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Perception of Farmers on Climate Change and Adaptation in Limpopo Province of South Africa

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ABSTRACT This paper investigated the perception of farmers on climate change and adaptation in Limpopo province in South Africa. A 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. Purposeful sampling technique was used to select three hundred farmers to be interviewed in order to cover uniformity and homogenous characteristics of farmers. The questionnaire included matters relating to climate change and agricultural production were used in the interviews. 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. The research was analysed with software package for social scientists (SPSS) and the following analyses were done: Descriptive analysis and Univariate analysis. The results showed that there is a great association among gender, employment, information of climate change, adaptation to climate change, information received through extension services, food scarcity, food security and agricultural production.

1. INTRODUCTION

Climate change directly affects agricultural production, as agriculture sector is inherently sensitive to climate conditions and is one of the most vulnerable sectors to the risks and impact of global climate change (Parry et al. 2005) .According to UNEP (2008) "humanity is living beyond its environmental means and running up ecological debts that future generations will be unable to repay as a result of global climate change". Agricultural production remains the main source of livelihood for rural communities in Africa, providing employment to more than 60 percent of the population and contributing about 30 percent of gross domestic product (Nhemachena and Hassan 2007). Southern Africa is expected to experience increases in temperature and declining rainfall patterns as well as increased frequency of extreme climate events (such as droughts and floods) as a results of climate change (Nhemachena 2008).

Several studies conducted to examine perceptions of farmers on climate change have shown that farmers had different perceptions on climate change adaptation. It was found by Diggs (1991) that approximately three-quarters of farmers surveyed in the Great Plains had different perceptions in climate variability and change. Another study conducted by Ishaya and Abaje (2008) in Nigeria, revealed that farmers perceived climate change to have occurred over the years due to diverse human activities. According to Mertz et al. (2009) in Sahel, Senegal farmers were aware of the climate variability and identified wind and occasional excess rainfall as the most significant factors that need adaptation.

The objective of this study was first to understand the perception of farmers on climate variability and change on agricultural production Limpopo province. Secondly to identify adaptation measures that reduces the impacts of climate variability and change on agricultural production in Limpopo province.

2. MATERIAL AND METHODS

This research has used both quantitative and qualitative design. A temperature and rainfall parameters for the past 30 years for two selected districts was obtained from the South African Weather Services. Data on crops yield, production. The survey targeted three hundred farmers from Sekhukhune and Capricorn districts and a village meeting was conducted with all community representatives present: chiefs, indunas and local councillors. The two districts namely

Sekhukhune and Capricorn were asked to provide the list of farmers in their municipalities. It was noted that 46 percent males and 54 percent females participated in the study. The study involved Sekhukhune and Capricorn districts (Table 1), with 56 percent farmers in Capricorn and 44 percent in Sekhukhune district. The following 10 local municipalities were visited: *Elias Motsoaledi, Makhuduthamaga, Fetakgomo, Ephraim Mogale, Tubatse, Lepelle Nkumpi, Blouberg, Aganang, Polokwane, and Molemole* (Table 1). The selection of the districts were based on different agricultural setups and different climatic conditions

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2.1 Univariate Analysis Model

Univariate analysis is able to demonstrate the relationship between dependent and independent variables as stated in the general equation below:

Wi = _ + _Xi + _i (1)
Wi is the dependent variable value for person i (2)
Xi is the independent variable value for person i (3)
_ and _ are parameter values (4)
_i is the random error term (5)
The parameter _ is called the intercept or the value of W when X = 0 (6)
The parameter _ is called the slope or the change in W when X increases by one (7)

3. RESULTS AND DISCUSSION

Various studies have shown that gender is an important variable affecting adoption decisions at the farm level. According to Bayard et al. (2007), female farmers are more likely to adopt natural resource management and conservation practices. It was also emphasised by Burton et al. (1999) that female farmers are indeed important in the choice of agricultural practices to adopt, particularly in regard to conservation agriculture or sustainable technology. According to Nhemachena and Hassan (2007), the possible reason for female to adapt is that in most rural smallholder farming communities, men are more often based in towns, and much of the agricultural work is done by women.

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
Lepelle Nkumpi	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

According to Gbetibouo (2006), 91 percent of farmers in the Limpopo basin perceived changes in temperatures over 20 years to be most significant in climate change. In other African countries, for example it was found that farming with diverse climatic zones have experienced decline in revenues with rise in temperatures (Kurukulasuriya et al. 2006). They further emphasised that revenues from agricultural products sales only increased with increased precipitation while Deressa et al. (2009) indicated that large numbers of farmers' perceived drought and windy weathers to be significant in climate variability and change hence adaptation is needed in those areas. According to Nhemachena and Hassan (2007) in Southern Africa, there is a perception

that most farmers perceive that long-term temperatures are increasing and the overall perception on long term changes in precipitation is that the region is getting drier and that there are pronounced changes in the timing of rains and frequency of droughts.

Table 2: Descriptive analysis (Perceived farmers adaptation strategies in Limpopo province (% of respondents)

Variable	*Number of farmers*	*Percentage*
Plant different varieties		
Yes 105	35	
No	195	65
Plant different crops		
Yes	118	39
No	182	61
Crop diversification		
Yes	151	50
No	149	50
Use different planting dates		
Yes	47	15.7
No	253	84
Shorten growing period		
Yes	2	1
No	298	99
Move to different site		
Yes	7	2
No	293	98
Change land size		
Yes	5	2
No	295	98
Change crops to livestock		
Yes	2	1
No	298	99
Change from farming to non farming		
Yes	10	3
No	290	97
Increase irrigation system		
Yes	198	66
No	102	44
Change use of fertilisers, chemicals and pesticides		
Yes	158	53
No	142	47
Increase water conservation		
Yes	17	6
No	283	94
Soil conservation		
Yes	22	7
No	278	93
Use insurance		
Yes	39	13
No	261	87
Use subsidies		
Yes	43	14
No	257	86
Total	300	100

This situation is not different to the selected Limpopo farmers interviewed, who identified their perceived adaptation strategies as seen in Table 2. Fifty percent of farmers prefer crop diversification as one of their adaptation strategies. Crop diversification can also serve as insurance against rainfall variability as different crops are affected differently by climate events (Orindi and Eriksen 2005; Adger et al. 2003). As an adaptation measure to unpredictable rainfall some farmers identified the following strategies as seen in Table 2: (a) use different planting dates (15.7 %); (b) plant different crops (39%); (c) plant different varieties (35%). It very clear from the above crop management strategies that majority of farmers did not recognise some of these strategies.

The majority of farmers perceive that soil fertility management may help them against climate variability and change. As seen in Table 2, almost 53 percent of farmers think change use of fertilisers, chemicals and pesticides will improve their adaptation capacity against climate change. According to IPCC (2011), chemicals, fertilisers and pesticides can improve crop yields tremendously but can also be costly to the environment. That is why some farmers in Limpopo province are applying organic fertilisers such as those resulting from composting. They believe that by emphasizing on organic farming carbon is stored in soils and contribute significantly to mitigate greenhouse gas emissions. This is true as carbon sequestration in soil has been recognised by Intergovernmental Panel on Climate Change and European Union as one of the possible measures to mitigate greenhouse gases (IPCC 2011).

Water management strategies for example, increased irrigation system was the most perceived strategy compared to other adaptation strategies. This is not surprising given the socio- economic challenges in Sekhukhune and Capricorn districts. The majority of farmers believe irrigation systems could make them adapt to climate change variability and change. Sixty percent of farmers prefer improved irrigation systems. The use of irrigation has the potential to improve agricultural productivity through supplementing rainwater during dry spells and lengthening the growing season (Baethgen et al. 2003; Orindi and Eriksen 2005). It is important to note that irrigation water is also subject to impacts from climate change. Use of irrigation

technologies need to be accompanied by other crop management practices such as use of crops that can use water more efficiently. Important management practices that can be used include: (a) efficient management of irrigation systems, (b) growing crops that require less water, and (c) optimizing of irrigation scheduling and other management techniques that help reduce wastage (Lo¸ et al. 2001). Other perceived strategies were mentioned by few farmers to deal with climate variability and change like: (1) Use insurance ; (2) Use subsidies; (3) Change land size; (4) Change crops to livestock; (5) Shorten growing period were not popular among most of the farmers. These perceived strategies were used by farmers with resources and those who have partnered with big companies like McCain and Lonmin mines etc.

According to Table 3 the odds of being affected by climate change are 1.00 percent higher for male farmers than female farmers. This situation is not surprising because it should be acknowledged that women play a vital role in supporting households and communities to adapt to climate change through experience gained in agricultural production. In Africa, for instance women are the primary producers of staple food and they contribute much of labor that will go into coping with climate risks through soil and water conservation UNDP (2009). This situation is not different from Limpopo province, where most information was given by female farmers. According to UNDP (2009) across developing countries women's leadership in natural resource management is well recognized. Women for centuries have passed on their skills to their communities in water management, forest management and the management of biodiversity, among others.

The odds of being affected by climate change are 0.72 times less for fulltime farmers than those part-time farmers as indicated in Table 3. This is true because being fulltime farmer increases the ability to take adaptation options. The response of farmers in Limpopo province is in line with the study conducted by Nhemachena and Hassan (2007) that fulltime farmers will not be affected much by climate change because they are more likely to have more information and knowledge on changes in climatic conditions than part-time farmers. Most of these farmers can also be targeted in promoting adaptation management by government to other farmers who do not have relevant experience and are not yet adapting to climate variability and change.

As indicated in Table 3 the odds of being affected by climate change is 4.50 percent times higher for farmers with information on climate change than those without information on climate change. This situation shows a bleak picture on access to climate information in Limpopo province. Limpopo province farmers should understand that information regarding climate change forecasting, adaptation options and agricultural activities are not easily available on radio and this increases high risks associated with climate variability and change. According to Baethgen et al. (2003) availability of climate

Table 3: Univariate analysis of potential determinants of agricultural production

Variable	*Total*	*Agric production (%)*	*OR [95%CI]*
Sex of Farmers			
Male	136	6.6	1.00[0.373 – 2.403]
Female	164	6.3	1
Employment			
Working fulltime	292	6.5	0.72[0.285 – 1.141]
Working part-time	8	0	1
Information of Climate Change			
Yes	171	2.9	4.50[1.585 – 12.697]
No	129	11.9	1
Adaptation to Climate Change			
Yes	55	1.8	5.01[1.654 – 38.383]
No	245	8.5	1
Information Received Through Extension Services			
Yes	146	4.1	2.45[1.585 – 12.697]
No	154	9.5	1

OR= Odds ratio; 95%CI = 95% confidence intervals

and agricultural information helps farmers to make comparative decisions in agricultural production and this allows them to better choose strategies that encourage climate variability, change and adaptation.

Another disturbing response is that of access to extension services by farmers. According to Table 3 the odds of being affected by climate change is 2.46 times higher for farmers that received information through extension services than those who did not receive information through extension services. This situation does not surprise me because some farmers especially resource poor farmers, were complaining that some extension officers do not have relevant qualifications to do the job. Again some extension officers were also complaining that government is not organising relevant training courses that deal with climate variability and change and agricultural production. This is a clear indication that extension officers need to be re-trained in order to provide valuable information to the farmers so that farmers can value them. As Mmbengwa (2009) emphasised that extension services have an important role to play in assisting farmers to acquire new technology, skills, innovation and production advice. Therefore Limpopo farmers and government should priorities extension service because it will significantly increase farmer awareness of changing climatic conditions as well as adaptation measures in agricultural production.

According to Table 3 shows that the odds of being affected by climate change are 5.01 times higher for farmers that can adapt to climate change than those who cannot adapt to climate change. This situation shows that even if some farmers are trying to adapt, the impact of climate change on agricultural production is a reality. Majority of farmers in those districts have agreed that they don't have capacity to adapt but the results also shows that even those who adapt are at risk against changing weather patterns.

According to Maddison (2007) situation like this can be addressed by governments like Department of agriculture and forestry, Agricultural research council and South African weather services to raise awareness of the changes in climatic conditions through appropriate communication pathways that are available to farmers such as extension services, farmer groups, input and output dealers, radio and televisions among others. This needs to be accompanied by the various crop and livestock management practices that farmers could take up in response to forecasted changes in climatic conditions such as varying planting dates, using irrigation, or growing crop varieties suitable to the predicted climatic conditions (IPCC 2011).

4. CONCLUSION

This paper has presented perceived adaptation strategies of selected Limpopo province farmers. Some of their perceived adaptation strategies included: (a) soil management strategies, (b) water management strategies and (c) others like use of subsidies and use of insurance. The results indicated that farmers are aware that Limpopo province is getting warmer and drier with increased frequency of droughts and changes in the timing of rains. That is why they identified some barriers to adapt to climate variability and change. Barriers like (a) lack of information, (b) lack of government support, (c) lack of education and skill should be addressed. Addressing these issues can significantly help farmers tailor their management practices to cope with climate variability. Adaptation is therefore critical and of concern in Limpopo province because the majority of poor resource farmers in the province have low adaptive capacity and also lack finance and technology. This will in turn have effect on agricultural production resulting in (a) decreases in agricultural activities, (b) loss of livestock, (c) shortage of drinking water, (d) low yields and shortage of seeds for subsequent cultivation.

5. RECOMMENDATIONS

A number of recommendations emerge from this paper and these recommendations could be considered by Limpopo province department of agriculture and other key stakeholders that are dealing with climate change issues and may require further research. Farmers need adequate knowledge about the importance of climate change in order for these farmers to be able to adapt effectively. Adaptation to climate variability and change must become an important policy priority to the government and effectively be mainstreamed into national, provincial, local and sectoral development agendas and the role of agricultural extension officers should be further explained to the farming communities in Limpopo province

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