Farmers' Response and Adaptation Strategies to Climate Change in Mafeteng District, Lesotho

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Farmers' Response and Adaptation Strategies to Climate Change in Mafeteng District, Lesotho

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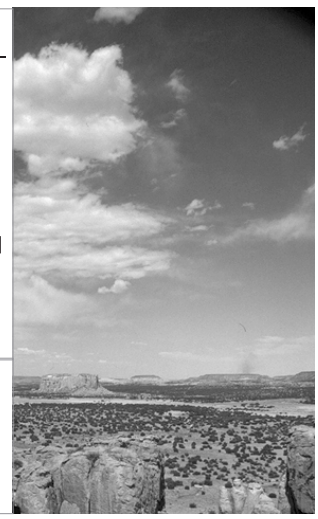

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Table of Contents

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Abstract

Over the years, Lesotho has witnessed changes in climatic conditions which are influencing the level of agricultural production (crop yield and quality) and general livelihoods. This study was carried out at Kolo and Ts'akholo areas in Mafeteng district of Lesotho to assess the response of farmers to changing climate and its impact on their livelihoods, and the potential of the three agricultural systems namely; agroforestry, conservation agriculture and conventional agriculture as adaptation strategies to climate change. Using a stratified sampling approach, 120 farmers were selected with 40 each practicing one of the three agricultural systems. Farmers in Kolo and Ts'akholo reported experiencing drought, sporadic and heavy rainfall periods, soil erosion, declining yield, pests and disease infestation, and short growing season and these have led to them developing their own adaptation/coping strategies to climate change. Some of the adaptation strategies include water harvesting technologies, conservation tillage, use of keyhole and trench gardens, agroforestry and application of traditional medicine to control pests and diseases. However, farmers in the two areas have an urgent need for support from either the government or local NGO's in terms of improved seeds, inputs subsidies, trainings, information and knowledge sharing. This study has contributed to knowledge in the field of global environmental change and its relationship with agriculture, food security and general livelihoods, especially for the farmer in two case-study areas as well as for policy makers in Lesotho.

1. Introduction

Lesotho is considered as one of the most vulnerable countries to climate change. Over the years, the country has been experiencing prolonged drought and erratic seasonal rainfall pattern (Chagutah and Mutasa, 2007; Obioha, 2010). This is compounded by increasing soil erosion, pest infestation and declining soil fertility which have heavily impacted on agricultural production. The country's economy which is dependent of rainfed agriculture has witnessed a decline in productivity over the past years. According to the Ministry of Natural Resources (2000), the last twenty years have seen the highest occurrence of droughts than any period of similar time span in the last 200 years.

In Mafeteng, one of the administrative districts located in the southern part of Lesotho, the dominant agricultural practices are mostly monoculture and conventional tillage. These farming systems, though embedded into community's cultural norms have not been effective in addressing agricultural production and household food security. There has been signs of environmental degradation due to impact of climate change over there years (International Federation of Red Cross and Red Crescent Societies, 2006). Drought and seasonal rainfall uncertainties coupled with high pest and disease infestation, increasing rates of soil erosion and consequent soil fertility decline, short growing season due to late rainfall characterize agricultural production in the district. This has had a negative impact on agricultural production subsequently reducing household income and subjecting communities in this district to high levels of poverty and very limited livelihood options (Mosenene, 1999).

According to FAO (2009) climate change adaptation strategies are now a matter of urgency. It is necessary that climate change adaptation is not separated from other development priorities but is integrated into development planning, programs and projects (World Bank, 2008). Responses aimed at adapting to climate change may, however, have negative consequences for food security, just as measures taken to increase food security may exacerbate climate change (CCAFS, 2009). It is therefore crucial to adopt effective adaptation strategies that can help communities adapt to the impact of climate change. Such adaptation strategies must be environmentally friendly, sustainable, easy for farmers to adopt and economically viable.

In the Mafeteng district, two agricultural systems namely- conservation agriculture and agroforestry are emerging as important adaptation strategies for climate change (International Federation of Red Cross and Red Crescent Societies, 2006; UNDP, 2011). As stated by Dumanski et al (2006), conservation agriculture applies modern agricultural technologies to improve production while concurrently protecting and enhancing the land resources on which production depends. Agroforestry provides many opportunities for value added production and is also used as living contour hedges for erosion control, to conserve and enhance biodiversity (Dumanski et al, 2006).

1.2 Objectives of the study

The purpose of this study was to assess the response of farmers to climate change and its impact on their livelihoods and the potential of the three agricultural systems namely; agroforestry, conservation agriculture and conventional agriculture in Kolo and Ts'akholo communities in Mafeteng District as adaptation strategies to climate change.

Specifically, the objectives of the study were to:

1. Assess farmer's perception and response to climate change impact in Mafeteng District
2. Describe farmer's adaptation practices, innovations and strategies in dealing with the impact of climate change in Mafeteng District
3. Assess the potential of three agricultural systems as climate change adaptation strategies in Mafeteng District

2. Literature Review

2.1 The concept of climate change

Climate change has moved from being a hypothesis to being a reality. This is substantiated by the fact that the global average surface temperature of the earth has increased by 0.6±0.20C since 1900 and it is likely that the rate and duration of the warming are greater than at any time in the past 1000 years (Intergovernmental Panel on Climate Change (IPCC), (2001a)).

Climate change has been defined by IPCC (2007) as a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. The UNFCCC (1992), on the other hand, defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and which is an addition to natural variability that has been observed over comparable time periods. Climate, however, is only one factor within the dynamic earth system. Changes in the physical and biogeochemical environment, either caused naturally or influenced by human activities such as deforestation, fossil fuel consumption, urbanization, land reclamation, agricultural intensification, freshwater extraction, fisheries over-exploitation and waste production, contribute to global environmental change (GEC), (CCAFS, 2009).

Furthermore, CCAFS report of 2009 concludes that climate change on its own represents an immediate and unprecedented threat to the food security of hundreds of millions of people who depend on small-scale agriculture for their livelihoods. Food security is achieved when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life, (FAO, 1996). Changing climatic conditions are projected to affect food security from the local to global level. It is predicted that patterns of rainy season will reduce, and the frequency and intensity of severe weather events such as floods, cyclones and hurricanes will increase. There will also be prolonged drought in some regions; and water shortages; and changes in the location and incidence of pest and disease outbreaks, (FAO, 2009).

2.2 Impacts of climate change on farming and livelihoods in Lesotho

Climate change is taking place at a time of increasing demand for food, feed, fiber and fuel, and has the potential to irreversibly damage the natural resource base on which agriculture depends, (IAASTD, undated). Changes in carbon dioxide concentrations, temperature and rainfall will have an impact on plant cover and land use which, in turn, substantially affect the behaviour of water when it falls as rain, (Muller, 2007). Due to reduced adaptive capacity and higher climate vulnerability smallholder and subsistence farmers in developing countries may not be able to cope with climate change effectively and such conditions pressure to cultivate marginal land or adopt unsustainable cultivation practices is likely and may increase land degradation, water scarcity and endanger biodiversity. Degraded lands in the southern lowlands of Lesotho are more susceptible to climate change impacts such as increased temperature and more severe drought, (Ministry of Natural Resources, 2000). Recorded land

degradation problems in Lesotho include massive soil erosion that leads to gully formation and abandonment of land, loss of biodiversity, severe loss of vegetation and low agricultural production and productivity, (Ministry of Agriculture and Bureau of statistics, 1994). According to Mekbib et al, (2011) Lesotho is heavily influenced by a variety of competing weather systems, which leave the country prone to natural disasters, drought and desertification, loss of biological diversity and land degradation. In accordance with article 4 of the UNFCCC, 2000, these conditions indicate Lesotho as a country highly vulnerable to climate change. UNDP (2007) asserts that climate change threatens food security, livelihoods and economic prosperity with emphasis on the vulnerable members of the community (including the poor, HIV/AIDS patients and orphans).

2.3 Farmers Adaptation Strategies to Climate Change in Mafeteng, Lesotho

Conservation Agriculture

Application of conservation agriculture promotes the concept of optimizing yields and profits while ensuring provision of local and global environmental benefits and services. Zero tillage, along with other soil conservation practices, is the cornerstone of conservation agriculture. In Mafeteng District, NGOs together with the Ministry of Agriculture and Food Security are promoting conservation agriculture for the purposes of minimizing soil erosion and increasing crop yield (International Federation of Red Cross and Red Crescent Societies, 2006).

Agroforestry

The term agroforestry is often perceived in the narrow sense of intercropping food plants and trees. In a broader sense, it signifies any system that includes food, and/or fodder and wood production, (Ahlback, 1995). Agroforestry systems, even if not primarily designed for carbon sequestration, present a unique opportunity to sequester carbon from the atmosphere (Verchot et al, undated). Carbon sequestration has been defined by the United Nations Framework Convention on Climate Change (UNFCCC), (2010) as the process of removing carbon from the atmosphere and depositing it in a reservoir. In this process atmospheric carbon dioxide is taken up by trees, grasses, and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage, and roots) and soils, (Center for Integrated Natural Resources and Agricultural Management and the Commonwealth Project, 2007). In essence, agroforestry core concerns include ecological and economic sustainability – resilience of environment and diversity of income. It is a system that blends production (food and income security at household- and community-level) with ecosystem services, (Jama, 2005).

Crop diversification

Crop diversity is large in the district (UNDP, 2010). It is well known amongst farmers that greater crop diversity and mixed farming (crops and livestock) offer considerable protection against farming risk, including climate-related risk (FAO, 2011). In order to prevent total loss of crop production larger farming enterprises with a range of different crop types, or even cultivars of the same crop with differing drought or pest resistance traits are being implemented in Mafeteng District (International Federation of Red Cross and Red Crescent Societies, 2006).

Keyhole and Trench gardens

Keyhole and trench gardens are fast growing adaptation strategies to climate change in Mafeteng, (International Federation of Red Cross and Red Crescent Societies, 2006). The two systems were introduced to Lesotho by Care Lesotho, a local non-governmental organization. Keyhole and trench gardens have proven an effective way to grow vegetables year round in semi-arid climate because they nourish the soil and help it retain moisture. These gardens reduce the labor required to produce food for the household (Weimer, 2008). This in turn helps households affected by chronic illnesses and HIV/AIDS, and households headed by children or the elderly, which often have limited labor capacity. This is a good example of a low-cost adaptation practice which is also supported by local government and can be up-scaled to the national level (UNDP, 2010).

3. Methodology

3.1 The study area

Mafeteng District has been chosen in this study because it is one of the most vulnerable districts to drought and poverty with 57% of the population living below poverty line and 7% living in a state of chronic illness (International Federation of Red Cross and Red Crescent Societies, 2006). Furthermore, the district also experiences droughts due to erratic rainfall. Kolo and Ts'akholo areas, in Mafeteng, were selected because they were among the hardest hit areas by drought, soil erosion, and reduced crop yield and, therefore, food insecurity.

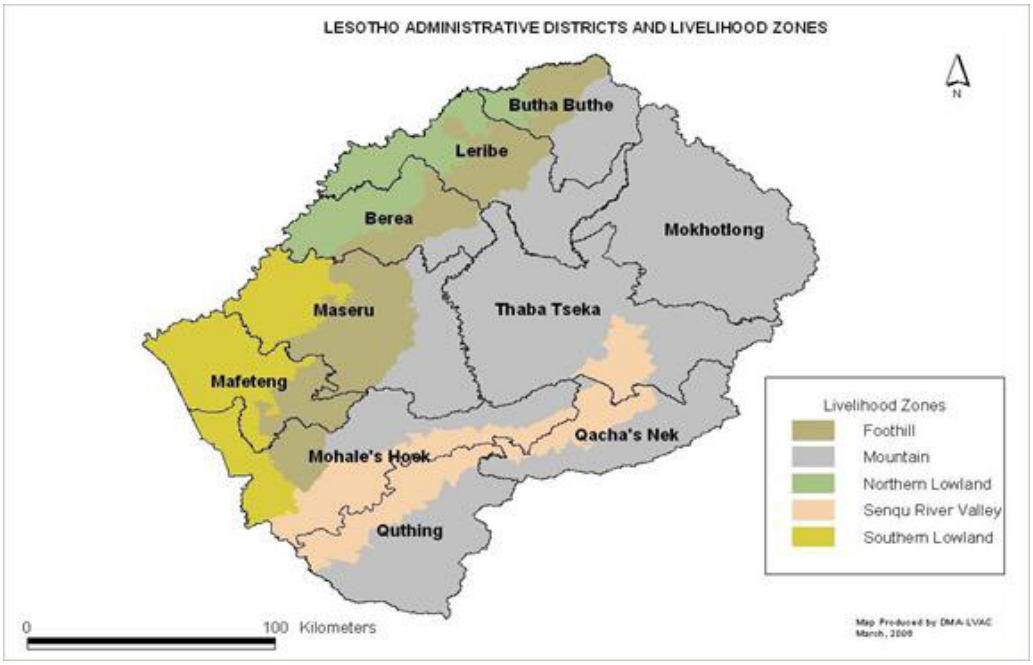

Figure 1: Map of Lesotho

3.2 Design of the Study

Since this study attempted to investigate climate change and its impact on farmers' livelihoods as well as assessing the potential of three agricultural systems to adapt to climate change, a combination of quasi (semi) experiment and interview schedule was used to gather data.

3.2 Population and Sample Selection

The target population for this study was all farmers in the two areas of Kolo and Ts'akholo in Mafeteng District. A representative sample was selected using a stratified sampling wherein members of a group were grouped into relatively homogeneous groups. The first stratum comprised of farmers that practice conventional farming, the second included farmers that practice conservation agriculture while the third stratum was farmers who practice agroforestry. The total number of farmers who participated in the study is 120. Each area had

60 farmers and this comprised of 20 farmers for conventional, conservation and agroforestry, respectively.

3.3 Interviews of Individual Farmers

Face to face interviews were conducted with individual farmers using a structured questionnaire with both open and closed-ended questions. The structured questionnaire was used mainly to maximize the relevancy and accuracy of the data collected and also to maximize the participation and co-operation of target respondents. Questions posted in the questionnaire were as concise as possible and included issues such as climate change awareness by the farmers, climate change impacts on farmers' livelihoods and their adaptation strategies to climate change. The interviews were conducted to determine the farmers' perceptions regarding impact of climate change on agricultural production and the technologies they use to adapt to climate change.

3.4 Data Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS). Descriptive Statistics were used to determine farmers' perceptions regarding impact of climate change on agricultural production and the technologies used by farmers to adapt to climate change.

4. Results and Discussion

4.1 Climate Change Awareness

The results demonstrated farmers' awareness of climate change though this is highest in men than women (figure 1). Fifty percent of the respondents (both men and women) attributed their awareness to climate change on mass media (especially radio). Twenty-nine percent of the interviewed men claimed that their awareness to climate change is rooted in their own observation of the impacts of climate change in their agriculture practice. This could be attributed to that fact that agriculture is a male dominated endeavor in Lesotho, (Ministry of Agriculture, 1995).

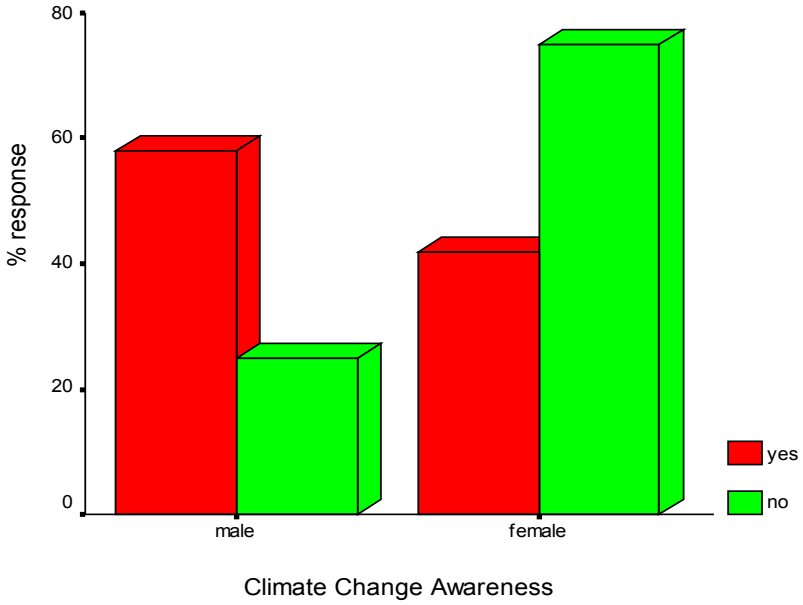

Figure 2: Climate change awareness to farmers at Kolo and Ts'akholo

When asked what they think should be done to spread climate change awareness participants pointed out that both workshops and "pitsos" (public gatherings) can be organized where information and knowledge sharing can take place between farmers and researchers (through extension services).

4.2 Impacts of Climate Change as Reported by Farmers

Farmers reported that the changing climate conditions have impacted greatly on their crop production; as such 40% of the farmers noted reduction of crop yields as a result of climate change. Some farmers (23%) said that they received below normal food produce from their fields as a result of prolonged drought and heavy rainfall. This claim is supported by a vast amount of literature (Obioha, 2010 and Ministry of Natural Resources, 2000). When researchers went to farmers' fields at both Kolo and Ts'akholo to observe existing conditions

they found both sheet and rill erosion. In this regard, 17% of the responding farmers in the two areas pointed out that soil erosion removed fertile surface soil resulting in soil fertility decline and consequently reduced crop yields. Furthermore, the quality of the produced crops has been on the decline and this is according to approximately 16% of the respondents at Ts'akholo and Kolo. They attribute the cause of declining crop quality to low soil fertility, scorching sun on their crops, pests, drought and excessive rainfall.

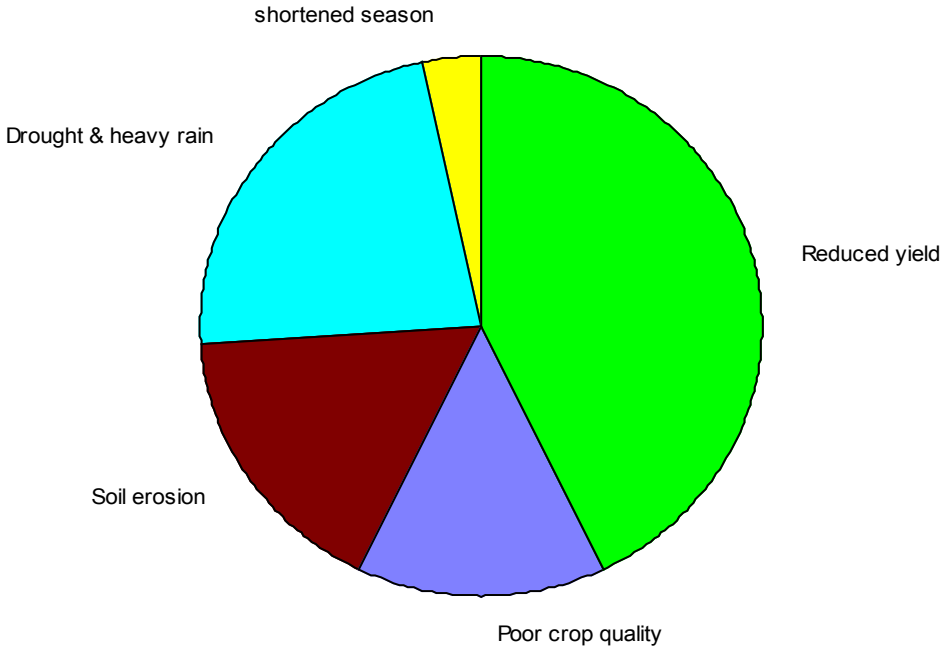

Figure 3: Impacts of Climate Change on Kolo and Ts'akholo

A small portion of the interviewees (4%) claim that climate change has resulted in shortened growing seasons. Through discussions with the farmers the researchers found out that famers receive rainfall late into the growing season and experience prolonged drought which hamper them from starting their cultivation ventures in time and by the time they start the growing season is already shortened. Figure 3 gives a summary of views of the interviewed farmers at Kolo and Ts'akholo in Mafeteng District on the impacts climate change has had on them.

4.3 Farmers' Climate Change Adaptation Strategies in Kolo and Ts'akholo, Mafeteng

In order to maintain their livelihoods in the unfavorable climatic conditions, responding farmers at Kolo and Ts'akholo have come up with a number of adaptation strategies. One of the dominant adaptation strategies in the two areas is trench and keyhole gardens (fig 4,5 and 6) which the respondents said they adopted from World Vision Lesotho and Lesotho Red Cross Society. The two NGO's conducted ''pitsos'' (community gatherings) where they shared their knowledge with community members and then conducted trainings for the local farmers and those who adopted the innovation were generously assisted and provided with essential resources such as shade nets and seeds.

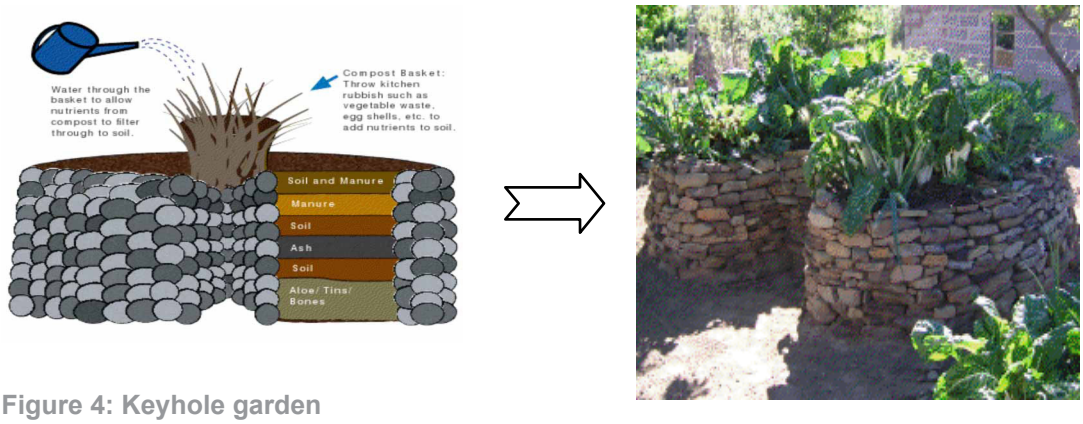

Figure 4: Keyhole garden

Keyhole gardens are easy to construct and advocate for use of locally available materials/ resources which include, among others; wood ash, manure, and aloe. A lot of material are required for construction of Keyhole gardens but once constructed they are easy to maintain.

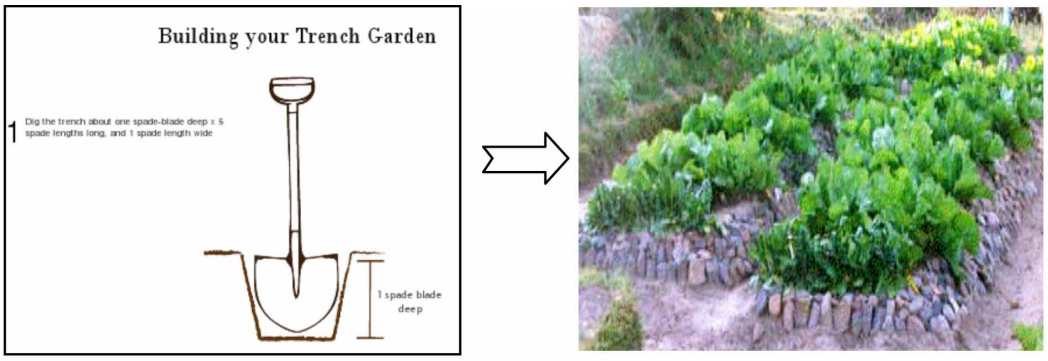

Figure 5: Trench garden

Trench gardens are dug into the ground (60 to 70cm deep) in the 1m x 2m space. Then a layer of aloe leaves, branches, cardboard or tin cans are placed at the bottom and the soil added on top. Dried grass or leaves are then added; lastly, a thin layer of soil is added and then a thick layer of manure.

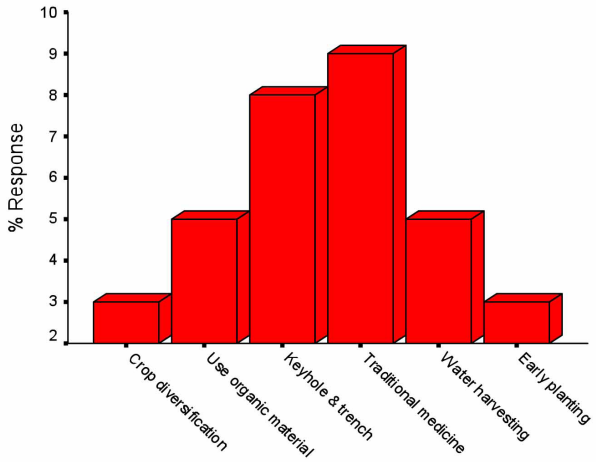

Figure 6: Emerging practices and adaptation strategies at Kolo and Ts'akholo

Many farmers in the two areas used traditional medicine to control pests and diseases while others adjusted their planting time in order to avoid some pests (figure 6). They plant early August to overcome cut-worm or plant in December when there is adequate rainfall. Farmers with livestock, especially cattle, use cow-dung instead of inorganic fertilizers when they plant to add fertility to the soil. Being drought prone areas, respondents from the two areas said they use roof water harvesting technology (figure 6) to collect water and store it in stone built-tanks next to their houses and this is used for watering crops in the garden as well as for household use.

4.4 Potential of the three agricultural systems: Agroforestry, Conservation Agriculture and Conventional Agriculture for Climate Change Adaptation

Participants were asked which agricultural system between agroforestry, conventional and conservation agriculture performed best in terms of yield. Most of the respondents acknowledged high yield from conventional agriculture than the other two systems (Table 2) and this yield is attributed to chemical fertilizer application which has been subsidized by the government. Soil erosion control and natural soil fertility enhancement were claimed to be highest in conservation agriculture and agroforestry systems respectively.

Table 1: Results of Farmer's Response regarding the Benefits of the three Agriculture Systems

Agricultural System	Benefits of the agriculture system			
	High yield	Moisture preservation	Soil erosion control	Enhance soil fertility
Conventional Agriculture	24*	1	1	0
Conservation Agriculture	10	6	10	4
Agroforestry	12	1	8	5

*Indicates number of respondents

The concern of some farmers regarding agroforestry farming is that trees take a long time to grow while conservation agriculture is labor intensive. On the other hand, participating farmers in Kolo and Tsakholo do not deny the fact that conventional agriculture poses a risk of soil erosion and subsequent soil fertility decline. The problem of soil erosion under conventional agriculture has been noted by a number of authors that include Chakela (1997) and WFP Lesotho (2006).

5. Conclusion and Recommendations

Farmers in Kolo and Ts'akholo have experienced yield decline as a result of impacts of climate change. Given the growing extent of land degradation, drought and scarcity of rainfall in Mafeteng district and the low returns from agriculture clearly calls for more productive and robust methods to agriculture. There is immense need for effective and resilient farming technologies among livelihoods that are agriculture-based as they will ensure the families are not vulnerable to climate change. Kolo and Ts'akholo areas have more undulating slopes than flat terrain and this means that conventional methods of agriculture (which tills the soil completely) promote soil erosion, especially if terraces are not properly constructed and planting not done along the contour. On the contrary, agroforestry and conservation agriculture are well suited to all terrains because they promote soil cover and discourage easy movement of soil particles. These two systems (conservation agriculture and agroforestry) can, therefore, be widely promoted in the district and other regions of Lesotho. In addition, in-depth research needs to be done on the integration of conservation agriculture to agroforestry as adaptation strategy to climate change and then policy formulated out of such a study.

It can be recommended that farmers be given more support from both local NGOs and the government in terms of trainings, information and knowledge sharing, and other fundamental resources that they need in their farming systems as has been done by Lesotho Red Cross Society. There is a need to promote systems such as agroforestry and conservation agriculture that promote ecosystem services. Farmers who practice environmentally friendly adaptation strategies can be paid or compensated (carbon trading) for their initiative as a way of encouraging other farmers to do the same or they can be assisted with high-breed seeds (tolerant to drought and fast growing) and subsidized agricultural inputs from NGOs and the government. Media outreach through radio can also be enhanced so that more farmers can be reached and informed about climate change, its causes, consequences, mitigation and adaptive measures.

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