“Factors explaining smallholder cattle farmers’ access to climate change information in semi-arid region of South Africa”

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Abstract

Climate change is a major bottleneck to agricultural development in semi-arid zone of South Africa. Therefore, this study analyzes smallholder cattle farmers' access to climate change information in Ngaka Modiri Molema district of North West Province, South Africa. A total of 150 smallholder cattle farmers were randomly selected for interview using structured questionnaire. Data were analyzed with descriptive and probit regression. The results showed that majority of the farmers (89%) were males, while 64.00% belonged to age group of 50-59 years. Farm land (4-10 hectares) was owned by 58% of the farmers. Access to climate change information was significantly influenced by number of cattle (p = 0.033), level of education (p = 0.03) and help from extension officer (p = 0.07). It was concluded that livestock farmers had low access to climate change information and efforts at enhancing their educational skill through extension contacts will facilitate access to climate change information.

Keywords: smallholder farmers, climate change, information, participation.
JEL Classification: Q5, Q54, Q540, Q580.

Introduction

The world's climate is continuing to change at rates that are projected to be unprecedented in human history. The global average surface temperature increased by about 0.6 °C during the twentieth century. According to the Fourth Assessment Report by Inter-governmental Panel of Climate Change [1], most of the observed increase in the globally averaged temperature since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations [1]. According to Rischkowsky [2], recent climate change scenarios showed that most of the Near East region would face a decrease in water availability by up to 40 mm per annum.

Agriculture is expected to be the most affected by these changes because it is highly dependent on climate variables such as temperature, humidity and precipitation [3]. Although increased heat is expected to reduce crop yields and increase level of food insecurity even in the moist tropics, it is predicted that during the next decade, millions of people, particularly in developing countries, will face major changes in rainfall patterns and temperature variability regimes thereby increasing risks of sustainable agriculture [1]. Probably more than 90% of the activities of human kind are largely responsible for the modern day climate change. South Africa is particularly vulnerable to climate change because of its geographical location, high levels of poverty and the interrelated impacts of HIV&AIDS. The poor typically have limited opportunities and, consequently, are disproportionately affected by the negative impacts of climate change. This is especially true, as climate change will directly affect the sectors upon which the poor are dependent, namely agriculture, biodiversity, ecosystems and water supplies [4].

There are significant geographical differences in future projected rainfall changes. Drier regions where livestock are kept are predicted to become drier thereby limiting livestock development [5]. According to Blummel [6], livestock contributes 40% to agricultural GDP and employs more than a billion people. It also creates livelihoods for more than 1 billion poor people. Research also shows that livestock production is the world's dominant land use, covering about 45 per cent of the earth's land surface, much of it in harsh and variable environments that are unsuitable for other uses. It is believed that climate change can impact the amount and quality of produce, reliability of production and the natural resource base on which agriculture depends.

The cattle industry contributes approximately 11% to the gross value of agricultural production in the RSA. Beef is produced throughout South Africa. The amount of beef produced depends on the infrastructure such as feedlots and abattoirs, not necessarily by the number of cattle available in those areas. South Africa has highly developed transport infrastructure that allows movement of cattle and calves from one area to another, even from other countries such as Namibia. For these reasons, Mpumalanga commands the greatest share of beef production in South Africa, accounting for 22% of the beef produced in 2010 followed by Free State, Gauteng and North West which accounted for 19%, 13% and 12% respectively [7].

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Climate change will have far-reaching consequences for dairy, meat and wool production, mainly arising from its impact on grassland and rangeland productivity. Heat distress suffered by animals will reduce the rate of animal feed intake and result in poor growth performance [8]. Lack of water and increased frequency of drought in certain countries will lead to loss of resources. Consequently, as exemplified by many African countries, existing food insecurity and conflict over scarce resources will be exacerbated. According to the FAO [9], when emissions from land-use were factored in, the livestock sector accounted for 9% of all carbon dioxide emissions derived from human-related activities, as well as 37% of methane emissions, primarily gas from the digestive system of cattle and other domesticated ruminants together with 65% of nitrous oxide gases, mostly from manure. It therefore became imperative that the problems surrounding livestock production be considered together with economic, social, health and environmental perspectives.

The livestock sector is predicted by a number of studies to be affected adversely by climate change. Studies predict that for livestock, there will be greater induced heat stress and water demand will become vital to the location of livestock systems [10]. Heat stress lowered feed intake of animals which in turn reduced their productivity in terms of milk yield, body weight and reproductive performance. Heat stress also reduced libido, fertility and embryonic survival in animals. Primary effect of environmental stress in neonates increased disease incidence associated with reduced immunoglobulin content in plasma. Heat stress in late gestation reduced foetal growth and altered endocrine status of the lamb. Access to climate information can assist livestock farmers to prepare for adverse climatic situations. This study analyzed the factors influencing access to climate information among livestock farmers in a semi-arid region of South Africa.

1. Materials and methods

1.1. Study area. The research was conducted in the Ngaka Modiri Molema District of North West Province. The district is the second largest district in North West Province, both in population and size. It comprises of five local municipalities, namely Ditsobotla, Mafikeng, Ratlou, Tswaing and Ramoshere Moiloa. Ngaka Modiri Molema District is situated in the extreme north-western part of the North West Province and shares an international airport with Botswana. The district covers an area of 31039 square km, and has five local municipalities within its area of jurisdiction. The population of the study comprises of smallholder cattle farmers in the district. Simple random sampling method was used to select 150 farmers. Data were collected through face-to-face interviews.

1.2. Probit model. According to Nagler [11], probit model constrains the estimated probabilities to be between 0 and 1 and relaxes the constraint that the effect of the independent variable is constant across different predicted values of the dependent variable. This is normally experienced with the Linear Probability Model (LPM). The probit model assumes that while we only observe the values of 0 and 1 for the variable Y, there is a latent, unobserved continuous variable Y^* that determines the value of Y. We assume that Y^* can be specified as follows:

$$Y_i^* = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + ... + \beta_k x_{ki} + \upsilon_i$$

The probit model taken in this study to analyze the effect of socioeconomics characteristics in relation to access to climate change information by smallholder cattle farmers is specified as:

$$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \\ + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \upsilon.$$

The independent variables and their measurements are presented in Table 1.

Table 1. Independent variables of access to climate change information

	Variable	Measurements	Excepted sign
Y_i	Access to climate change information	Yes = 1, otherwise = 0	
x_1	Number of cattle	Continuous	+
x_2	Gender	Male = 1, female =0	+
x_3	Age	Continuous	–
x_4	Education level	Continuous	+
x_5	Hired labor	Continuous	+
x_6	Where got capital	Own = 1, bank = 0	+
x_7	Experience	Continuous	+
x_8	Got help from extension officer	Yes = 1, no = 0	+
x_9	Size of land	Continuous	+
x_{10}	Occupation	Full time famer = 1, part-time famer = 0	+

2. Results and discussions

2.1. Demographics characteristics of the respondents. Gender of the respondents is presented in Table 2. The Table shows that the majority of the farmers were males (89%) while the female farmers were 11%. The results showed that farming in the study area was dominated by males. The majority of the farmers were in the age category of 50-59 (64%) years. Age of household head was important because it determines experience. In addition, to a certain extent, age indicates the position of the household in the life cycle. Household head's experience further influences household members' farming activities since they usually get guidance from the head.

Majority (55%) of the farmers had 10 to 12 years of formal education and 45% of these farmers had 6 to 9 years of education. Education increases the ability of cattle keepers to use their resources efficiently. Also, majority (91%) of the farmers were married although lowest percentage of 4% was divorced. The marital status of the farmers influences how decisions concerning production and marketing. Number of household members among the respondents is presented in Table 2. The majority (44%) of the farmers had household members of 6 to 10 in a household, while lowest percentage 24% of the farmers had household members of 10 to 15. Also, 59% of the farmers had 11 to 17 years of farming experience, followed by 41% of respondents having experience up to 10 years.

Table 2. Demographics characteristics of cattle farmers

Gender	Frequency	%
Male	134	89
Female	16	11
Age		
40-49	30	21
50-59	96	64
60-75	24	15
Years of education		
6-9	66	45
10-12	84	55
Marital status		
Divorced	6	4
Single	7	5
Married	137	91
Number of household members		
2-5	48	32
6-9	66	44
10-15	36	24
Farming experience		
1-10	61	41
11-17	89	59

Table 3 shows that 93% of the farmers used personal land, while 6% had permission to occupy. The majority (63%) of the farmers managed their own farms and 35% of the farmers managed their farms with family members. The majority (64%) of the farmers owned the farm themselves, while 36% of the farmers own the farms with family members. Also, majority of the farmers (65%) inherited the farms and 17% acquired their farms through LRAD. Majority (58%) of the farmers owned land size of 4 to 10 hectares, while 7% had 20 to 30 hectares.

The results of the smallholder cattle farmers' access to information on climate change is presented in Table 3. The results show that 84% of the farmers did not receive information on climate change, while 16% of the farmers had received information about climate change. The majority (84%) of the farmers did not receive information about climate change through extension officers. Climate change had been found to have serious environmental, economic, and social impacts in South Africa. Most rural farmers depend on natural resources, agriculture and especially livestock production for their livelihoods. Climate change has been seen as a threat to agricultural productivity which is mostly rain-fed.

Table 3. Access to production resources and ownership methods

Land tenure system	Frequency	%
Private	140	93
Communal	1	1
Permission to occupy	9	6
Farm management		
Individual	95	63
Farmers' members	53	35
Cooperative	2	2
Farm ownership		
Individual	96	64
Farmers members	54	36
Farm financing		
Own finance	28	18
LRAD	25	17
Inheritance	97	65
Farm size		
4<10 ha	87	58
12<19 ha	53	35
20<30 ha	10	7
Occupation		
Full time farmer	108	73
Other	42	27
Access to information on climate change		
Yes	24	16
No	126	84
Access to information on climate change through extension officers		
Yes	24	16
No	126	84

1.2. Results from the probit model. The results in Table 4 indicate that number of cattle, education level and help from extension officers have significant effect on access to information of climate change. The constant term is also significant in the

model. Number of cattle was found to have a significant positive relation with access to information about climate change at the 5% level of significance. This implies that farmers with large number of cattle were more likely to have access to information about climate change. The larger the herd size, the more likely the farmer wants to know about climate change so that production of herd is not adversely affected.

Level of education was found to have a significant positive relation with access to information about climate change at the 5% level of significance. The coefficient is positive implying that education has a strong influence in access to climate change information. The higher the level of education, the higher the probability of the farmer gaining access to climate change information. This implies that as farmers in study area acquire more education, the probability of having access to climate change information increases. Education is known to improve a person's ability to read, write and analyze.

The help from extension officers was also found to have a significant positive relationship with access to information about climate change at the 1% level of significance. This implies that more climate change information dissemination through extension services increase the likelihood of farmers access to climate change information. The more the help from extension officer the better the farmer will acquire information about climate change.

Table 4. Probit results of the effect of socio-economic factors on farmer's access to climate change information

Access to information about climate change	Coefficient	Std. error	*z*-statistics	*P* > |z|	[95% conf. interval]	
Number of cattle	.085359**	0.400288	2.13	0.033	.0069041	.163814
Gender	1.270507	.9837761	1.29	0.197	-.6576584	3.198673
Age	.0419621	.0587563	0.71	0.475	-.073198	.1571223
Education	1.245642***	.4261677	2.92	0.003	.4103682	2.080915
Hired labor	.1627988	.2367139	0.69	0.492	-.3011519	.6267495
Where got capital	.08892204	.8546424	0.10	0.917	-1.586148	1.763989
Experience	.0190852	.1644512	0.12	0.908	-.3032333	.3414037
Got help from extension officer	8.117248***	2.996511	2.71	0.007	2.244194	13.9903
Size of land	.3934295	.0544425	0.67	0.500	-.0699669	.1434439
Occupation	64.47118	.9835224	0.40	0.689	-1.534239	2.321098
Constant	-23.37598***	7.947307	-2.94	0.003	-38.95241	-7.79954

Notes: (*) *dy/dx* is for discrete change of dummy variable from 0 to 1, ***significant at 1% level, **significant at 5% level, *significant at 10% level.

Conclusions

Small scale livestock farmers play important role in income generation and job creation in the North West Province rural areas. The livestock sector has been targeted for poverty alleviation, especially in the livestock stronghold districts where the majority of the rural communities are poor and depend on subsistence livestock agriculture for survival. To improve the profitability of livestock farming, access to information about climate change and raise the standard of living of the rural poor, the participation of small-scale farmers in the mainstream markets is important. The variables that are likely to increase farmer's access to information about climate change are: number of cattle, level of education and help from extension officer. The farmers should be encouraged to increase level of education, increase production and more assistance from extension officer. More emphases should be placed on educating farmers more about climate change and ways to cope with it. Education plays an important role in enabling farmers to get access to information on climate change. In terms of the total herd size, an economically viable herd size is important in unlocking opportunities within the small-scale cattle sector. This entails research pertaining to the optimal herd size given scarce resources. The study revealed that majority of the farmers lacked climate change information. This study therefore recommends dissemination of information to be a critical element because cattle farmers were not informed about climate change in the study area. Extension officers who are already agents of information can be assigned to convey messages about the climate change to cattle farmers in the area of study. It is further suggested that appropriate information about climate change must be provided timely through the extension programs.

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