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Climate Change Adaptation Strategies used by Limpopo Province Farmers in South Africa

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Abstract

The aim of the paper was to identify the adaptation strategies used by Limpopo province farmers against climate variability and change. A representative sample of 300 farmers aged 16-65+ years (46 percent males and 54 percent females) participated in the study. The study involved Sekhukhune and Capricorn districts, with 56 percent farmers in Capricorn and 44 percent in Sekhukhune district. The following 11 local municipalities were visited: Elias Motsoaledi, Makhuduthamaga, Fetakgomo, Ephraim Mogale, Tubatse, Lepelle Nkumpi, Blouberg, Aganang, Polokwane, and Molemole. Focus group discussions, questionnaire and observations were used to identify climate variability and change adaptation strategies in Limpopo province.The paper presented adaptation strategies of selected Limpopo province farmers. Some of their adaptation strategies included: (a) Use of DACOM system for monitoring, (b) Use of Indigenous Knowledge practices (c) Use of wind directions and clouds to determine rainfall expectation , (d) Use of nets to monitor temperature level etc. Other important adaptation strategies being used by farmers were also discussed in this paper including different adaptation measures against colds, heat, frost, abnormal wind, hail, lack of extension support, nematodes, insecticides, worms, temperature and rainfall. The adaptation strategies identified in this paper are potentially valuable to the agricultural sector considering the threats that climate change poses across climate sensitive sectors

Keywords: climate variability, climate change, adaptation strategies, Limpopo, South Africa

1. Introduction

According to IPCC (2007) Africa will be hit hardest by climate change as larger areas could be stricken by yield decreases of over 50 percent by the year 2020 as results of increasingly hotter and drier climate. This will threaten food security and people livelihoods in most parts of Africa. It is against this background that means have to be found to adapt to climate change and therefore essential for development partners to deliver on their commitments to support African countries to adapt to the unavoidable impact of climate change which includes scaling up efforts in order to (a) improve and increase access to climate data; (b) investment and transfer of technologies for adaptation in key sectors; (c) developing and implementing best practice guidelines for screening and assessing climate change risk in their development projects and programs in climate sensitive sectors; (d) mainstreaming climate factors into development planning and implementation; (e) providing significant additional investment in disaster prevention.

Limpopo province is one of the poorest provinces in South Africa. Climate change threatens the livelihood of the people. For instance as a result of drought many families lost their livestock and shortage of water was identified as the cause of the increased mortality rate of livestock (Letsatsi-Duba, 2009). At provincial and district levels there is awareness of the need to address climate impacts and adaptation and some assessments have highlighted the need for the development of adaptive strategies. At district level (Capricorn and Sekhukhune) there is evidence that people are developing adaptation strategies to changing patterns of water availability and the ever-prevalent stress of limited finance, for instance some small scale farmers in Sekhukhune district have set up traditional food seed banks to help maintain food security and at the same time help curb climate change (GSDM, 2011). Farmers also plant traditional crops that require no chemical fertilisers or pesticides and they are drought resistant as well. However there is also an inability among farmers to understand potential impacts and to take appropriate action

before, during, and after particular consequences to minimize negative effects and maintain the ability to respond to changing conditions.

Climate change is costing communal farmers hundreds of lost livestock due to a lack of grazing and water shortages Limpopo province. Some farmers are now accusing the government of managing crisis instead of implementing preventative measures. They are also accusing government of not providing them with information on how to manage their livestock amid climate change. This is a very serious matter that needs a proactive approach on climate change to give all stakeholders information on how to manage this crisis.

Identification of adaptation strategies is very important especially for poorer and more vulnerable communities in Limpopo province. The following adaptation strategies were identified by Molope (2006) as vital for the Limpopo province: (a) Sustainable conservation practices such as reduced, minimum or no till in conjunction with crop rotation and multi-cropping to enhance soil health, (b) Use of baseline information already available such as national collections of insects, arachnids, fungi and nematodes to monitor the effect of climate change on biodiversity, (c) Continuous drought and heat to lerant crop development by both conventional breeding and biotechnology with emphasis on successful production in marginal areas, (d) Decision support systems to assist livestock farmers in handling the effect and consequences of adverse climatic conditions, (e) Investigation of the adaptive abilities of indigenous crops; water and rainfall use efficiency technologies to facilitate the principle of more crop per drop, (f) Climate change awareness campaigns to reduce the vulnerability of the people and to facilitate the adoption of water use efficiency and conservation ethics, (g) Evaluation of the significance of climate change relative to other contextual factors that confront development, (h) Development of predictive early warning models, biological control and integrated pest management techniques to ensure adaptive capabilities in view of changing pest and disease dynamics, (i) Early warning systems and risk and disaster management are pivotal and should constantly be developed and refined, (j) Awareness and adoption of water use efficiency to ensure storage in the soil and as little runoff as possible, and of rainwater harvesting technologies, (k) Water use efficiency and sustainability in irrigated agriculture, (l) Strengthening the social, economic and environmental resilience of the poorest and most vulnerable against climate change and variability, (m) Investigation and extrapolation of the suitability of crops in different areas in view of biofuel production.

By understanding, planning for and adapting to a changing climate, individuals and societies can take advantage of opportunities and reduce risks. As results of increasing variability of climate communities are being forced to change their ways of living in order to adapt: (a) growing different crops, (b) making better use of scarce water resources, (c) using different production methods, (d) or preparing for more frequent weather-related disasters. It should also be noted that adaptation to climate change is rooted in the local context and people's knowledge culture and values, as these will determine how they can best cope with change.

The aim of this paper is to identify the impacts and adaptation options of climate variability and change on agricultural production in Limpopo province. This will be guided by the following objectives: (a) To understand the impacts of climate variability and change on agricultural production in Limpopo province, (b) To assess the impacts of climate variability and change on agriculturalproduction in Limpopo province and (c) To identify adaptation measures that could reduce the impacts of climate variability and change on agricultural production in Limpopo province.

2. Material and Methods

This paper used both quantitative and qualitative designs as questionnaire which included matters relating to climate change and agricultural productionwas used in the interviews and focus group discussions was conducted after face to face interviews with farmers. A temperature, rainfall and humidity parameters for the past 30-50 years for two selected districts was obtained from the South African Weather Services. Data on crops yield, tons, production and percent area planted for the past 30-50 years was obtained from the National Department of Agriculture. Permission was asked from the two district offices to conduct research in their different local municipalities. The following local municipalities were visited: *Elias Motsoaledi, Makhuduthamaga, Fetakgomo, Ephraim Mogale, Tubatse, LepelleNkumpi, Blouberg, Aganang, Polokwane and Molemole*as seen in Table 1. The survey targeted three hundred farmers in Sekhukhune and Capricorn Districts as seen in figure 1. The two districts namely Sekhukhune and Capricorn were asked to provide the list of farmers in their municipalities.

Purposeful sampling technique was used to select three hundred farmers to be interviewed in order to cover uniformity and homogenous characteristics of farmers. The mixed questionnaire included matters relating to climate change and agricultural production were used in the interviews. Before the interviews start a village meeting was conducted with all community representatives present: chiefs, indunas, local councillors and NGO’s.

The nature of the research and the contents of the questionnaire were explained to them. Focus group discussion was conducted after face to face interviews with farmers. Notes were also taken from observing the study areas.

Table 1: Summary characteristics of sample in 10 local municipalities

Variable	Total	Percentage
Number of Farmers per District		
Capricorn	167	56
Sekhukhune	133	44
Number of Farmers per Local Municipality		
Aganang	26	8.7
Blouberg	16	5
Polokwane	31	10
LepelleNkumpi	51	17
Molemole	43	14.3
Greater Tubatse	22	7
Makhuduthamamga	20	6.7
Fetakgomo	31	10.3
Ephraim Mogale	52	19
Elias Motsoaledi	8	2.3
Sex of Farmers		
Male	136	46
Female	164	54
Total	300	100

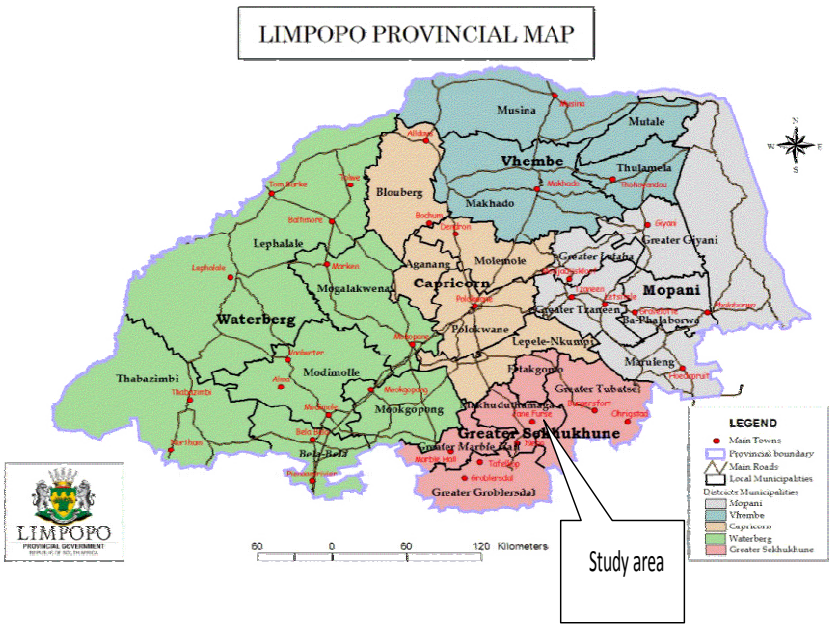

Figure 1. Geographic location of the Greater Sekhukhune district, Limpopo Province (StatsSA, 2006)

2.1 Univariate Analysis Model

According to Deressa et al. (2009), Univariate analysis is able to demonstrate the relationship between dependent and independent variables as stated in the general equation below:

$$Wi=\_+\_Xi+\_i \quad (1)$$

2.2 *Multivariate Analysis Model*

The application of multivariate analysis depends on many factors such as nature of variables used, research question, experimental design etc (Deressa et al., 2009). The equation can be written as follows:

$$Wi=\_+\_1INFCi+\_2ADCi+\_3INFEXi+\_4SEXFi \quad (1)$$

3. Results and Discussions

This section presents various adaptation strategies being used by some Limpopo province farmers in response to changing climatic conditions based on the survey. The adaptation strategies are grouped into Colds, Heat, Frost, Abnormal Wind and Hail; Extension Support; Drought; Rainfall; Temperature and Nematodes, Insecticides and Worms.

3.1 Colds, Heat, Frost, Abnormal Wind and Hail

Some farmers with resources are using the Dacom system, which is an environmental tool that foresees incoming weather change like frost, hot days, abnormal winds and colds. They also apply 8 mm water the night before frost to avoid excessive damage. Farmers also put nets around their crops to protect against colds, heat and frost as seen in picture 1. Tyre burning is also popular among resource poor farmers to protect their crops against cold. This burning of tyres serves as a blanket for crops like tomatoes during cold season. Farmers also diversify their crops to minimise total loss of production due to unforeseen weather conditions. Some farmers prefer to plant cotton during hot weather because of its resistance to hot weather. The selection of crops which are not damaged also serve as other farmers' adaptation measure which is available to them. Those with water adapt by irrigating crops the following day after weather damage. This has proven positive in some instances. Fertilisers are also applied after cold/hail/frost damage to revive production.

Picture 1**.** Nets/shades as adaptation measure against cold and heat conditions

Picture 2. Wood serving as adaptation measure against abnormal winds

Wood also serves as adaptation measure especially for tomatoes against abnormal wind as seen in picture 2. In some instances Germ tomatoes is preferred as it can grow well under cold weather conditions. Reducing of planting space is also used by some resource poor farmers against cold weather. This is used mostly by cabbage and spinach farmers, who believe that by reducing planting space, crops serves as blankets to each other during cold weather and this method is working very well.

3.2 Extension Support

Big companies like Lonmin in Limpopo province offered farmers with extension services. These farmers are also offered opportunity to attend skills development workshop regarding climate and agricultural issues. Government is also playing an important role in providing farmers with seeds, fertilisers, pesticides, skills training but they don't offer this to all affected farmers and some farmers needs support like labour, packaging, financial and harvesting assistance from government. Joint ventures/partnerships are also a good adaptation measure to deal with climate change. Here resource poor farmers partnered with skilled white commercial farmers in order to receive skill transfer, climate advisory information, technical, markets availability and infrastructural assistance. Some of the commercial farmers mentor and plough back their adaptation measures to resource poor farmers. Some commercial farmers even went extra mile to register other farmers at technikons or universities.

3.3 Rainfall

Dacom system is used to foresee incoming weather change like low and high rainfall in some parts of Limpopo province. The use of cultivars that is resistance to high/low rainfall is used by some well resourced farmers in Limpopo province. Few farmers as seen in figure 2 are using Dacom system to change planting dates in case of unexpected weather patterns. Through this Dacom system farmers can harvest too early not to lose product quality and they can also shift harvesting through day and night harvesting. But this is labour intensive since all products should be harvested before expected damage. Farmers also use clouds as an indicator for possible rainfall. When clouds are clustered and dark, for example, farmers know that they will have rain within short period of time. Wind direction is also used by some farmers as an indicator for possible rainfall. They believe that when wind came from the western side they would receive rain within 12 hours.

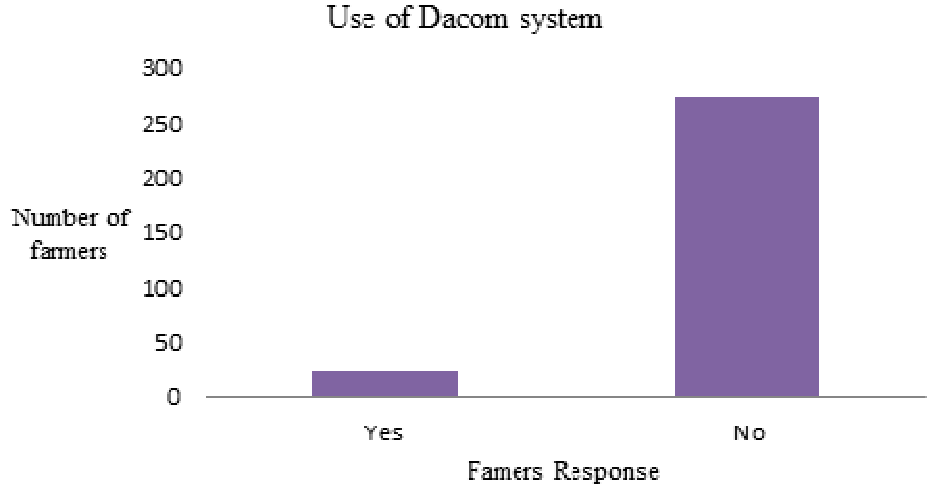

Figure 2. Use of Dacom system by Limpopo province farmers

3.4 Drought

Farmers in the area also developed drought-coping mechanisms and longer term research on the ecological, economical and social effects of drought. Some of the conservation practices used includes the following: (a) Minimum tillage; (b) Water harvesting; (c) Multi cropping and rotation practice; (d) Mulching system; (e) Rain gauge.

As shown in picture 3 minimum tillage is the low-impact system replacing ploughing which enhances carbon retention in soil. Minimum tillage is considered to be best management practice. The aim of this practice was to minimise soil disturbance and also retaining moisture throughout. This practice it also provides a wet season cover crop to protect the beds from slumping. Some of the advantages of minimum tillage includes: (a) better soil structure, (b) reduced soil loss and (c) reduced fuel costs. Picture 4 shows how rain water harvesting is practiced in the province. Water harvesting as indicated in picture 4 is when water is collected from the ground and this has achieved excellent results especial in some dry parts of Limpopo province. The primary reason to use this practice is to store available rainwater during the wet season and also to use the water for crop irrigation in the dryseason. This technique is also being practice in the Southern African Development Countries region due to its efficiency.

Picture 3. Minimum tillage practice by farmers in Limpopo Province

Source: ARC-ISCW (2007).

Picture 4. Water harvesting and optimization practice by farmers inLimpopo Province and other parts of the country

Source: ARC- ISCW (2007).

Crop rotation and multi cropping has become very popular in some dry parts of Limpopo province. As indicated in picture 5, crop rotation contributes to diversification of crop species and decreases the of diseases and pests attack. Greater nutrient utilization, less use of pesticides, and improved soil quality may reduce the overall environmental impact of crop production. The other preferred practice is multi cropping, which is the practice of growing two or

more crops in the same space during a single growing season and can reduce the risk of total loss from drought or pests. As shown in picture 6, mulching is essential to the survival of crops during drought periods. Mulch will reduce the amount of water that evaporates from the soil. Mulching improves the quality of the soil by breaking up clay and allowing better water and air movement through the soil. The benefits of this practice includes conserving moisture, slowing flood waters, slowing climate variability and change, lessening the need for pesticides, healthier crops and smothering weeds.

Due to drought some farmers established ventilation points in the soil for water to evaporate. A rain gauge as seen in picture 7 is also used by some farmers to measure the amount of rainfall. The data from rain gauges are especially important for farming in order to make decisions about crop planting (UNEP, 2008). In order to adapt against drought some farmers have water all the time as a measure of adaptation. They have good irrigation systems like centre pivots, drips and dams. Latest machines to take water to the fields are also available while some have boreholes and water underground.

Picture 5. Multi cropping and rotation practice by farmers in Limpopo Province and other parts of the country Source: ARC-ISCW (2007).

Picture 6**.** Mulching system practiced by framers in Limpopo Province andother parts of the country Source: ARC-ISCW (2007).

Picture 7. Environment monitoring tool-rain gauge

3.5 Temperature

The dacom system is being used by farmers with resources as adaptation measure against increased temperature. This basically helps farmers to monitor temperature levels in the soils. They also have fertilisers and chemicals to use against unacceptable temperature levels. Some resource poor farmers rely on friends, fellow farmers to establish temperature levels.

3.6 Nematodes, Insecticides and Worms

The well resourced farmers in Limpopo province are using chemical agents from reputable agrochem companies for dealing with nematodes, insecticides and worms. They use nemamate as a chemical to prevent nematodes infestation and if damage has already occurred they use nemacur. Most farmers emphasised the reading of recommendation as very important. Resource poor farmers plant onions alongside other crops to kill insects and worms. In this way onions kill insects and worms through its smell. This adaptation measure is more effective and positive results are achieved.

4. Summary and Conclusion

Important adaptation options being used by farmers were also discussed in this paper. This included different adaptation measures against colds, heat, frost, abnormal wind, hail, lack of extension support, nematodes, insecticides, worms, temperature and rainfall. As mentioned earlier, Limpopo province farmers have low capacity to adapt, it was interesting to observe some farmers using indigenous coping strategies like burning of tryes to adapt. So supporting these coping strategies of local farmers will help increase the adoption of adaptation measures thus bringing great benefits to vulnerable farmers in Limpopo province. According to DAFF (2011) there is sufficient evidence in South Africa to confidently predict that yields for certain crops will increase in some areas and decrease in others, while certain previously climatically unsuitable areas for specific crops will become suitable and vice-versa. Current maize production areas in the west of the country could become unsuitable for maize production due to increased rainfall variability (DAFF, 2011). Marginal land will become prone to reduced yields and crop failure because of diminished soil productivity and land degradation. Evidence also suggests that small-scale and urban homestead dry-land farmers are most vulnerable, and large-scale irrigated production is least vulnerable to projected climate change, given sufficient water supply for irrigation (IPCC, 2011). The government of South Africa has also outlined key adaptation measures to be taken against climate change across all its nine provinces (DEA, 2011).

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