and worsening of the composition of the soil or pollution with unfavorable impacts on climate change, biodiversity and international waters which threatens the welfare and sustainable growth of the people that are dependent on agriculture for their livelihood when it occurs on their land of cultivation (Pagiola 1999). Therefore, it is important to find out the major causes of land degradation and understand the physical, economic, political, and social aspects.

1.2.1 Concepts and Theories on Land Degradation

1.2.1.1 Policy Issues

According to Lutz & Hazell (1998), land degradation can be affected by three different theories, and they include the theory of social cost, collective goods, and property rights. In the theory of social cost, land degradation occurs because farmers use unsustainable

farming practices that do not carry the full cost and so leading to downstream costs such as soil erosion, water pollution, deforestation, and loss of biodiversity. For Wachter (1997) the theory of collective goods is made up of non-exclusion, non-rivalry in consumption and externalities with the externalities being environmental problems such as land degradation which is a result of farmers exploiting scarce resources with no conservation nor maintenance and therefore leads to an uneven distribution of the benefits amongst farmers. Nevertheless, the theory of property rights indicates that land degradation is not a result of externalities but due to undefined property rights over land which determines if a farmer will practice a sustainable land management practice (Lutz & Hazell 1998).

Furthermore, Assefa & Hans-Rudolf (2016) claims that agricultural policies made by the government and land tenure system to ban selling and purchasing of land but making accessibility of land only by leasing, shared cropping, borrowing or inheritance has affected the land management practices since the farmers are afraid that the government will take the land and redistribute it to others. Ståhl (1993) adds that land tenure act as a hindrance in land improvement practices for a long time due to the absence of a well-defined property right, while Davies et al. (2015) believes the lack of knowledge and agreement about land roles makes the farmers to lack interest in sustainable land management practices which in turn leads to land degradation.

1.2.1.2 Population Growth

According to Malthus (1998), population growth occurs geometrically while food supply happens arithmetically; therefore, an increase in population will lead to land destruction and limited food supply to sustain the growing population and to avoid starvation, people will move to other lands, thus increased population in these lands will cause land scarcity and overexploitation which will cause land degradation (Tesfahunegn 2019a). Ovuka (2000) supported this theory by claiming that overpopulation will cause people to occupy potential cultivation lands, which could lead to soil erosion. Even though numerous studies are denying these claims, there are also a few studies that show a positive connection between a growing population and deforestation, overgrazing, soil erosion, infertile soil, together with other problems of the environment (Pender 1998).

In contrast to the Malthusian theory, the Boserup theory claims that population growth has an impact on farming techniques, land investments and technology (irrigation facilities, soil conservation) more agricultural production, use of fertilizers (organic and inorganic), and increase in agricultural labor (Boserup 1965; Lutz & Hazell 1998; Tesfahunegn 2019a). To support this theory (Tiffen & Moretimore 1994) study on a Machakos, a district in Kenya proves that increased population led to increased agricultural production, increased use of manure, and more crop yields. However, Grepperud (1996) in Ethiopia shows that areas with increased population had higher chances of land degradation which proves that the Boserup theory is limited since it does not consider the policies and resources of the countries.

1.2.1.3 Poverty

Research by Mabogunje (2002) claims that the link between poverty and the environment is a noticeable characteristic in less developed countries because of development activities, commercialization, and overpopulation which causes the displacement of the poor from their resources to a more marginal land which leads to over-cultivation, overgrazing, and deforestation, and thus land degradation. Similarly, World Bank (1992) claims that the poor are more concerned with their daily survival; therefore, limited access to resources, credits, insurance, and markets hinders them from investing in environmental protection, but they will expect fast outcomes when they make these investments.

1.2.2 Concepts and Theories of the Perception of Land Degradation.

Armstrong (1961) defines perception as the knowledge gotten using our senses that are influenced by many factors. Other studies by Megersa (2011) define perception as a process of attitudes that can be explained by the psychological states of an individual's characteristics, socio-demographic attributes, institutional and physical factors. A study by Atiqul et al. (2010) shows that land degradation is not always perceived to be the cause of population growth but that people will use birth control if they perceive that their environment is degraded while Biddlecom et al. (2005) indicates that there is a desire for a larger family amongst individuals who perceive environmental degradation because they will need their children to obtain natural resources. Besides, the way people perceive agricultural and environmental policies, survival household strategies, household characteristics (family size, age, education, and income level), societal and communal

features (economic opportunities and access to extension services) can influence the way farmers perceive land degradation (Biddlecom et al. 2005). Therefore, it is vital to understand farmers' perceptions about land degradation because it will help in the integration of technologies and governmental programs that will mitigate the issues of problem and minimize further degradation (Joshi et al. 1996).

1.2.1 Indicators of Land Degradation

Knowing the indicators of land degradation is important because they reveal the underlying causes in the region with its specific culture, environment, and climatic condition. After all, some indicators cannot apply to every region, nation, or the level of farms, nor can an indicator of a region be applied at a nation nor the level of the farm (Kapalanga 2008). Similarly, Stringer & Reed (2007), shows that land degradation indicators can be agriculturally based (crops and livestock), vegetative based (grass cover and tress), soil-based (soil color), reduction of the number of wild animals and insects, and a set of other indicators. Moreover, a study by (Kairis et al. 2014) used soil and vegetation indicators, which proves that using the indicator-based approach is competent in monitoring land degradation in an area.

1.2.2.1 Soil Quality

Soil quality can be visually represented by seven indicators accepted by the LADA-L(land degradation assessment on dryland) which include soil texture, roots, soil color, soil structure, soil depth, surface crust, and soil life (Bunning et al. 2016). The soil texture refers to the amount of clay, sand, and silt present in the soils and the impact they have on soil properties such as the soil's ability to retain water and nutrients and how the soil resists acidification. For Schoonover & Crim (2015), soil color determines how soils can be classified because soil color varies as a result of topography, climatic factors, and soil depth. The soil color reveals the material sources, climatic and human factors that influence the condition of the soil and also indicates the source of water, and lastly, it is a reflection of the status of the organic matter in the soil. A bright, red, or orange color is an indication of good soil aeration and drainage, a dull or grey color indicates low soil water and a possible waterlogging while a dull-grey or black color indicates waterlogging (Bunning et al. 2016).

1.2.2.2 Vegetation Cover

Vegetation is vital for the preservation of soil nutrients and the prevention of wind and water erosion (Stocking & Murnaghan 2001a). Vegetation is also essential in determining if there is cropland, grassland or woodland and some of the indicators include the reduction in the vegetation cover, changes in the structures of the crops, loss of biodiversity, changes in the amount of a specific species, the type of land management practices and the reduction in productivity (Bunning et al. 2016). A similar study by Gisladottir & Stocking (2005) claims that the elimination of organic matter and colloid due to degradation gives soils a lighter color and causes a reduction in soil biodiversity. Writers like Sala (2000) state that if there is land degradation, it will be difficult for the land to sustain vegetative biomass; hence, it will become unsustainable to species that are sensitive and vulnerable.

1.2.2.3 Lower Yields

Lower yields are the most important indicator of land degradation. It causes a high level of inputs on farms or causes farmers to abandon their lands temporally or permanently while some might even change their plots for lower value uses like substituting crop types like planting maize instead of cassava, croplands might become lands for grazing, and the fallow period may become longer (Yadav 2001). However, Bunning et al. (2016) reveal that sometimes lower crop yields is not always a result of land degradation since it could be a result of other unknown causes and so it is important to reconstruct the timeline of crop yields so that the causes of changes in yields can be revealed.

1.2.3 Causes of Land Degradation.

According to Negm (2017), the causes of land degradation can either be human-induced or natural and the reasons attributed to these causes are determined by land-use, land-use change, socio-economic factors such as possibilities of land investment, accessibility to land and markets, and infrastructures which are important for the farmer to maximize their production. Nkonya & Gerber (2011); Braun et al. (2013) categorized the causes of land degradation into proximate causes (biophysical and unsustainable land management practices) with a direct impact on the ecosystem and underlying causes which have an indirect effect on the proximate causes such as the socio-economic, institutional and policy factors (Figure 1). The proximate and the underlying causes are interrelated to each

other and do not act alone, making the causes and processes of land degradation are interconnected.

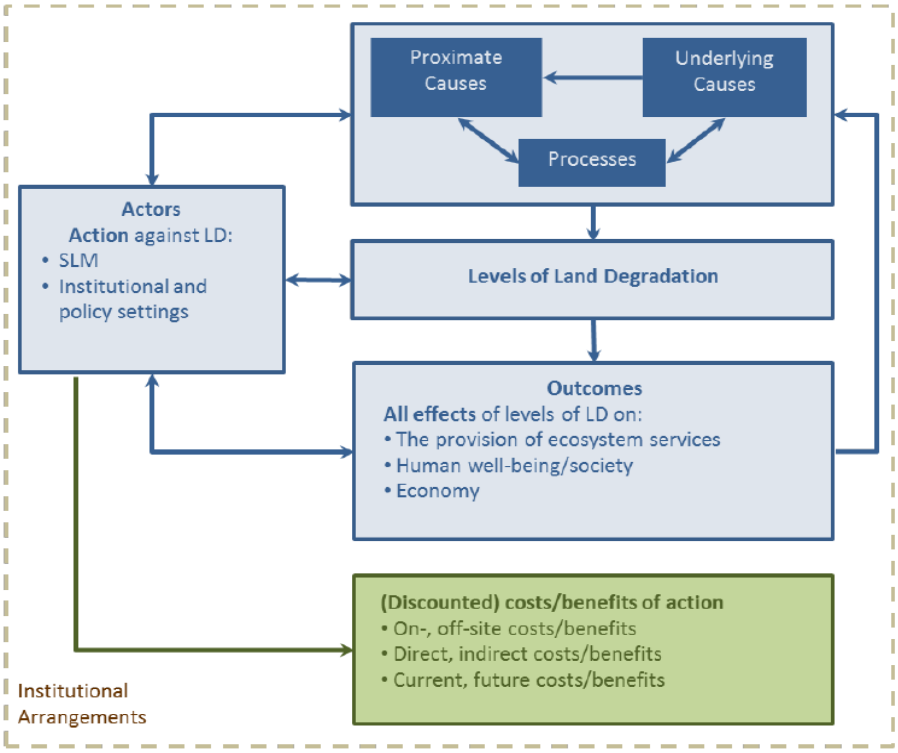

Figure 2. Conceptual Framework of the causes of Land Degradation (Nkonya & Gerber 2011)

1.2.3.1 Climate Change

The relationship between the climate, human activities, and the state of the land is complicated because these interactions can cause the land to deteriorate and thus affect the atmospheric and climatic conditions in the future and these are influenced by land management practices are influenced by climatic factors, and equally, climatic factors limit sustainable land management practices (Henry et al. 2007). In addition, Bullock (2005) claims that the consequences of climatic changes on soils can be direct or indirect because soils can either be a source or an absorber of greenhouse gases that can respond positively or negatively to climate change. Also, Narisma et al. (2007) claim that the climatic systems interact in complicated ways, which may lead to an immediate positive response to climate changes that can seriously affect the semi-arid and arid regions.

1.2.3.2 Soil Erosion

Soil erosion is the natural movement of earth's particles from one place to another with the help of erosive drivers like water, wind, animals, humans, and snow (Apollo et al.

2018). It has been recognized as a major issue to the ecosystem and global agriculture with the destruction of about 430 million hectares of natural resources in various countries (Lal 1990). For Bullock (2005), soil erosion occurs when natural resources are removed for crop cultivation and unsuitable farming practices which together with climate changes and bad weather makes the land suitable for soil erosion.

Soil erosion can also be influenced by land exposure to raindrops and wind energy (Tefera 2002; Pimentel & Burgess 2013), or when the environment is mismanaged (Raghavan et al. 1990). This condition is exacerbated when there is an expansion of the humans and livestock population, or through cultivating on lands with poor nutrients, and adopting extensive, resource-based, and subsistence farming practices (Lal 2001) and thus, reduces productivity (Pimentel et al. 1995).

Wind Erosion.

Wind erosion is the movement of soil particles especially in semi-arid and arid regions (Bullock 2005) usually at a speed of 25mph when these soil particles are being displaced from susceptible soils (Pimentel et al. 1995). According to Blanco-Canqui & Lal (2008), extreme wind erosion caused by anthropogenic practices that misuse the soils can directly influence the state of the soil surface through deforestation and extreme tillage and thus render the land infertile. Factors that determine the effect of wind erosion include, the soil erodibility, roughness of the surface, wind velocity, wetness of the soil, vegetation cover, and management practices (as a result of windbreak) while tillage practices that expose the smooth surfaces of soils, and the regular movement of animals in search of water and food on the roads increases the severity of wind erosion in an area (Tefera 2002). A similar study by Balba (1995) states that dry soil, reduced vegetation cover, large cultivation land, and enough wind velocity to move particles causes the occurrence of wind erosion.

Water Erosion

Blanco-Canqui & Lal (2008) stresses that water erosion is the most serious form of erosion and in contrast to wind erosion, it is characterized by rainstorms and is dominated in humid and sub-humid regions but could also be an issue in the arid and semi-arid region where precipitation is limited. Different forms of water erosion include splash, rill, sheet, and gully (IFAD 1992). The concentrated gully erosion is the most extreme because of

its ability to cause erosion with a single intensity of high rainfall which exposes the crop roots, limit plant growth, and landscape stability by decreasing the water table thus, making it the main cause of sedimentation and loss of soil nutrients (Blanco-Canqui & Lal 2008).

1.2.3.3 Low Soil Nutrients

The depletion of nutrients in African soils are aggravated by the natural low soil fertility, low water retention capacity, climatic features of large interior plains and plateau, overpopulation that increases land pressure, intensive cultivation practices with ineffective management, and addition of land nutrients (Henao et al. 1999). The writer adds that the social and economic conditions, policies, biophysical, soil and management restrictions, and crop production are the reasons why there are declines in fertility which eventually leads to land degradation in Africa. As a result, mineral fertilization, deposition of nutrients, and nitrogen fixation are used to enhance nutrients on African soil.

1.2.4 Land Management Practices

According to Dame (2017), land management, agriculture, and the environment are connected; hence, agricultural production and the health of the environment rely on the appropriate management techniques on the farms. Pender et al. (2006) claim that these land management techniques are decided privately by a farmers' household or collectively by a group of farmers or a community. For instance, a farmer's household will make decisions on the type of land use, crops planted, labor, investment, and agronomic practices that will either improve soil fertility or reduces the number of pesticides whereas the community will impact land management practices by making investments or regulations on land use collectively. If these land management techniques are inappropriate, it might result in land degradation problems (Scherr 2000).

There are varieties of recommended sustainable land management techniques by (Megersa 2011) some of which are used for erosion control (contour tillage, zero tillage or physical soil conservation measures), soil nutrient replacement (application of organic or inorganic fertilizer). However, with increasing use of land, traditional erosion practices like mulching and long-term fallowing are no longer being used. Nevertheless, Pretty (1995) claims that farmers will still adopt new technologies and practices even though there are varieties of successful sustainable land management practices. For the writer,

this happens because there is more to sustainable agriculture than what is presented by researchers, policymakers and external officers, therefore for there to be sustainability in agriculture, agricultural professionals should be willing to learn from farmers, external institutions should provide support, and the system needs to be able to manage the natural resources.

1.2.5 Factors Influencing Adaptation of Land Management Practices

The conceptual framework of Meijer et al. (2015) stresses that the process of adopting a new agricultural practice is dependent on extrinsic, intrinsic, and contextual factors. These extrinsic factors include (socio-demographic characteristics, biophysical characteristics, and farm attributes) and intrinsic factors include (farmers' perception, knowledge, attitudes) and institutional (source of information and extension services). Other studies by Mercer (2004) showed that farmers are unable to adopt new strategies because of no credits, limited information, small farm sizes, limited human resources, no land tenure motivations, no equipment, which causes chaos in the distribution of inputs (seeds, chemical, water) and also undesirable transport buildings.

1.2.5.1 Socio-demographic Attributes

According to Kassie et al. (2009), the decision to adopt any farming practice is influenced by socio-demographic characteristics, which is a reason why larger household sizes are more likely to adopt sustainable land management practices because of an increase in the household size increases labor insensitivity. Studies by Baumgart-Getz et al. (2012) who categorized education into extension training and formal education instead of categorizing them into years of studies or school attendance showed that those who had extension training had a higher possibility of adopting new land management practices.

Another important attribute is the farmers' knowledge about the environment, which, according to the studies by Baumgart-Getz et al. (2012) had a positive impact on the adoption decision. Similar research by Meijer et al. (2015) explains the difference between the farmers' knowledge and perception and highlight that, farmers' knowledge refers to the reliability of the information they get which includes their understanding of the agricultural practice and the benefits they can achieve from doing it whereas farmers' perception is about the views the farmers have which are influenced by past experiences and are not really in alignment with the reality.

1.2.5.2 Farmers' Perception

Using and managing land resources is influenced by farmers' perception of the causes, seriousness, and implications of land degradation on their land which determines if the farmer will accept and apply different indigenous land management practices or implement land management actions (Assefa & Hans-Rudolf 2016). Similarly, Stocking & Murnaghan (2001) claims that farmers' perception of land degradation is a representation of if they want to know about environmental deterioration and the decline in their livelihood; additionally, farmers will only implement measures based on their perception of the risk of production or their awareness of socio-economic or natural costs of land degradation. Likewise, Tesfahunegn (2019b) stresses that farmers' perception can also be influenced by household sociological factors (age, gender, marital status, education), farm factors (farm size, land tenure, access to irrigation), biological attributes (crop production, knowledge on soil erosion) and institutional attributes (access to information).

1.2.5.3 Farm Attributes

Studies carried out by Feder et al. (1985) show that an increasing farm size causes an increase in fertilizer usage. Similarly, studies by (Knowler & Bradshaw 2007; Bwambale 2015) also indicate that farmers with large farm sizes were willing to invest in extensive soil management practices while those with smaller land sizes were not willing to invest in intensive farming. Other writers like (Kassie et al. 2009) on his study in Uganda show that farmers who had livestock made use of animal manure than any other adaptation strategy.

1.2.5.4 Institutional Factors

According to Mercer (2004), limited access to credit is one of the factors that influence adoption amongst farmers. Likewise, Gbetibouo et al. (2010) claim that poverty, increase demand for credit, and lack of finance are the major difficulties that are associated with adopting suitable land management practices amongst farmers. Similar studies in Tanzania accounts that, even when farmers are aware of the many adaptation methods and are ready to implement them, the absence of finance will still be a major problem

because of their inability to purchase complementary inputs or associated tools such transportation, infrastructure or hiring workers (O'Brien et al. 2000).

1.2.5.5 Information Sources

Introducing new practices always requires information that will help farmers make an adoption decision (Wozniak 1984). There are many sources in which the farmer can get information from, but for Gbetibouo et al. (2010) agricultural extension is the most efficient way for farmers to analyze their adoption. IFPRI (2020) also claims that agricultural extension plays an important part in increasing agricultural production, which in turn increases food security. Similarly, Adesina & Baidu-Forson (1995) study showed a positive relation between adopting new practices and accessing extension services.

2. Aims and Objectives

Aims

This master's thesis aimed to identify the factors that affect the perception of land degradation amongst smallholder farmers of the Tiko municipality.

Specific Objectives:

- To examine the socio-demographic factors of the farmers.
- To examine the institutional characteristics and farm attributes of the farmers.
- To identify the adaptation strategies.
- To identify farmers' perception of the causes and indicators of land degradation.
- To analyze the determinants of farmer's perception of land degradation.

Research Questions:

- What are the socio-demographic factors of a household head?
- What are the institutional characteristics of the household and farm?
- What adaptation strategies do they use on their lands?
- What factors affect a farmer's' perception of land degradation?

3. Methodology

3.1 Study Area

Cameroon is located in the Central part of Africa and shares its borders with Nigeria, Chad, Central African Republic, Equatorial Guinea, Gabon, Republic of Congo from the West to the North, Northwest, East, and South, respectively. These borders are located from south to north between longitudes 8^{0} and 16^{0} E and latitudes 1^{0} and 13^{0} N, from the Atlantic Ocean, and Lake Chad with an estimated land area is 475,400 km (Hughes 1992). This country has an estimated population of 25 million (World Bank 2018), which makes it the 54^{th} most populated country in the world (Ruppel & Ruppel-schlichting 2018). The country has 10 regions, which comprise of two Anglophone regions (Northwest and Southwest) and the other eight Francophone regions (South, East, Central, Littoral, Adamawa, North, Far North) with Douala and Yaounde being the most significant cities.

The Republic of Cameroon is often referred to as 'Africa in miniature' due to its diversity in culture, ethnicity, and geography (Ndenecho 2011). The country is made up of natural features like beaches, forests, mountains, savannahs, deserts, and mountains (Inc 2015). Equally important, Cameroon is made up of five agro-ecological zones (Figure 2), which include the Sudano-Sahelian upland, Guinean savannah, Western highlands, rainforest with monomodal rainfall pattern, and rainforest with bimodal forest pattern and lays between latitude 2° and 13°N (Nafan 2008).

3.1.1 Agriculture

The agricultural sector of Cameroon is diverse and has a huge variety of crops and animal species from its five agro-ecological zones (Akoa et al. 2016). The economy of the country is mainly agrarian, which causes the exploitation of the country's natural resources, which is the driving force for economic development (Lambi & Forbang 2009). Also, three-quarter of those employed into agriculture is the active population that lives in the rural areas where a majority of the population live in poverty, thus providing the rural youths with little opportunities which makes them susceptible to poverty (Maitre 2018).

Even though the agricultural sector of Cameroon is vital for the country's economy, productivity in the country is lower when compared globally because the farming

practices are mostly manual with traditional farming practices that include traditional equipment and outdated methods of production with limited industrialized farming and thus cultivation is often difficult. (Akoa et al. 2016). Household farming and agriculture in Cameroon are usually subsistence and done on a small piece of land with inadequate infrastructure, reduced credit access, and limited market. The most common cultivated crops include corn, groundnuts, vegetables, and poultry (most popular), goats, and sheep being the main livestock (Kouame et al. 2018). Similar studies by (Ngo-Mbogba et al. 2015) states that shifting cultivation and slash and burn is the main farming system practiced dominantly amongst subsistence farmers and (Yemefack 2005) agrees by claiming that shifting cultivation is a dominant farming system practiced amongst smallholder farmers of Cameroon.

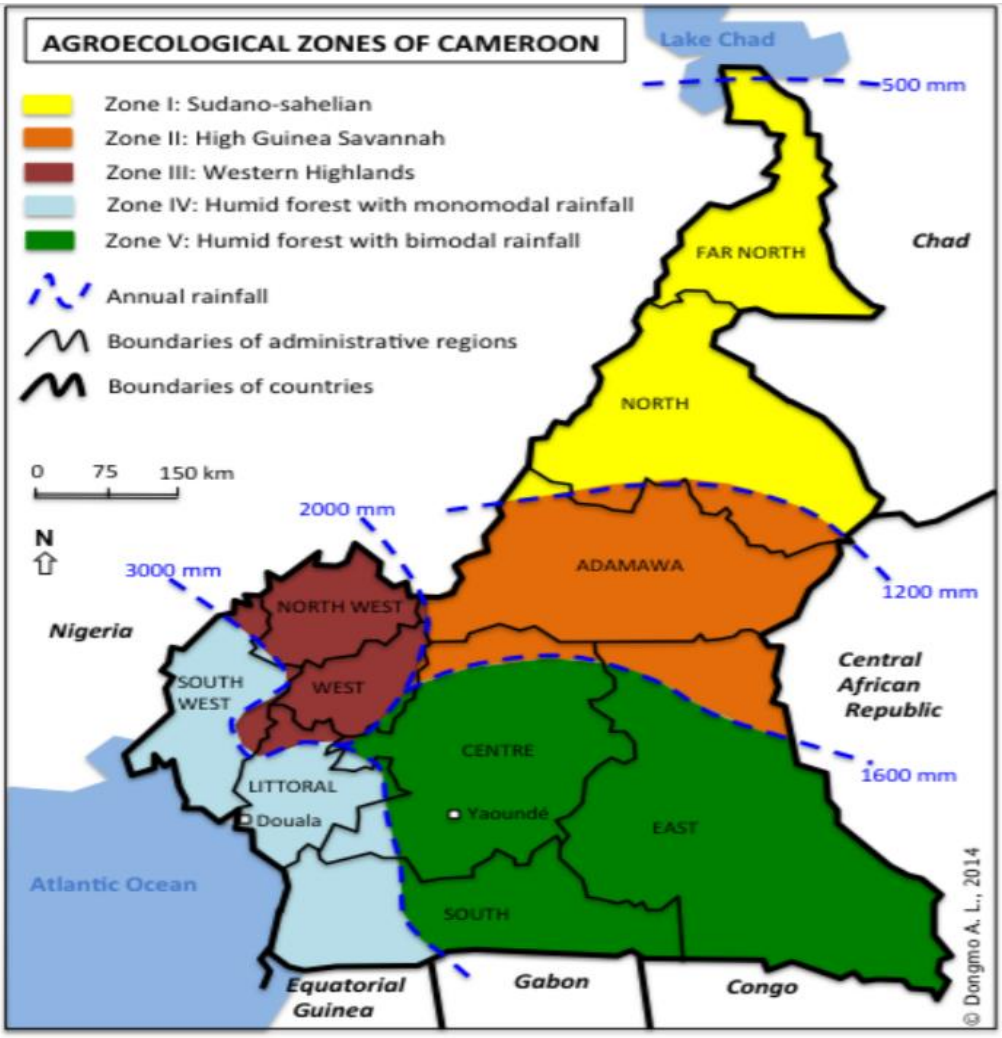

Figure 2. Ten different regions with five agro-ecological zones of Cameroon. I -Sudano-Sahelian upland; II – High Guinea savannah; III – Western highlands; IV – Humid forest with monomodal rainfall; V – Humid forest with bimodal rainfall (Akoa et al. 2016)

3.1.2 Tiko Municipality

Tiko municipality is one of the six communes of the Fako division in the Southwest (SW) region of Cameroon and bordered by Limbe, Buea, Muyuka and Dibombari to the West, North, East and South respectively (SIRDEP 2011) with a surface area of 4,840 km2 with a total of 134,649 inhabitants with 28 persons/ km2 (Mokondo 2014).

3.1.2.1 Biophysical Features

Climatically, Tiko has 8 months of rainy season and 4 months of dry season, which gives the municipality two cultivation seasons and suitable for planting of perennial and annual crops (SIRDEP 2011). It is worthy to note that rainfall is vital for agriculture in Tiko

because it determines the type of farming system practiced and the type of crop cultivated and occurs yearly with a range of 2000mm - 4000mm (Mokondo 2014).

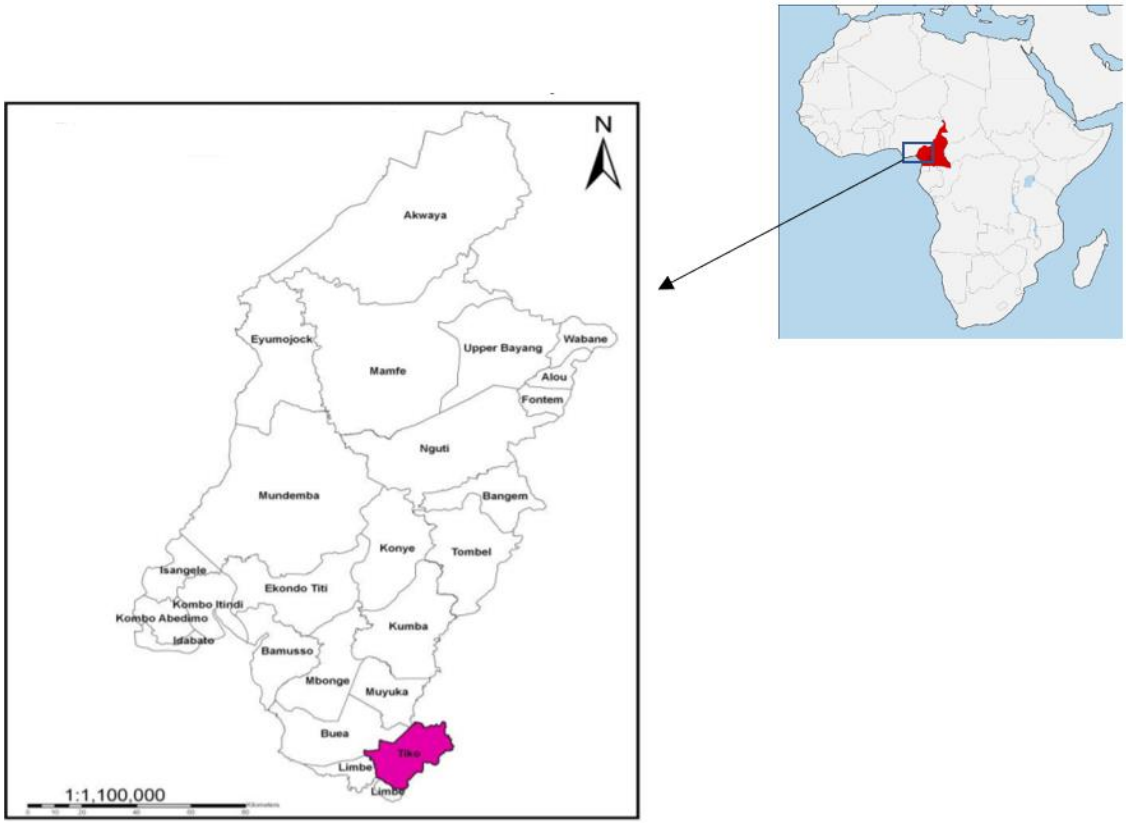

Figure 3. Map of Southwest Region by SIRDEP, 2011

Agriculture is the primary source of income for the inhabitants of this community, and its fertile soil and two seasons make it useful for cultivation. However, the farming practices are unsuitable which has led to a decline in yields leads to lower yields such as the over usage of 80% forest lands by the Cameroon Development Cooperation (CDC) to cultivate palm oil, rubber, and banana which causes loss of natural resources (Mokondo 2014). The researcher also states that little information about the soils of Tiko, but it has been observed that the soils are sandy alluvial and volcanic, which makes very potential for agriculture. However, there is a decrease in soil fertility due to unsustainable farming practices.

3.2 Research Design

The researcher adopted a convergent parallel mixed-methods design, which, according to Creswell (2013) is when both quantitative and qualitative data are collected simultaneously and then analyzed separately and then results are then compared for a conclusion. This mixed-method design was outstanding because it included the different

aspects of both the qualitative methods, which is usually used when investigating topics that are included in ethnography and can be known as descriptive, case, interview, grounded, observational, or field studies. This research method originates from anthropology and sociology, which is a detailed examination of the culture or the people of a region. In contrast, the quantitative methods, on the other hand, include empirical or statistical studies (Morse 1990). Therefore, the convergent parallel mixed-method design helped in a clear interpretation of the data.

The research was carried out based on a pragmatic worldview, which, according to (Cherryholmes 1992), does not rely on the events of the antecedents but depends on possible actions and consequences. Pragmatism does not include only one method but is a liberal understanding of the beliefs from both qualitative and quantitative approaches, so parallel mixed-methods are believed to offers a better understanding of the issue through triangulating quantitative and qualitative research (Creswell 2013).

3.3 Data Sources

This thesis was based on two main data sources that are secondary and primary data. The secondary data sources were used for the literature review and to better understand the problem before surveying the research area while the primary data were collected from the respondents.

3.3.1 Secondary Data

Secondary data was obtained from reading the available literature, and the sources of data were from a different academic database, and essential research was obtained from Science Direct, Web of Science, Google Scholar, and EBSCO. However, specific journals that published articles that were topic specific such as Land Degradation and Development, Land Use Policy, Environmental Science and Policy, Global Environmental Challenge, were used. Also, FAO, IPCC, UN was used to get a broader perspective on the problem. In terms of the research design and methodology, the book by Creswell (2013) on research design was used while the book by Salvatore & Reagle (2001) on statistics and econometrics was used to better elaborate and explain econometric modelling and statistical evaluation of data.

3.3.2 Primary Data

Different tools were used to gather quantitative and qualitative data. The qualitative data were collected using a focus group based on a FGD checklist. At the same time, the quantitative data were collected using open-ended and close-ended questionnaires and informal conversations. Close-ended questions were used to ask about the causes and indicators of land degradation and also see the various farming practices and adaptation strategies.

3.4 Tools for Data Collection

3.4.1 Questionnaire Structure

The questionnaire was the main tool used for gathering primary data, basing it on the work of (Assefa & Hans-Rudolf 2016; Liu et al. 2018; Emerton & Snyder 2018; Tesfahunegn 2019b). The survey had four sections, with a total of 26 questions, which included Likert scale questions, closed-ended, and open-ended questions. The questionnaire was designed to help the researcher gain a better understanding of the farmers' perception of land degradation together with the causes, indicators, and the adaptation strategies they use to combat infertile soils. A full questionnaire is presented in Appendix 1. Below are the different sections of the questionnaire.

Perception. It included questions about awareness of land degradation, the perceived impact of the causes and indicators of land degradation.

Technologies. It included questions about adaptation strategies (soil protection, increased productivity, climate adaptation, and household security) and constraints for adaptation.

Information Behavior. It included questions about access to credit and inputs in the last 5 years, sources of information, group membership, and agricultural shows participation.

Socio-demographic Profile. It comprised of education level, age, marital status, farming experience, farming types, land sizes, crop types, animal types, land tenure and household members.

3.4.2 Pilot Testing

The draft of the first questionnaire was given to two personal contacts from the Tiko municipality before travelling for the data collection. While in Cameroon, three experts from the Tiko Agricultural extension office were given the questionnaire for an additional pilot study for more examination because of their knowledge of the research population.

As a result, slight modifications were made on the questionnaire to get the final questionnaire.

3.4.3 Focus Group Discussion (FGD).

The FGD was carried out based on a checklist that focused on the farmer' perception of the causes and indicators of land degradation, and which adaptation strategies they used. The FGD was important because it helped the researcher in gaining a better understanding of the farmers' perception of land degradation and the difficulties they encounter while trying to adopt land management practices. Two focus groups with a total of 11 participants. The smallholder farmers were aged 35–50 years with different cultural experiences and marital status but living in the same municipality that the FGD occurred. The first FGD had a total of 5 participants (3 men and 2 women) while the second one had 6 participants (4 men and 2 women) who attended voluntarily after being contacted by the extension officer.

Interview and Protocol.

The extension officer chose one of the farmers' houses as a site for the focus group discussion because it was a neutral environment and was accessible for all the participants, including the researcher. The focus groups occurred on a Monday because places are lockdown (*ghost town)* in the Southwest regions on Mondays and so everyone is usually at home.

At the beginning of the FGD, the extension officer introduced the researcher, stated the reason for the research, and then informed the participant about the confidentiality of their participation in the discussion. The participants were then given short forms that required their demographic profiling, and it included their marital status, household members, farm sizes, ages, and other information that the respondents considered private, which they did not want to share in the focus group discussion. In case there were any difficulties in comprehending any question, an extension officer had to intervene and help the respondents.

FGD Checklist Questions

Opening Question*:* The opening question was about their awareness of land degradation.

Follow-up Questions*:* The follow-up questions included questions about the perception of the causes and indicators of land degradation.

Final Question*:* The final question was about their adaptation strategies.

Conclusion

After the final question, the participants were free to ask questions concerning the FGD. Later, all the forms and notes were collected and kept inside a properly labelled file. This was followed by the sharing an in-kind incentive as an appreciation for their time and participation on the FGD.

Figure 4. Interview with Farmer

Figure 5. First Focus Group

3.5 Sample Size and Sample Selection

The researcher planned to do a random sampling which was impossible because farmers were not easily accessible due to the political issues in the research area. However, the researcher focused on the exponential non-discriminative snowball sampling based on (Dudovskiy 2018) book of research methodology, where the scholar described the exponential non-discriminative as a method where a recruited individual brings other referrals, and each referral brings more referrals until the researcher reaches their desired sample size.

This method was advantageous because it was less costly, farmers were accessible, and the sample was obtained in a short time. Some of the available smallholder farmers contacted other farmers who lived in different areas but who were still representatives of the region of the research. However, some farmers refused to participate or refer to other smallholder farmers because of their beliefs and culture. A total of 150 questionnaires were distributed amongst the farmers, but only 122 were returned.

3.6 Time Frame of Diploma Thesis

This thesis included five different stages from choosing the thesis topic to its finalization from February 2019 - May 2020, as seen in Figure 6 below.

Thesis Formulation

Thesis formulation can be referred to as the initial or theoretical stage. It involved identifying the appropriate thesis topic and accompanied by discussing with the thesis supervisor. This initial stage included a full literature review to find out research gaps to formulate objectives and hypotheses.

Research Design

This stage was executed with the help of the theoretical stage. It included the creation of the questionnaire and development of methodology with the help of the thesis supervisor and contacting personal contacts in the area of research for pilot testing and information about the state of the country. Also, further piloting was done by expertise from the Tiko agricultural extension office while in Cameroon to make slight changes before printing the final questionnaires for distribution.

Data collection and Data Processing

This stage was focused entirely on data collection and data processing. Distributed questionnaires were collected and inputted for coded using Microsoft excel files.

Data Analysis and Coding

Data analysis and coding were done using SPSS 25. It also included the interpretation of the data that was analyzed based on literature review and writing results, conclusions, and recommending possible solutions to the problems.

Finalization

Finalization was the final stage where corrections were made using appropriate university thesis layout, and results were interpreted and later submitted.

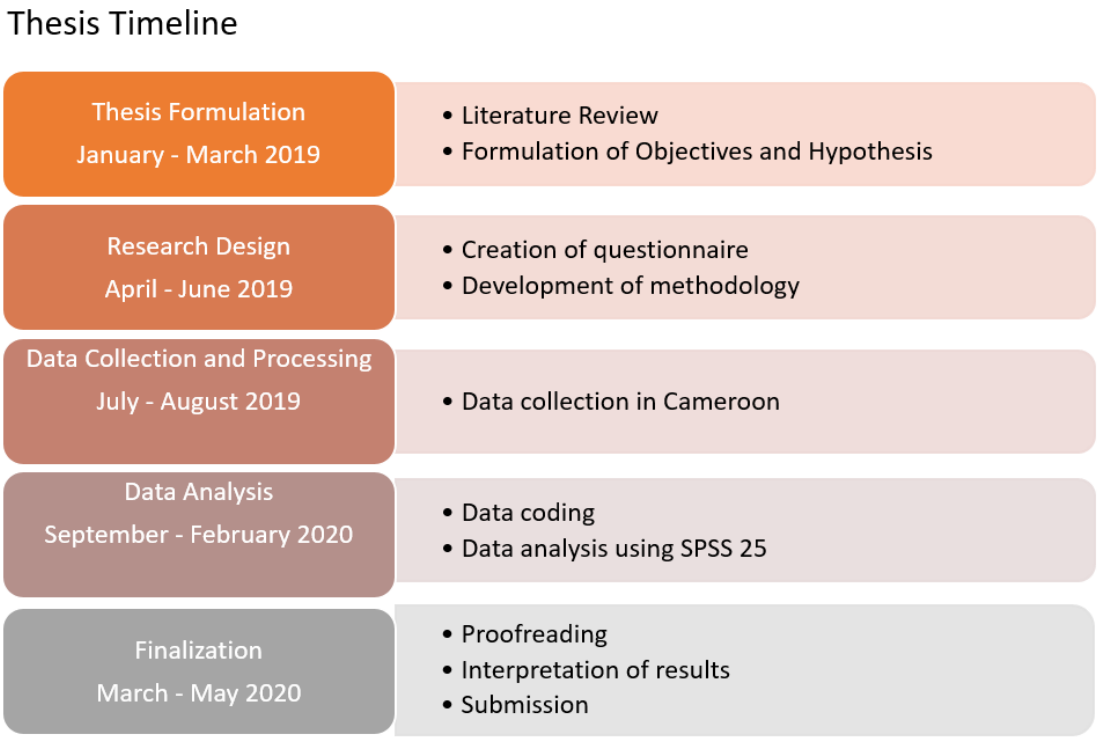

Figure 6. Thesis timeline

3.7 Data Analysis Methods.

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 25 and Microsoft excel tools.

3.7.1 Descriptive statistics

The mean, frequency, and percentage were used to describe the socio-demographic characteristics of the sample population, information sources, perception, and awareness of land degradation, adaptation strategies, and adaptation constraints.

3.7.2 Binary Logistic Model (BLM)

The BLM is used when the dependent variable is a dummy, dichotomous or binary, while the independent variables are a mixture of categorical, continuous, or both (Greene 2003; Midi et al. 2010). The binary model was chosen over the probit model because it is mathematically easier to compute and interpret (Tesfahunegn et al. 2016) and also because normality is not being tested

According to Maxwell & Bickman (2009), the odds ratio is essential for binary logistic. It shows a relationship between the dependent and independent variable because if it is

more than one, there is a probability that there will be a positive relationship between the dependent and independent variables (Tesfahunegn 2018). Below is the equation of the Binary logistic function as estimated by (David et al. 2013; Tesfahunegn 2018).

$$\ln\left[\frac{P}{1-p}\right] = ß_0 + ß_1x_1 + ß_2x_2 + ß_3x_3 + ... + ß_k x_k \quad (2)$$

Where;

$\left[\frac{P}{1-p}\right]$ = Odds ratio (likelihood)

P = Probability that farmers perceived on land degradation

$1 - p$ = Probability that farmers did not perceive land degradation

$ß_0$ = Intercept

$ß_1x_1 + ß_2x_2 + ß_3x_3 + ... + ß_k x_k$ = Coefficient of independent variables

In this study, the binary logistic model was used to show relationships between the dependent variable (farmers' perception on land degradation) and independent variables that were obtained when conducting the literature review and dependent adaptation strategies used to mitigate land degradation at probability level *(P) ≤0.05*.

Research by Cramer (2003) indicates that the binary logistics model will only fit the model if there is no multicollinearity amongst the independent variables. As a result, all the independent variables were tested using the variance inflation factor (VIF) and tolerance which for O'Brien et al. (2000) are the most used measures to tests for multicollinearity, and the variance inflation factor (VIF) should not be above 10 and tolerance should not be less than 0.10. In this study, all the variable for tolerance and VIF gave acceptable variables to safely say that the study did not violate any multicollinearity rule.

3.8 Variables Selection

The dependent variables include the farmers' perception of land degradation while the independent variables had a mixture of both continuous and categorical variables. The independent variables were divided into socio-demographic variables (age, gender, marital status, education level, number of household members), farm features (land size, type of farming practices, farming experience, types of crops planted, types of livestock,

land tenure, adaptation strategies), biophysical attributes (knowledge on the indicators and causes of land degradation), and institutional characteristics (access to credit, farmer group membership, participation in agricultural extension services, access to technologies for prevention measures). These variables are presented in Table 1.

3.8.1 Biophysical Attributes

The biophysical attributes included information about farmers knowledge on the indicators of land degradation based on soil quality. Farmers were asked to rate each indicator of land degradation based on the change in soil colour, the soil texture(ploughing) lower yields and decreased vegetation. The biophysical attributes were based on the study by Bunning et al. (2016) who attributed a change to soil quality as a virtual representative of land degradation based on seven indicators such as soil texture, soil texture, roots, soil color, soil structure, soil depth, surface crust, and soil life. Other studies by Yadav (2001) represented lower yields as an indicator of land degradation while Sala (2000) attributed the loss of vegetation cover as an indicator of land degradation because of the inability of the land to sustain vegetation when it is degraded. Therefore, being aware of these indicators will have an impact on which adaptation strategies is chosen by the farmers.

3.8.2 Institutional Characteristics

The institutional characteristics included farmer's access to credit and information, group membership and their participation in agricultural extension shows in the last 5 years. This variable was important because according to Daba (2003) having access to information determines the perception of farmers on the causes (soil erosion) of land degradation which therefore predicts the success in eradicating land degradation.

3.8.3 Socio-demographic Characteristics

The socio-demographic characteristics included the ages of the farmers, family size, gender, their farm attributes all have a potential influence on their perception about land degradation and if they are going to adapt to sustainable farming.

Table 1. Dependent and Independent Variables used For Statistical Results

Variables	Types	References
Dependent		
Perception of Land Degradation	Dichotomous/Yes, No	Tesfahunegn (2018)
Independent		
Socio-demographic attributes		
Age	Continuous/ Years	Shiferaw & Holden (1998)
Gender	Dichotomous/ Male, Female	Tesfahunegn et al. (2016)
Education	Continuous/Years	Nigussie et al. (2017)
Household size	Continuous/Number	Biddlecom et al. (2005)
Farming experience	Continuous/Years	
Farm attributes		
Farm size	Continuous/ha	Meshesha (2016)
Land Tenure	Dichotomous/ Owned, Not owned	Ståhl (1993)
Biophysical attributes		
Causes of land degradation	Ordinal/ Not important, Very important	Apollo et al. (2018)
Indicators of land degradation	Ordinal/ Not serious, Very serious	Stringer & Reed (2007)
Institutional attributes		
Access to credit	Dichotomous/Yes, No	Mercer (2004)
Member of Farmer group	Dichotomous/Yes, No	Tesfahunegn (2018)
Attendance of Agricultural shows	Dichotomous/ Yes, No	Hammond & Sloan (2016)
Sources of Information		
Information sources		
Other Farmers	Ordinal/Never, Frequently	Tesfahunegn (2018)
Internet	Ordinal/Never, Frequently	Somda et al. (2002)

4. Results

4.1 Qualitative Results

Two FGD were carried out with a total of 11 participants with 7 men and 4 women all from the Tiko municipality. The participants' ages ranged from 35–50 years.

4.1.1 Farmer' Perception of Land Degradation using FGD

The participants in the FGD were asked to identify how they perceived the causes and indicators of land degradation on their various farms. The identified indicators included low crop production, soil texture (ploughing problem, stones), presence of weed, and the absence of termites. According to Stringer & Reed (2007), the results obtained from particularly assessment could be used for the generation of land degradation indicators (shown in table 2 below).

Table 2. Indicators of Land Degradation from FGD

Indicators	Participants	Reference
Decreased Crop Production	11	Stocking & Murnaghan (2001)
Soil Texture (ploughing and presence of stone)	11	Dejene (1997)
Soil colour changes	9	Stocking & Murnaghan (2001b)
A decrease in Livestock size	5	Behnke (1994)
Reduction in milk production from cattle	3	Stringer & Reed (2007)
Absence of termites	6	Alemneh et al. (1997)
Presence of weed	11	Tesfahunegn (2018)
Absence of traditional medicinal plants	8	Shanley & Luz (2003)
Stunted growth of plants	10	Stocking & Murnaghan (2001)
Reduced supply of wood for fuel	8	IFAD (1992)

Additionally, when asked about the causes of land degradation, all the farmers believe it due to a reduction in soil nutrients as the main reason for land degradation whereas only 7 of the farmers perceive farm location to be the cause of land degradation.

Table 3. Causes of Land Degradation from FGD (n=11)

Causes	Number of respondents
Soil Erosion	9
Low soil Nutrients	11
Farm Location	4
Natural (weather)	9
Over usage of Land	7

4.1.2 Land Management Practices mentioned at FGD

The farmers made use of different soil management practices to cope with land degradation. A majority of the farmers used fertilizers, intercropping, and ash (slash and burn), respectively, which is in line with the study by (Bwambale 2015). A description of the adaptation strategies can be seen in Table 4 below.

Table 4. Land Management Practices FGD (n=11)

Adaptation strategies	Number of respondents
Fertilizers	11
Contour ridges	8
Intercropping	11
Fallowing	4
Compost	9
Animal manure	7
Burning of farmland	10

Figure 7. Contour ridges between yams for water erosion adaptation

Figure 8. Crop used for composting

4.2 Quantitative Results

4.2.1 Socio-demographic Characteristics

Table 2 shows a summary of the socio-demographic characteristics of the 122 respondents of the quantitative study. The mean age of the farmers was 53.98 years, with the youngest and oldest respondents being 34 and 74 years. The percentage of the gender of the sample reveals that 79.5% were male, and 20.5 % were female. The marital status of the participants who were single, married, widowed 3.3 %, 94.3%, 2.5% respectively, and no divorced participants. An average family had a mean of 3.7, which is lower than the 5.2 average household size in Cameroon (UN 2017). Additionally, the level of education of the farmers was primary, secondary, technical (vocational), and tertiary, which was 22.1%, 29.5%, 32.0%, and 16.4%, respectively. This study showed that a considerable amount of the farmers had completed the expected years of schooling, which, according to UNDP (2019), is 12.5 years of schooling. Also, the average years of farming was 18.30 years (minimum = 5years and maximum = 35years).

4.2.2 Farm Attributes

The farm sizes ranged from 0.5 to 10 hectares, with an average farm size of 3.47 hectares. Surprisingly, the farm size was above 2 hectares, which is the average farm size expected of smallholder farmers in African and Asian countries, according to (Nelson et al. 2012). The proportion of farmers who practiced arable, pastoral, and mixed farming which were 74.6%, 2.5%, and 23.0%, respectively. The most cultivated crops were vegetables, cassava and corn, while the major livestock owned were chicken, goats, pigs. The number of animals raised was not significant, which will reduce the accessibility to animal manure, according to Tesfahunegn (2018). Another important aspect was the land tenure, which revealed that 44.3% of the farmers owned their lands while 55.7% had titled or undocumented land ownerships. A detailed description of the sample is shown in table 2 below

4.2.3 Institutional Characteristics

Surprisingly, 85.2%% had no group membership, whereas only 37.7% have participated in an agricultural show. Additionally, only 14.4% of the smallholder farmers had access to credit and inputs to support their farm in the last 5 years.

Table 5. Descriptive Statistics of Participants (n=122)

Variables	Total (%)	Min value	Max value	Mean
Socio-demographic Characteristics				
Gender				
• Male	97(79.5%)	-	-	-
• Female	25(20.5%)	-	-	-
Marital status				
• Single	4(3.3%)	-	-	-
• Married	115(94.3%)	-	-	-
• Divorced	0	-	-	-
• Widowed	3(2.4%)	-	-	-
Level of Education				
• Primary	27(22.1%)	-	-	-
• Secondary	36(29.5%)	-	-	-
• Technical	39(32.0%)	-	-	-
• University	20(16.4%)	-	-	-
Household Members				
• Children (below 15years)	-	0	5	1.66
• Adults (16-59)	-	0	4	1.52
• Elderly (60^{+})	-	0	2	0.53
Ages	-	34	74	53.98
Farm Attributes				
Farming Practice				
• Arable farming	91(74.6%)	-	-	-
• Mixed	28(23.0%)	-	-	-
• Pastoral	3(2.5%)	-	-	-
Major crops				
• Vegetables	99(81.1%)	-	-	-
• Cassava	71(58.2%)	-	-	-
• Corn	62(50.8%)	-	-	-
• Egusi	49(40.2%)	-	-	-
• Yams	34(27.9%)	-	-	-
• Plantain	17(13.9%)	-	-	-
Livestock				
• Chicken	25(20.5%)	-	-	-
• Pigs	19(15.6%)	-	-	-
• Cows	11(9.0%)	-	-	-
• Goats	7(5.7%)	-	-	-
Land tenure				
• Owned	54(44.3%)	-	-	-
• Titled deed (documented)	68(55.7%)	-	-	-
Farming experience (years)	-	5	35	18.30
Farm size (hectares)	-	0.5	10	3.47

4.2.4 Information Sources

In research, farmers were asked to rank how well informed they were about soil fertility improvements, and their responses showed that 50 (41.0%) of the farmers were slightly informed with just 40(32.8%) of them had no information about the current trends to improve soil fertility. Also, the farmers ranked the different information sources they used from 0=never to 4=frequently, and the outcome showed that 64.8%, 58.2, 44.3%, 32.8%, 17.2% used newspaper, radio and television, other farmers, extension staffs and the internet respectively used the different information sources.

4.3 Farmers' Perception of Land Degradation

In this study, 89.3% of the farmers perceived land degradation, and 50% of them believe it is severe on their farm. Most of the farmers (76.2%) perceive lower yields as a very important indicator of land degradation, which has already been identified by previous studies (Stocking & Murnaghan 2001a; Tesfahunegn 2018). Accordingly, 50.8% of the respondents perceive water erosion to be the cause of land degradation.

Table 6. Perception of Land Degradation (n=122)

Variables	Not Important	Slightly Important	Important	Fairly Important	Very Important
Indicators					
Soil color	26 (21.3%)	39 (32.0%)	35 (28.7%)	10 (8.2%)	12 (9.8%)
Soil Texture	14 (11.5%)	13 (10.7%)	15 (12.3%)	36 (29.5%)	44 (36.1%)
Decreased Vegetation	32 (26.2%)	6 (4.9%)	15 (12.3%)	24 (19.7%)	45 (36.9%)
Lower yield	-	2 (1.6%)	10 (8.2%)	17 (13.9%)	93 (76.2%)
Causes					
Water Erosion	9 (7.4%)	15 (12.3%)	19 (15.6%)	17 (13.9%)	62 (50.8%)
Wind Erosion	17 (13.9%)	17 (13.9%)	24 (19.7%)	23 (18.9%)	41 (33.6%)
Low Soil Nutrient	12 (9.8%)	12 (9.8%)	26 (21.3%)	18 (14.8%)	54 (44.3%)

4.4 Adaptation Strategies used by Farmers

In this context, the reasons for the adaptation was to protect the soil, increase productivity, adapt to climate change, household food security. The adaptation strategies used by the farmers showed that fertilizers 69.7% and contour ridges 65.6% were the most used adaptation strategies, while mulching 23.8% was the least used.

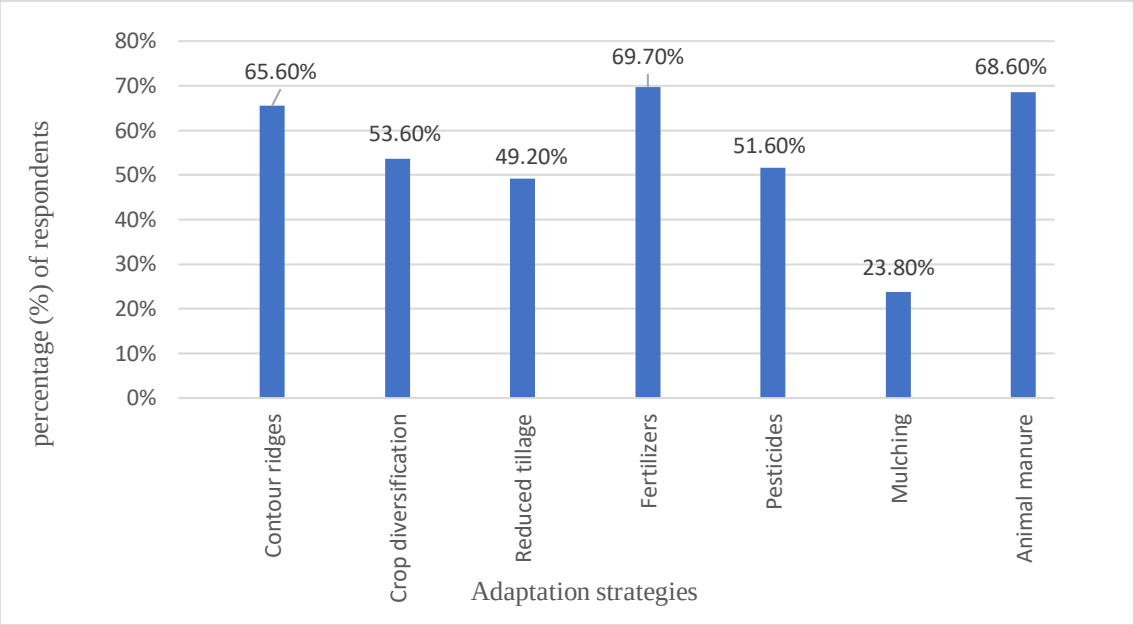

Figure 9. Adaptation strategies applied by Farmers

The average number of adaptation strategies used was 3.84, and a majority of the farmers (38.5%) used 4 different adaptation strategies, while only 1.6% applied all 7 adaptation strategies used in the study. According to the focus group discussion, some of the farmers applied more than one land management strategy because they had large farm sizes, or they owned their lands, and mostly because they were getting assistance from the government or an international organization. Adopting more strategies is in line with a study by Knowler & Bradshaw (2007), which claims that farmers will be willing to invest more in land management practices if they had larger farm sizes.

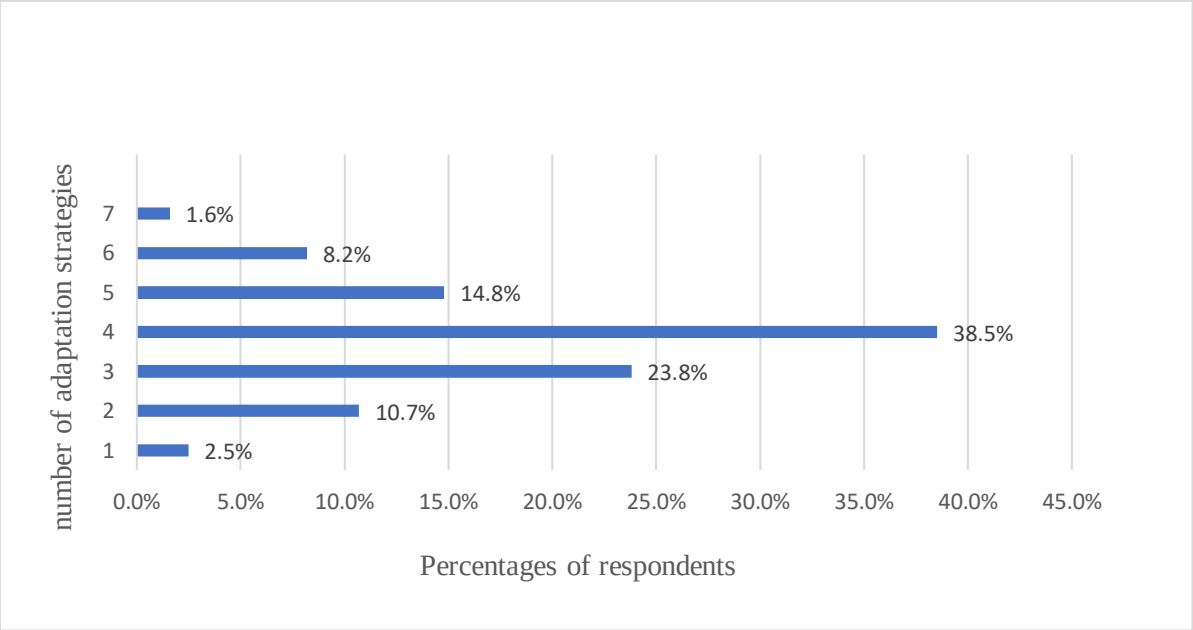

Figure 10. Number of applied adaptation strategies

4.5 Adaptation Constraints

Farmers were asked about their adaptation constraints to understand why a specific adaptation strategy was chosen. Likert scale questions rated 0 (=not relevant), and 4 (=relevant) were used to answer this question, and the results indicated mean values above 2, which was an indication of relevance. Potential constraints used for this research included no government support, no finance, no land, and a lack of information. As a result, lack of finance (3.20) and no government support (3.01) had the most influence on the farmers, while lack of information had the least impact on the farmers. (Figure 11 below shows an illustration of the mean of these adaptation constraints).

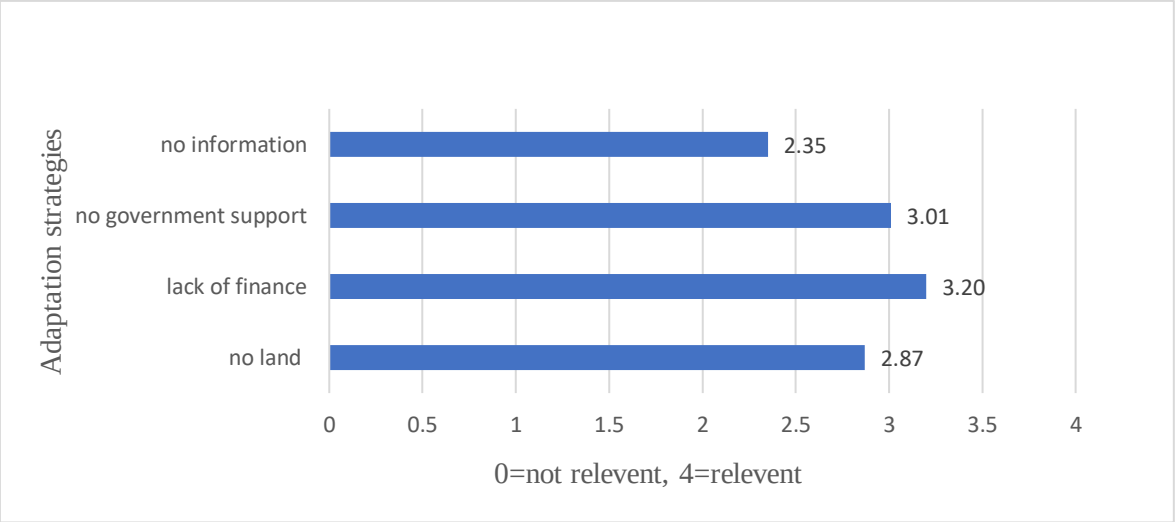

Figure 11. Adaptation Constraints that Affect Farmer's Adaptation strategies

4.6 Factors that Affect Farmers' Perception on Land Degradation

This research aimed to find out the factors that influence farmers' perceptions of land degradation using the BLM. The data analysis was carried out only on quantitative research. The BLM was used because the dependent variable (perception of land degradation) was binary, while the independent variables were a combination of categorical and continuous. According to Greene (2003), such values could be used for BLM analysis. Table 7 below gives an insight into how the model fits the research.

Table 7. Model Fit

Indicators	Perception on Land degradation
Omnibus Test	
Chi test	48.422
Df	22
Sig.	0.001
Models Classification	
Overall Percentage	95.1

Df is the Degree of freedom; Overall percentage is the prediction power of the model

Table 7 shows that the model fits at chi-square (x^2 = 48.4, p = 0.001) with an overall percentage of 95.1% for the relationship between the dependent and independent variables.

BLM results show that perception of land degradation is influenced by socio-demographic characteristics, institutional factors, farm attributes, soil indicators perception, and farm attributes. This can be seen on table 8 below.

Table 8: Results of Binary Logit Model

Dependent Variable Farmers Perception on Land Degradation	SE	P-Value	Odds Ratio
Independent Variables			
Socio-demographic characteristics			
• Ages	0.085	0.300	0.916
• Gender	1.877	0.061*	0.001
• Education	1.098	0.021**	12.547
• Total Household Members	0.809	0.043**	5.153
Farm Attributes			
• Farming Experience	0.073	0.304	0.928
• Land Tenure	0.869	0.134	3.684
• Farm Size	0.665	0.010**	5.503
Institutional variables			
• Access to credit	6.187	0.997	4.526
• Group Membership	2.965	0.027**	7.060
• Agricultural shows	1.664	0.473	0.303
Information source			
• Extension officers	1.635	0.206	0.126
• Other Farmers	1.190	0.636	0.569
• Internet	2.051	0.234	11.485
• Radio	1.711	0.094*	17.574
• Newspaper	1.504	0.130	9.774
Indicators of Land degradation			
• Soil colour	0.633	0.957	1.032
• Soil Texture	0.633	0.037**	3.736
• Lower Yields	1.628	0.009***	70.094
• Decreased Vegetation	0.373	0.691	1.160
Causes of Land Degradation			
• Wind Erosion	0.524	0.058*	0.370
• Water Erosion	0.475	0.499	1.382
• Low soil Nutrients	0.442	0.327	0.649

ß is the estimated coefficient, SE is the standard error, Odd Ratio is the Exponential of Coefficient. * Is significant at 1%. ** significant at 5%. *significant at 10%**

A total of 22 independent variables were used for the research and the estimated coefficient for the model showed a positive correlation for 8 dependent variables. These variables that influenced the dependent variables were distributed amongst the socio-demographic characteristics (gender, education, and total household members), farm

attributes (farm size), institutional variables (group membership), information source (radio), indicators of land degradation (lower yields) and causes of land degradation (wind erosion).

The results show that an increase in the household size causes an increase in the perception of land degradation. This was statistically significant at 5%. In addition, being educated was also significant and shows an increased in the likelihood of perceiving land degradation. Other predictors such as farm size and group membership also showed significance at 5%: an increase in farm size will increase the likelihood of farmers' perception of land degradation and also being a group member increase the probability of farmers' perception on land degradation.

Furthermore, the use of radio as a source of information was significant at 10%. Increasing the use of radio is likely to increase farmers' perception of land degradation. Lower yield was the only predictor that was significant at 1% and with a high odd ratio. This shows that farmers who used lower yield as an indicator are most likely to perceive land degradation. Moreover, the significance of soil texture shows that, those who use it as an indicator of land degradation were more likely to perceive that their land were degraded. The study also shows that wind erosion was significant at 10% and had an influence on how farmers perceive land degradation. Surprisingly, land tenure was not significant in this study.

5. Discussion

5.1 Farmers Perception on the Causes and Indicators of Land Degradation

In this study, 83.9% of the farmers were aware of the presence of land degradation on their farms, which is in line with other studies in India (Joshi et al. 1996), Ethiopia (Assefa & Hans-Rudolf 2016) and Nigeria (Akinnagbe & Umukoro 2011). This result indicates that not all farmers are aware of the presence of land degradation, thus making them more susceptible to the effect of land degradation.

All the farmers were able to identify more than one indicator of land degradation, and for Stocking & Murnaghan (2001) it is important because a single indicator will only provide a single element of land degradation. According to the farmers, lower yields and decreased vegetation indicated land degradation. In line with the previous studies, These indicators are similar to other researches that were used to determine farmers' perception on land degradation (Bewket & Sterk 2003; Saguye 2018). However, studies by Stocking & Murnaghan (2001) claim a reduction in crop yield should not only be seen as an indicator of land degradation because land degradation might be occurring even with an increase in crop yields. The writer further claims that some land management practices might hide the effect of land degradation, such as fertilizer or changing crop types, to the ones that are more tolerant of the farmland. Also, FGD result showed that apart from lower yields, the presence of weed and ploughing problems were also perceived as indicators of land degradation, and this is similar to studies carried out in Ethiopia by (Tesfahunegn 2018).

Most of the causes of land degradation mentioned in this study have already been identified by previous researchers, such as (Nkonya et al. 2016). As seen in Table 3, water erosion and low soil nutrients were ranked as the most important indicators of land degradation. Similarly, Meshesha (2016) research in Ethiopia showed that farmers also perceived water erosion as a cause of land degradation from the farmers. Besides, results from the FGD also revealed similar perceptions as those who participated in the quantitative research.

5.2 Variables that Influence Farmer’s Perception

5.2.1 Socio-demographic Variables

Education significantly influenced farmers' perception of land degradation. The results indicates that farmers with higher education are twelve times more likely to perceive land degradation. Similar findings by Shiferaw & Holden (1998), which shows a positive relationship between perception and soil erosion on smallholder farmers of North Shewa in Ethiopia. However, this result is contrary to similar studies by Nigussie et al. (2017), who claims that even though formal education is believed to enhance farmers' perception, formal education in this field of studies does not place emphasis on problems of the environment but make emphasis on basic literacy. A possible explanation for this result is that farmers that are educated are better researchers and are accessible to reports that talk about the indicators and causes of land degradation.

The more the household members the higher the probability that farmers will perceive that their land is degraded. Study in Nepal by Biddlecom et al. (2005) also revealed that more people would desire larger families if they perceive environmental degradation because with land degradation comes scarcity of natural resources. In contrast, Atiqul et al. (2010), people will use contraceptives for a smaller family size when they perceive that their environment is degraded, which prevents them from accessing natural resources. The results would suggest that people who perceive land degradation will desire a larger family size because, in most developing countries like Cameroon, family members are the main source of labor since hiring laborer is expensive. Surprisingly, gender and age did not have any significance in this research, just like previous studies. A possible explanation could be because most of the farmers were male.

5.2.2 Farm and Institutional Attributes

Farm size also had a likelihood of influencing farmers' perception on land degradation which is in line with the study of Meshesha (2016); Tesfahunegn (2018) in Ethiopia and Sahu & Mishra (2013) who claim that farm size influences farmers' perception. The explanation for this study is that those who perceive land degradation will desire a larger land size, which will also influence their desire for different methods of adaptation.

Additionally, being a group member increases the probability of the perception of land degradation, just like in previous studies (Tesfahunegn 2018). A possible explanation could be because being a group member makes the farmers aware of land degradation and give them access to other farmers, which they can share their experience. However,

this study is contrary to other studies from Gebrehaweria et al. (2016), which shows that the farm attributes such as the years of farming and land tenure have an impact on the perception that farmers have about land degradation. The reason for no significance could be that the sample size was small, and most of the farmlands were used only titled or documented and not owned.

5.2.3 Information source

Radio was the only significant source of information. Yet, studies by Nigussie et al. (2017); Tesfahunegn (2018); Shiferaw & Holden (1998) shows that farmers who used extension officers or participating in agricultural extensions were more likely to make the farmer perceive soil erosion since it gave them access to sustainable land management measures. The explanation for no significance could be that the quality of the information they have access to are either outdated or not sufficient and because the farmers still rely on their indigenous knowledge about the land.

5.2.4 Knowledge on Causes and Indicators of Land Degradation

In this research wind erosion was significant as a cause of land degradation. Also, land degradation indicators like soil texture and lower yield were more likely to impact land degradation which makes the study similar to researches from Alemneh et al. (1997); Kassie et al. (2009), who indicated that farmers aware of the low soil nutrients and soil erosion are likely to perceive land degradation and vice versa. A possible explanation for the lack of significance with the cause of land degradation could be due to that farmers perceive land degradation using their indigenous knowledge.

6 Conclusion

6.1 General Remarks

The overall study shows that smallholder farmers from the Tiko municipality recognize the presence of land degradation (including the causes and the indicators) on their farmlands. Even though a majority of the farmers perceived land degradation on their lands, only half of the sample recognized the severity of the issue. The study showed significance among some socio-demographic, farm and biophysical attributes, and institutional factors, implying these factors could influence farmer's perception about the causes, severity, and indicators of land degradation in Tiko municipality.

Also, the way the smallholder farmers of Tiko municipality perceive the problem of land degradation impacted their adaptation strategies, which is aimed to help improve soil fertility, climate change, improve productivity, and household food security. Many of the farmers perceive water erosion and low soil nutrients for being the most important cause of land degradation on their lands. However, during the focus group discussion, some of the farmers listed the location of their farm, or over-farming since some of their lands were inherited.

Even though no information source was significant in this study, most of the farmers used other farmers as a source of information concerning technical measures on suppressing land degradation on their lands. The BLM showed that education, total household members, farm size, group membership, soil texture, and lower yield were significant. However, the odds ratios for lower yields and total household members were significantly higher than the others, which proves that they were the most used variables for determining how farmers perceive land degradation.

6.2 Recommendations

Cameroon government should implement programs that will educate farmers on the current trends on land degradation prevention and how they can implement them on their farmland.

In this study, only 14.8% of the farmers were group members. A group membership affected the land degradation perception. The government needs to encourage farmers to

become members of a group because this will increase the possibilities of learning and getting information about land degradation and protection issues from other farmers.

Although there was no statistically significant relationship between land ownership and land degradation perception in our model, a majority of the farmers still mentioned the insecurity of land tenure as an adaptation constraint. Cameroon government should take the problem of insecure land ownership into a political discussion.

6.3 Limitations

Data was collected only from the Southwest region because of the political crisis during the time of research: it was impossible to collect data from the three anticipated regions in Cameroon.

The desired sample size for the quantitative study was supposed to be 150 respondents, but we only sampled 122 farmers. In addition, the qualitative study managed to have two focus group discussions instead of five. Consequently, the study cannot represent the entire population of the Tiko municipality.

Data was collected using exponential non-discriminative snowball sampling because getting to farmers was difficult due to constant lockdown in the Southwest region which was motivated by political instability. So those who participated in the research were requested by the extension officers.

7. Reference

Adesina AA, Baidu-Forson J. 1995. Farmers' perceptions and adoption of new agricultural technology: evidence from analysis in Burkina Faso and Guinea, West Africa. Agricultural Economics **13**:1–9. Available from http://www.sciencedirect.com/science/article/pii/0169515095011428 (accessed April 14, 2020).

Akinnagbe O, Umukoro E. 2011. Farmers' Perception of the Effects of Land Degradation on Agricultural Activities in Ethiope East Local Government Area of Delta State, Nigeria. Agriculturae Conspectus Scientificus **76**:135–141.

Akoa EJ et al. 2016. FDN-3-2016-Status of Agricultural Innovations,Innovation Platforms and Innovations Investment in Cameroon:104. Available from https://library.faraafrica.org/wp-content/uploads/2019/10/FDN-3-2016-Innovations-Innovation-Platforms-and-Innovation-Investmentsd-in-Cameroon.pdf (accessed April 7, 2020).

Alemneh D, Elieho K S, Yanda P, Johnsen F, editors. 1997. Land degradation in Tanzania: perception from the village. World Bank, Washington, D.C.

Apollo M, Andreychouk V, Bhattarai SS. 2018. Short-Term Impacts of Livestock Grazing on Vegetation and Track Formation in a High Mountain Environment: A Case Study from the Himalayan Miyar Valley (India). Sustainability **10**:951. Multidisciplinary Digital Publishing Institute. Available from https://www.mdpi.com/2071-1050/10/4/951 (accessed March 31, 2020).

Armstrong DM. 1961. Perception, and the Physical World. Journal of Philosophy **59**:384–388.

Assefa E, Hans-Rudolf B. 2016. Farmers' Perception of Land Degradation and Traditional Knowledge in Southern Ethiopia—Resilience and Stability. Land Degradation & Development **27**:1552–1561. Available from https://onlinelibrary.wiley.com/doi/abs/10.1002/ldr.2364 (accessed April 3, 2019).

Atiqul HSMd, Vanwing T, Hens L. 2010. Perception, Environmental Degradation and Family Size Preference: a Context of Developing Countries. Journal of Sustainable Development **3**:p102. Available from http://www.ccsenet.org/journal/index.php/jsd/article/view/8544 (accessed April 6, 2020).

Balba AM. 1995. Management of Problem Soils in Arid Ecosystems. CRC Press.

Baumgart-Getz A, Prokopy LS, Floress K. 2012. Why farmers adopt best management practice in the United States: A meta-analysis of the adoption literature. Journal of Environmental Management **96**:17–25. Available from https://linkinghub.elsevier.com/retrieve/pii/S0301479711003598 (accessed April 14, 2020).

Behnke R. 1994. Natural Resource Management in Pastoral Africa. Development Policy Review **12**:5–28. Available from http://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-7679.1994.tb00053.x (accessed May 11, 2020).

Bewket W, Sterk G. 2003. Assessment of soil erosion in cultivated fields using a survey methodology for rills in the Chemoga watershed, Ethiopia. Agriculture, Ecosystems & Environment **97**:81–93. Available from http://www.sciencedirect.com/science/article/pii/S0167880903001270 (accessed May 3, 2020).

Biddlecom AE, Axinn WG, Barber JS. 2005. Environmental Effects on Family Size Preferences and Subsequent Reproductive Behavior in Nepal. Population and Environment **26**:583–621. Available from http://link.springer.com/10.1007/s11111-005-1874-9 (accessed September 15, 2019).

Blaikie P. 2016. The Political Economy of Soil Erosion in Developing Countries. Routledge. Available from https://www.taylorfrancis.com/books/9781315637556 (accessed January 31, 2020).

Blaikie P, Brookfield H. 2015. Land Degradation and Society. Routledge.

Blanco-Canqui H, Lal R. 2008. Wind Erosion. Pages 55–80 in H. Blanco-Canqui and R. Lal, editors. Principles of Soil Conservation and Management. Springer Netherlands, Dordrecht. Available from https://doi.org/10.1007/978-1-4020-8709-7_3 (accessed April 2, 2020).

Bojö JP. 1991. Economics and Land Degradation. Ambio **20**:75–79. Available from https://www.jstor.org/stable/4313780 (accessed January 31, 2020).

Boserup E. 1965. The Economics of Agrarian Change under Population Pressure:108.

Braun J von, Gerber N, Mirzabaev A, Nkonya E. 2013. The Economics of Land Degradation. SSRN Electronic Journal. Available from http://www.ssrn.com/abstract=2237977 (accessed April 3, 2020).

Bullock P. 2005. CLIMATE CHANGE IMPACTS. Pages 254–262 Encyclopedia of Soils in the Environment. Elsevier. Available from https://linkinghub.elsevier.com/retrieve/pii/B0123485304000898 (accessed April 1, 2020).

Bunning S, McDonagh J, Rioux J. 2016. Land Degradation Assessment in Drylands: Manual for Local Level Assessment of Land Degradation and Sustainable Land Management:195. Available from http://www.fao.org/3/a-i6362e.pdf.

Bwambale N. 2015. Farmers' Knowledge, Perceptions, and Socioeconomic Factors Influencing Decision Making For Integrated Soil Fertility Management Practices in Masaka and Rakai Districts, Central Uganda:99.

Cherryholmes CH. 1992. Notes on Pragmatism and Scientific Realism. Educational Researcher **21**:13–17. Available from http://journals.sagepub.com/doi/10.3102/0013189X021006013 (accessed February 8, 2020).

Conacher A, Conacher JL, Dragovich D, Maude A. 1995. Rural land degradation in Australia. Oxford University Press. Available from https://research-repository.uwa.edu.au/en/publications/rural-land-degradation-in-australia (accessed October 12, 2019).

Cramer JS. 2003. Logit models from economics and other fields. Cambridge University Press, Cambridge, UK ; New York. Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.527.242&rep=rep1&type=pdf.

Creswell JW. 2013. Research design: qualitative, quantitative, and mixed methods approaches.

Daba S. 2003. An investigation of the physical and socioeconomic determinants of soil erosion in the Hararghe Highlands, eastern Ethiopia. Land Degradation & Development **14**:69–81. Available from http://onlinelibrary.wiley.com/doi/abs/10.1002/ldr.520 (accessed April 9, 2020).

Dame M. 2017. ASSESSMENT OF LAND MANAGEMENT PRACTICES IN GIRAR JARSO WOREDA, CENTRAL ETHIOPIA:77. Available from

http://etd.aau.edu.et/bitstream/handle/123456789/5711/Motuma%20Dame.pdf?sequence=1&isAllowed=y.

David WH, Lemeshow S, Sturdivant RX. 2013. Applied Logistic Regression. John Wiley & Sons.

Davies J et al. 2015. With contributions from Global Drylands Initiative,:19.

Dejene A. 1997. Land Degradation in Tanzania: Perception from the Village. World Bank Publications.

Delphis F, Levia J. 1999. Land Degradation: Why Is It Continuing? Ambio **28**:200–201. Available from https://www.jstor.org/stable/4314877 (accessed January 25, 2020).

Dudovskiy J. 2018. Snowball sampling. Available from https://research-methodology.net/sampling-in-primary-data-collection/snowball-sampling/ (accessed February 11, 2020).

Emerton L, Snyder KA. 2018. Rethinking sustainable land management planning: Understanding the social and economic drivers of farmer decision-making in Africa. Land Use Policy **79**:684–694. Available from https://linkinghub.elsevier.com/retrieve/pii/S0264837718302631 (accessed March 29, 2019).

Eswaran H, Lal R, Reiche PF. 2001. Land degradation: an overview. In: Bridges, E.M.,I.D. Hannam, L.R. Oldeman, F.W.T. Pening de Vries, S.J. Scherr, and S. Sompatpanit(eds.). Responses to Land Degradation. Proc. 2nd. International Conference on LandDegradation and Desertification, Khon Kaen, Thailand. Oxford press.

Feder G, Just RE, Zilberman D. 1985. Adoption of Agricultural Innovations in Developing Countries: A Survey. Economic Development and Cultural Change **33**:255–298. The University of Chicago Press. Available from https://www.journals.uchicago.edu/doi/10.1086/451461 (accessed April 13, 2020).

Gbetibouo GA, Hassan RM, Ringler C. 2010. Modelling farmers' adaptation strategies for climate change and variability: The case of the Limpopo Basin, South Africa. Agrekon **49**:217–234. Routledge. Available from https://doi.org/10.1080/03031853.2010.491294 (accessed April 14, 2020).

Gebrehaweria G, A A D, G G, Meredith G, Simon L. 2016. An Assessment of Integrated Watershed Management in Ethiopia. International Water Management Institute (IWMI).

Gisladottir G, Stocking M. 2005. Land degradation control and its global environmental benefits. Land Degradation & Development **16**:99–112. Available from http://doi.wiley.com/10.1002/ldr.687 (accessed February 3, 2020).

Greene WH. 2003. Econometric analysis5th ed. Prentice Hall, Upper Saddle River, N.J.

Grepperud S. 1996. Population Pressure and Land Degradation: The Case of Ethiopia. Journal of Environmental Economics and Management **30**:18–33. Available from https://linkinghub.elsevier.com/retrieve/pii/S0095069696900029 (accessed March 24, 2020).

Hammond M, Sloan B. 2016. Rural-Urban Relationships in the Nineteenth Century: Uneasy neighbours? Routledge.

Henao J, Baanante C, Julio H. 1999. agement Initiative of the CGIAR, the Desertification Convention, and the Initiative for Soil Fertility Improvement. Library of Congress Cataloging-in-Publication Data.

Henry B, McKeon G, Syktus J, Carter J, Day K, Rayner D. 2007. Climate Variability, Climate Change and Land Degradation. Pages 205–221 in M. V. K. Sivakumar and N. Ndiang'ui, editors. Climate and Land Degradation. Springer Berlin Heidelberg, Berlin, Heidelberg. Available from http://link.springer.com/10.1007/978-3-540-72438-4_11 (accessed February 28, 2020).

Hughes RH. 1992. A Directory of African Wetlands. IUCN.

IFAD. 1992. Soil and water conservation in Sub-Saharan Africa : towards sustainable production by the rural poor. Amsterdam. Available from https://portals.iucn.org/library/node/21656 (accessed April 2, 2020).

IFPRI. 2020. Agricultural Extension | IFPRI : International Food Policy Research Institute. Available from https://www.ifpri.org/topic/agricultural-extension (accessed April 13, 2020).

Inc I. 2015. Cameroon Business Law Handbook Volume 1 Strategic Information and Basic Laws. Lulu.com.

Israr M, Ullah S, Ahmad S, Yaseen A, Pervaiz U, Ahmad N. 2018. Perceptions Vulnerability Index: A Measure of Land Degradation Process in Northern

Irrigated Plains of Pakistan. Sarhad Journal of Agriculture **34**:840–849. Available from http://infozdroje.czu.cz/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=135951059&lang=cs&site=eds-live (accessed May 30, 2019).

Johnson DL, Lewis LA. 2007. Land Degradation: Creation and Destruction. Rowman & Littlefield. Available from https://books.google.cz/books?id=HhNnjrqlXCQC.

Joshi PK, Wani SP, Chopde VK, Foster J. 1996. Farmers' Perception of Land Degradation: A Case Study. Economic and Political Weekly **31**:A89–A92. Available from https://www.jstor.org/stable/4404335 (accessed July 1, 2019).

Kairis Or et al. 2014. Evaluation and Selection of Indicators for Land Degradation and Desertification Monitoring: Types of Degradation, Causes, and Implications for Management. Environmental Management **54**:971–982. Available from http://link.springer.com/10.1007/s00267-013-0110-0 (accessed October 17, 2019).

Kapalanga TS. 2008. A Review of Land Degradation Assessment Methods:52.

Kassie M, Zikhali P, Manjur K, Edwards S. 2009. Adoption of sustainable agriculture practices: Evidence from a semi-arid region of Ethiopia. Natural Resources Forum **33**:189–198. Available from http://onlinelibrary.wiley.com/doi/abs/10.1111/j.1477-8947.2009.01224.x (accessed April 5, 2020).

Knowler D, Bradshaw B. 2007. Farmers' adoption of conservation agriculture: A review and synthesis of recent research. Food Policy **32**:25–48. Available from http://www.sciencedirect.com/science/article/pii/S0306919206000224 (accessed April 14, 2020).

Kouame E, Motsomi A, Mutsonziwa K. 2018. Cameroon-Agriculture_English_7-June-2018.pdf. Available from http://www.finmark.org.za/wp-content/uploads/2018/06/Cameroon-Agriculture_English_7-June-2018.pdf (accessed April 7, 2020).

Lal R. 1990. Soil Erosion and Land Degradation: The Global Risks. Pages 129–172 in B. A. Stewart, editor. Advances in Soil Science: Soil Degradation Volume 11. Springer, New York, NY. Available from https://doi.org/10.1007/978-1-4612-3322-0_4 (accessed March 30, 2020).

Lal R. 2001. Soil degradation by erosion. Land Degradation & Development **12**:519–539. Available from https://onlinelibrary.wiley.com/doi/abs/10.1002/ldr.472 (accessed January 31, 2020).

Lambi C, Forbang T. 2009. The economic impact of climate change on agriculture in Cameroon. IOP Conference Series: Earth and Environmental Science **6**:092017. Available from https://iopscience.iop.org/article/10.1088/1755-1307/6/9/092017 (accessed May 9, 2020).

Liu K, Huisingh D, Zhu J, Ma Y, O'Connor D, Hou D. 2018. Farmers' perceptions and adaptation behaviours concerning land degradation: A theoretical framework and a case-study in the Qinghai–Tibetan Plateau of China. Land Degradation & Development **29**:2460–2471. Available from https://onlinelibrary.wiley.com/doi/abs/10.1002/ldr.3011 (accessed April 3, 2019).

Lutz E, Hazell P. 1998. Agriculture and the Environment: Perspectives on Sustainable Rural Development. World Bank Publications.

Mabogunje AL. 2002. Poverty and Environmental Degradation: Challenges within the Global Economy. Environment: Science and Policy for Sustainable Development **44**:8–19. Available from http://www.tandfonline.com/doi/abs/10.1080/00139150209605588 (accessed March 25, 2020).

Maitre P. 2018. Investing in rural people in Cameroon:4. Available from https://www.ifad.org/documents/38714170/39972302/Cameroon_e/853484e6-e804-41b5-bb45-75973db67222.

Malthus T. 1998. An Essay on the Principle of Population:134. Available from http://old.esp.org/books/malthus/population/malthus.pdf.

Maxwell J, Bickman L. 2009. Handbook of applied social research methods:69–100.

Megersa T. 2011. Assessing the Role of Traditional Land Management Practices. LAP LAMBERT Academic Publishing. Available from https://www.morebooks.shop/store/gb/book/assessing-the-role-of-traditional-land-management-practices/isbn/978-3-8465-9923-5 (accessed May 8, 2020).

Meijer SS, Catacutan D, Ajayi OC, Sileshi GW, Nieuwenhuis M. 2015. The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. International

Journal of Agricultural Sustainability **13**:40–54. Available from https://www.tandfonline.com/doi/full/10.1080/14735903.2014.912493 (accessed April 14, 2020).

Mercer DE. 2004. Adoption of agroforestry innovations in the tropics: A review. Agroforestry Systems **61**:311–328. Available from https://doi.org/10.1023/B:AGFO.0000029007.85754.70 (accessed April 13, 2020).

Meshesha T. 2016. Farmer's Perception on Soil Erosion and Land Degradation Problems and Management Practices in the Beressa Watershed of Ethiopia. Journal of Water Resources and Ocean Science **5**:64.

Midi H, Sarkar SK, Rana S. 2010. Collinearity diagnostics of binary logistic regression model. Journal of Interdisciplinary Mathematics **13**:253–267. Available from http://www.tandfonline.com/doi/abs/10.1080/09720502.2010.10700699 (accessed April 29, 2020).

Mokondo DN. 2014. TIKO. Available from http://www.cvuc.cm/national/index.php/fr/carte-communale/region-du-sud-ouest/142-association/carte-administrative/sud-ouest/fako/575-tiko (accessed February 12, 2020).

Morse JM. 1990. Qualitative Nursing Research: A Contemporary Dialogue. SAGE Publications.

Nafan D. 2008. Phenotypic Diversity of Shea (Vitellaria Paradoxa C. F. Gaertn.) Populations across Four Agro-Ecological Zones of Cameroon. Journal of Crop Science and Biotechnology:9.

Narisma GT, Foley JA, Licker R, Ramankutty N. 2007. Abrupt changes in rainfall during the twentieth century. Geophysical Research Letters **34**. Available from https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2006GL028628 (accessed February 28, 2020).

Ndenecho EN. 2011. Decentralisation and Spatial Rural Development Planning in Cameroon. African Books Collective.

Negm AM, editor. 2017. The Nile Delta. Springer International Publishing, Cham. Available from http://link.springer.com/10.1007/978-3-319-56124-0 (accessed March 26, 2020).

Nelson G, Cai Z, Hassan R, Godfray C, Santos M, Swaminathan H. 2012. HLPE Project Team members:102. Available from http://www.fao.org.infozdroje.czu.cz/3/a-me421e.pdf.

Ngo-Mbogba M, Yemefack M, Nyeck B. 2015. Assessing soil quality under different land cover types within shifting agriculture in South Cameroon. Soil and Tillage Research **150**:124–131. Available from http://www.sciencedirect.com/science/article/pii/S0167198715000161 (accessed April 7, 2020).

Nigussie Z, Tsunekawa A, Haregeweyn N, Adgo E, Nohmi M, Tsubo M, Aklog D, Meshesha DT, Abele S. 2017. Farmers' Perception about Soil Erosion in Ethiopia. Land Degradation & Development **28**:401–411. Available from http://onlinelibrary.wiley.com/doi/abs/10.1002/ldr.2647 (accessed May 5, 2020).

Nkonya E, Gerber N. 2011. The Economics of Land Degradation: Toward an Integrated Global Assessment. Lang. Available from https://books.google.cz/books?id=g8_RygAACAAJ&dq=Nkonya+et+al.+(2011)&hl=en&sa=X&ved=0ahUKEwiHpouE5NDoAhWQzqQKHVZ6DIkQ6AEIWDAG.

Nkonya E, Mirzabaev A, von Braun J. 2016. Economics of Land Degradation and Improvement: An Introduction and Overview. Pages 1–14 in E. Nkonya, A. Mirzabaev, and J. von Braun, editors. Economics of Land Degradation and Improvement – A Global Assessment for Sustainable Development. Springer International Publishing, Cham. Available from https://doi.org/10.1007/978-3-319-19168-3_1 (accessed March 27, 2020).

O'Brien K, Sygna L, Næss LO, Kingamkono R, Hochobeb B. 2000. Is information enough? User responses to seasonal climate forecasts in Southern Africa. CICERO Center for International Climate and Environmental Research - Oslo. Available from https://pub.cicero.oslo.no/cicero-xmlui/handle/11250/191938 (accessed April 14, 2020).

Oldeman LR. 1990. Global Extent of Soil Degradation. Annual Report:19. Available from https://edepot.wur.nl/299739.

Ovuka M. 2000. More people, more erosion? Land use, soil erosion and soil productivity in Murang'a District, Kenya. Land Degradation & Development - LAND DEGRAD DEV **11**:111–124.

Pacheco FAL, Sanches Fernandes LF, Valle Junior RF, Valera CA, Pissarra TCT. 2018. Land degradation: Multiple environmental consequences and routes to neutrality. Current Opinion in Environmental Science & Health **5**:79–86. Available from http://www.sciencedirect.com/science/article/pii/S246858441830028X (accessed March 29, 2019).

Pagiola S. 1999. The Global Environmental Benefits of Land Degradation Control on Agricultural Land. Available from http://documents.worldbank.org/curated/en/816721468739507219/pdf/multi-page.pdf.

Pender J, Place F, Ehui S. 2006. Strategies for Sustainable Land Management in the East African Highlands. International Food Policy Research Institute. Available from http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/129585 (accessed May 8, 2020).

Pender JL. 1998. Population growth, agricultural intensification, induced innovation and natural resource sustainability: An application of neoclassical growth theory. Agricultural Economics **19**:99–112. Available from http://www.sciencedirect.com/science/article/pii/S0169515098000243 (accessed September 17, 2019).

Pimentel D et al. 1995. Environmental and Economic Costs of Soil Erosion and Conservation Benefits. Science **267**:1117–1123. Available from https://www.sciencemag.org/lookup/doi/10.1126/science.267.5201.1117 (accessed March 30, 2020).

Pimentel D, Burgess M. 2013. Soil Erosion Threatens Food Production. Agriculture **3**:1–21. MDPI, Open Access Journal. Available from https://econpapers.repec.org/article/gamjagris/v_3a3_3ay_3a2013_3ai_3a3_3ap_3a443-463_3ad_3a27851.htm (accessed March 30, 2020).

Pretty JN. 1995. Participatory learning for sustainable agriculture. World Development **23**:1247–1263. Available from http://www.sciencedirect.com/science/article/pii/0305750X9500046F (accessed May 8, 2020).

Raghavan GSV, Alvo P, McKyes (auth.) E, Lal R, Stewart (eds.) BA. 1990. Advances in Soil Science: Soil Degradation, 1st edition. Springer-Verlag New York. Available from

https://books.google.cz/books?hl=en&lr=lang_en&id=KL7kBwAAQBAJ&oi=fnd&pg=PA129&ots=H7MLJGHJ1O&sig=2p07xrrhMr_kOMQSgQk9XNDtcFY&redir_esc=y#v=onepage&q&f=false (accessed March 30, 2020).

Reed MS, Dougill AJ. 2002. Participatory Selection Process for Indicators of Rangeland Condition in the Kalahari. The Geographical Journal **168**:224–234. Available from https://www.jstor.org/stable/3451337 (accessed March 21, 2019).

Reimer AP, Weinkauf DK, Prokopy LS. 2012. The influence of perceptions of practice characteristics: An examination of agricultural best management practice adoption in two Indiana watersheds. Journal of Rural Studies **28**:118–128. Available from https://linkinghub.elsevier.com/retrieve/pii/S0743016711000878 (accessed April 14, 2020).

Ringrose S, Musisi-Nkambwe S, Coleman T, Nellis D, Bussing C. 1999. Use of Landsat Thematic Mapper Data to Assess Seasonal Rangeland Changes in the Southeast Kalahari, Botswana. Environmental Management **23**:125–138. Available from https://doi.org/10.1007/s002679900173 (accessed May 12, 2020).

Rosegrant MW, Cline SA, Li W, Sulser TB, Valmonte-Santos R. 2005. Looking Ahead: Long-term Prospects for Africa's Agricultural Development and Food Security. Intl Food Policy Res Inst.

Ruppel OC, ruppel-schlichting K. 2018. CAMEROON IN A NUTSHELL – HUMAN AND NATURAL ENVIRONMENT, HISTORICAL OVERVIEW AND LEGAL SETUP. Pages 51–74 in O. C. Ruppel and E. D. K. Yogo, editors. Environmental law and policy in Cameroon - Towards making Africa the tree of life | Droit et politique de l'environnement au Cameroun - Afin de faire de l'Afrique l'arbre de vie, 1st edition. Nomos Verlagsgesellschaft mbH. Available from https://www.jstor.org/stable/j.ctv941sr6.7 (accessed May 9, 2020).

Saguye T. 2018. Analysis of Farmers' Perception on the Impact of Land Degradation Hazard on Agricultural Land Productivity in Jeldu District in West Shewa Zone, Oromia, Ethiopia. Energy and Environment Research **8**:20.

Sahu N, Mishra D. 2013. Analysis of Perception and Adaptability Strategies of the Farmers to Climate Change in Odisha, India. APCBEE Procedia **5**:123–127.

Sala OE. 2000. Global Biodiversity Scenarios for the Year 2100 Science **287**:1770–1774. Available from

http://www.sciencemag.org/cgi/doi/10.1126/science.287.5459.1770 (accessed February 3, 2020).

Salvatore D, Reagle D. 2001. Schaum's Outline of Statistics and Econometrics, 2nd edition. McGraw Hill Professional. Available from https://books.google.cz/books?id=paeOUPNlXeIC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false.

Scherr SJ. 1999. Soil degradation: a threat to developing-country food security by 2020? Internat. Food Policy Research Inst, Washington, DC.

Scherr SJ. 2000. A downward spiral? Research evidence on the relationship between poverty and natural resource degradation. Food Policy **25**:479–498. Available from https://linkinghub.elsevier.com/retrieve/pii/S0306919200000221 (accessed May 8, 2020).

Schoonover JE, Crim JF. 2015. An Introduction to Soil Concepts and the Role of Soils in Watershed Management. Journal of Contemporary Water Research & Education **154**:21–47. Available from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1936-704X.2015.03186.x (accessed April 25, 2020).

Shanley P, Luz L. 2003. The Impacts of Forest Degradation on Medicinal Plant Use and Implications for Health Care in Eastern Amazonia. BioScience **53**:573. Available from https://academic.oup.com/bioscience/article/53/6/573-584/224740 (accessed May 11, 2020).

Shiferaw B, Holden ST. 1998. Resource degradation and adoption of land conservation technologies in the Ethiopian Highlands: A case study in Andit Tid, North Shewa. Agricultural Economics **18**:233–247. Available from http://www.sciencedirect.com/science/article/pii/S016951509800036X (accessed May 5, 2020).

SIRDEP. 2011. Tiko council. Available from https://sirdep.wordpress.com/tag/tiko-council/ (accessed May 9, 2020).

Somda J, Nianogo AJ, Nassa S, Sanou S. 2002. Soil fertility management and socio-economic factors in crop-livestock systems in Burkina Faso: a case study of composting technology. Ecological Economics **43**:175–183. Available from https://linkinghub.elsevier.com/retrieve/pii/S0921800902002082 (accessed May 10, 2020).

Ståhl M. 1993. Land Degradation in East Africa. Ambio **22**:505–508. Available from https://www.jstor.org/stable/4314139 (accessed October 17, 2019).

Stocking M, Murnaghan N. 2001a. Handbook for the Field Assessment of Land Degradation.Earthscan.Availablefrom https://books.google.cz/books?hl=en&lr=lang_en&id=6ttZU4vacUYC&oi=fnd&pg=PR3&ots=bgTuVneVXW&sig=bhX-KlTaTXxCpdIHLRnoARXaFf4&redir_esc=y#v=onepage&q&f=false.

Stocking M, Murnaghan N. 2001b. Handbook for the Field Assessment of Land Degradation. Earthscan.

Stringer LC, Reed MS. 2007. Land degradation assessment in Southern Africa: integrating local and scientific knowledge bases. Land Degradation & Development **18**:99–116. Available from http://doi.wiley.com/10.1002/ldr.760 (accessed June 1, 2019).

Tefera B. 2002. Nature and Causes of Land Degradation in the Oromiya Region: A Review. ILRI (aka ILCA and ILRAD). Available from https://books.google.cz/books?hl=en&lr=lang_en&id=ZJR0INMX_DIC&oi=fnd&pg=PR4&dq=causes+of+land+degradation&ots=3JnGs8tE_J&sig=33yErC9FIjavJjBR27S7EzBunHM&redir_esc=y#v=onepage&q=causes%20of%20land%20degradation&f=false.

Tesfahunegn GB. 2018. Farmers' perception on land degradation in northern Ethiopia: Implication for developing sustainable land management. The Social Science Journal **56**:268–287. Available from https://www.tandfonline.com/doi/full/10.1016/j.soscij.2018.07.004 (accessed April 5, 2020).

Tesfahunegn GB. 2019a. Farmers' perception on land degradation in northern Ethiopia: Implication for developing sustainable land management. The Social Science Journal **56**:268–287. Available from https://linkinghub.elsevier.com/retrieve/pii/S0362331918300843 (accessed June 1, 2019).

Tesfahunegn GB. 2019b. Farmers' perception on land degradation in northern Ethiopia: Implication for developing sustainable land management. The Social Science Journal **56**:268–287. Routledge. Available from https://doi.org/10.1016/j.soscij.2018.07.004.

Tesfahunegn GB, Tamene L, Vlek PLG, Mekonnen K. 2016. Assessing Farmers' Knowledge of Weed Species, Crop Type and Soil Management Practices in Relation to Soil Quality Status in Mai-Negus Catchment, Northern Ethiopia: ASSESSING FARMERS' KNOWLEDGE OF SOIL QUALITY INDICATORS. Land Degradation & Development **27**:120–133. Available from http://doi.wiley.com/10.1002/ldr.2233 (accessed September 19, 2019).

Tiffen Mary, Moretimore MJ. 1994. More people, less erosion : John Wiley & Sons, Chichester :

UN. 1994. United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa **2**. Available from https://treaties.un.org/doc/Treaties/1996/12/19961226%2001-46%20PM/Ch_XXVII_10p.pdf.

UN. 2017. household_size_and_composition_around_the_world_2017_data_booklet.pdf. Available from https://www.un.org/en/development/desa/population/publications/pdf/ageing/household_size_and_composition_around_the_world_2017_data_booklet.pdf (accessed April 9, 2020).

UNCCD. 2008. UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION IN THOSE COUNTRIES EXPERIENCING SERIOUS DROUGHT AND/OR DESERTIFICATION, PARTICULARLY IN AFRICA. In the 10-Year Strategy of the UNCCD (2008-2018). Available from http://catalogue.unccd.int/936_UNCCD_Convention_ENG.pdf.

UNDP. 2019. | Human Development Reports. Available from http://hdr.undp.org/en/countries/profiles/CMR (accessed April 9, 2020).

Vogt JV, Safriel U, Maltitz GV, Sokona Y, Zougmore R, Bastin G, Hill J. 2011. Monitoring and assessment of land degradation and desertification: Towards new conceptual and integrated approaches. Land Degradation & Development **22**:150–165. Available from https://onlinelibrary.wiley.com/doi/abs/10.1002/ldr.1075 (accessed September 21, 2019).

Wachter D. 1997. Land Titling and Prospects for Land Conservation: Lessons from a Case-Study in Honduras. Page (de Groot JP, Ruben R, editors). Palgrave

Macmillan UK, London. Available from https://doi.org/10.1057/9780230378087_11 (accessed March 22, 2020).

World Bank. 1992. World Development Report 1992: Development and the Environment. The World Bank. Available from http://elibrary.worldbank.org/doi/book/10.1596/0-1952-0876-5 (accessed March 26, 2020).

World Bank. 2018. Overview. Available from https://www.worldbank.org/en/country/cameroon/overview (accessed April 7, 2020).

Wozniak GD. 1984. The Adoption of Interrelated Innovations: A Human Capital Approach. The Review of Economics and Statistics **66**:70–79. The MIT Press. Available from https://www.jstor.org/stable/1924697 (accessed April 14, 2020).

Yadav S. 2001. Land Degradation in the Developing World: Implications for Food, Agriculture, and the Environment to 2020:42.

Yemefack M. 2005. Modelling and monitoring soil and land use dynamics: withing shifting agricultural landscape mosaic systems. Utrecht (Netherlands) ITC. Available from http://agris.fao.org/agris-search/search.do?recordID=XF2015015616 (accessed April 7, 2020).

Appendices.

Appendix 1 Questionnaire

Appendix 2 Focus Group Checklist

Appendix 1. Questionnaire

Survey - Farmers' Perceived impact of Land Degradation

Region: Fako Division, Southwest Region, Tiko Municipality**.**

A. Perception on Land Degradation

1. Is your land degraded?	
Yes	No

2. If yes, how serious is the problem of land degradation on your farm?				
Not serious – 0	1	2	3	4 – Very serious

3. How important are the indicators of land degradation for your farm?					
Not important - 0	1	2	3	4 – Very Important	
Indicators					
Soil color changes					
Soil texture (ploughing problems)					
Lower yields					
Decreased Vegetation					
Others (please indicate)					

4. Please indicate the seriousness of the causes of land degradation at your farm.					
Not serious - 0	1	2	3	4 -Very Serious	
Causes					
Water Erosion					
Wind Erosion					
Low soil nutrient					
Others(please indicate)					

5. Please indicate the importance of the following strategies.						
Not Important 0 1 2 3 4 Very Important						**Reason for strategy** Soil protection Economic (increased productivity) Climate adaptation Household food security Others
Contour ridges	0	1	2	3	4	
Crop diversification	0	1	2	3	4	
Mulching	0	1	2	3	4	
Fertilizers	0	1	2	3	4	
Pesticides	0	1	2	3	4	
Reduced Tillage	0	1	2	3	4	
Animal manure	0	1	2	3	4	
Others	0	1	2	3	4	

6. Which of the adaptation strategies did you use in the last 5years?							
Contour ridges	Crop diversification	Mulching	Fertilizer	Pesticides	Reduced tillage	Animal manure	Others

B. Technologies Used

7. What makes it difficult to adopt to land degradation? Fully agree - 0 1 2 3 4- Disagree					
Difficulties					
No land	0	1	2	3	4
Lack of finances	0	1	2	3	4
No government support	0	1	2	3	4
No information	0	1	2	3	4
Others	0	1	2	3	4

C. Information Behavior

8. Did you use credit to support your farm within the last 5 years?	
Yes	No

9. If Yes, what was your credit source?			
Meetinghouse	Inputs	Credit union	Others (please indicate)

10. Do you think you are well informed about current trends on the methods to improve soil fertility?				
Not informed - 0	1	2	3	4 -Very informed

11. **How often do you use the following technologies for land degradation prevention?**					
	Never	Rarely	Very rarely	Occasionally	Frequently
Internet					
Radio/Television					
Newspaper					
Extension staffs					
Other farmers					

12. Have you participated in any Agricultural extension services?					**Extension services** NAERP. Agricultural Value Chain PCP-ACEFA GIC
Never	Seldomly (less than once in 5 years)	Occasionally (around once every 2-3 years)	Frequently (around once per year)	Very often (several times per year)	

13. Do you belong to any farmer groups (associations, cooperatives)? If yes, please name them.	Farmer groups CIG CARITAS
No	Yes

14. What is important for you as a farmer?					
Less important – 0		1	2	3	4 Very important
Credit	0	1	2	3	4
Inputs	0	1	2	3	4
Farming techniques	0	1	2	3	4
Land Ownership	0	1	2	3	4

D. Socio-Demographic Profiling

15 Please indicate your gender	
Male	Female

16 Please indicate your current age

17. Marital status			
Single	Married	Widow	Divorced

18. Level of education			
Primary	Secondary	Vocational or Technical	University

19. Number of people living in your household		
Children (below 15years)	Adults (16-59)	Elderly (60^{+})

20. What type of farming do you practice?		
Arable(crops)	Pastoral (animals)	Mixed (animals and crops)

21. How many years have you been a farmer?

22. Please Indicate your total land size (in ha)

23. What share of land (%) is		
Rented	A titled deed or documented	Owned

24. How many hectares of lands are you currently using for arable cultivation?

25. Which major types of crops do you grow?						
Maize	Yams	Cassava	Egusi	Plantain	Veggies	Others

26. Please indicate the number and names of animals you have, and the size of the land occupied in 2019.	
Type of animals	Number

Appendix 2. Focus Group Discussion Checklist

Focus Group Discussion Checklist.

Study Area/Community Name……..

Date of Discussion…….

1. Population size/Number of Household …….

……

2. Awareness of Land degradation…….

……

……

3. Causes and Indicators of Land Degradation in the Community.

Causes	Locally perceived Indicators

4. Land Management Adaptation Strategies and Reason for Adaptation in the community

Land Management Strategies	Reasons for Adaptation

5. Important Information Recorded during Focus Group Discussion.

……

……

.....