Climate change and Adaptation Coping Strategies among Sheep and Goat Farmers in Ivo Local Government Area of Ebonyi State, Nigeria.

Estrategias de adaptación al cambio climático y adaptación entre ganaderos de ovejas y cabras en el área del gobierno local de Ivo del estado de Ebonyi, Nigeria.

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ABSTRACT

Climate change and Adaptation Coping Strategies among Sheep and Goat Farmers in Ivo Local Government Area of Ebonyi State, Nigeria was studied. The specific objectives of the study are to describe the sheep and goat farmers' socio-economic characteristics, identify the adaptation strategies adopted by the farmers, det ermine the effect of the farmers' socio-economic characteristics on adoption of climate change adaptation coping strategies, ascertain the effects of variability of climate change elements on sheep and goat production and identify the factors limiting farmers' adaptation to climate change in the study area. A total of 60 respondents were selected through multi-stage random sampling technique for the study. Data for the study were collected using structured questionnaire. Percentage responses and multiple regressions were used to analyze the data. The results revealed that males (73.3%) were more prominent in sheep and goat farming with age range of 41-61 years old. Also, majority of the sampled farmers were married (66.7%), educated (93.3%) with household size of 7-12 persons. Also, the adaptation coping strategies adopted

by the farmers were use of shade (93.3%), Use of nutrient-dense diet s (63.7%), destocking (58.3%) and enough drinking water (90%). In addition, rainfall (3.378)***, temperature (2.72)** and relative humidity (2.107)** were the weather elements that effected sheep and goat production in the study area. Furthermore, the farmers socio-economic characteristics that affected the adaptation of climate change coping strategies in sheep and goats production were level of education (4.665)***, farming experience(2.345)** and age of the farmers (6.336)***. Finally, the factors limiting farmers' adaptation coping strategies were poor access to credit (83.4%), poor access to information (81.6%) and poor access to extension services (57%). The need to ensure farmers' access to credit, education and extension services were recommended.

Keywords; Climate change, Adaptation, Coping Strategies, Sheep and Goat, Farmers.

RESUMEN

Cambio climático y adaptación Estrategias de adaptación entre ovinos y caprinos en Ivo Se estudió el área del gobierno local del estado de Ebony, Nigeria. Características socioeconómicas, identificar las estrategias de adaptación adoptadas por los agricultores, det erminar el efecto de las características socioeconómicas de los agricultores en la adopción de estrategias de adaptación a la adaptación al cambio climático, det erminar los efectos del cambio climático en la producción de ovejas y cabras e identificar los factores que limitan la adaptación de los agricultores al cambio climático. Un total de 60 encuestados fueron seleccionados a través de la técnica de muestreo aleatorio de múltiples et apas para el estudio. Los datos fueron recolectados utilizando un cuestionario estructurado. Las respuestas porcentuales y la regresión múltiple se usaron para analizar los datos. Los resultados revelaron que los varones (73.3%) eran más prominentes en la cría de ovejas y cabras con un rango de edad de 41-61 años. Además, la mayoría de los agricultores incluidos en la muestra estaban casados (66.7%), educados (93.3%) con un tamaño de hogar de 7-12 personas. Además, los agricultores adoptaron las estrategias de adaptación adaptadas (93.3%), el uso de diet as ricas en nutrientes (63.7%), reducción de ganado (58.3%) y suficiente agua potable (90%). Además, la lluvia (3.378) ***, la temperatura (2.72) ** y la humedad relativa (2.107) ** los elementos climáticos que afectaron la producción de ovejas y cabras en el área de estudio. Además, las características socioeconómicas de los agricultores afectaron la adaptación de las estrategias de supervivencia frente al cambio climático en ovejas y cabras (4.665) ***, experiencia agrícola (2.345) ** y edad de los agricultores (6.336) ** *. Finalmente, los factores que limitaron las estrategias de adaptación de los agricultores fueron el acceso deficiente al crédito (83.4%), el acceso deficiente a la

información (81.6%) y el acceso deficiente a los servicios de extensión (57%). Se recomendó garantizar el acceso de los agricultores a los servicios de crédito, educación y extensión.

Palabras clave Cambio climático, Adaptación, Estrategias de afrontamiento, Ovinos y caprinos, Agricultores.

INTRODUCTION

Although climate change is a global problem but it's impact differs across regions and continents. Studies show that people with weakest economic position (the poor and elderly) is often the most vulnerable (FAO, 2007). It is estimated that over 2.8 billion people mostly in semi-arid dry land belt countries, sub-Saharan Africa, south Asia, Latin America, small Island developing states and the arctic are prone to more than one type of physical manifestation of climate change, including flood, storms, drought and rise in sea level (FAO, 2005). World Bank (2007) observed that small scale farmers is very vulnerable to climate change as result of poverty, lack of technology adoption and credit constrain.

Sheep and goat are among commonest domestic animals reared by small scale farmers for producing milk, meat, skin, hair and miscellaneous reasons including income source, investments, insurance against crop failure and slaughtering during religious and customary rites (Albert and Okidhim, 2012). The other features of sheep and goat are lower cost of production compared to other livestock, ability of goats to effectively utilize poorer quality forage, all year-round goat production with effective reproductive management, excellent browsers and forage for biological controls for weeds, forage on a broader range of plants than do other small ruminant livestock and survive well on poor or fair grazing areas (Amefule and Okoye, 2010). These beneficials of the animals could be sustained and reinforced by its' attributes such as ability to withstand adverse condition, high fertility, high reproductive rates and efficiency in the digestion of cellulose (Kemausuor, et al., 2011). These potentials of the small ruminant animals are eroded by factors according by Omoruyi et al., (1998) include diseases and pests infestations, low centenary service in many level communities, low use of purchase inputs, limited extension services, non conferment of sheep and goat by many farmers and climate change (Alam, et al., 2011).

Climate change could be a long-term changes in rainfall patterns and shifting temperature zones which could be det rimental to the food security and economic growth of the affected locality (IPCC, 2006). Climate change is a result of human activities causing the emission of green house gas, in effect the animal's performance are drastically affected. The specifics of ill /effects of climate change on sheep and goat are lack of pasture for the

animals, reduced feed-grain availability and price, impact on pastures and forage production and quality, changes in the distribution of livestock disease and pests and direct effects on animals health, growth and reproduction (Dhakalet al., 2011). The indirect effects of climate change in sheep and goat, included longevity of endemic species, goat health, productivity, availability of feed from by products due to change in priorities, cost of production will increase (especially in intensive production) and reduced market options (Mendelson, 2006)

Studies show that small ruminant animal farmers have varied forms of adaptation strategies to climate change, including destocking, provision of sunshade, adequate ventilation, use of drought - resistant breeds, extensive rearing of the animals and improved nutritional management (IPCC, 2001, World Bank, 2007, Dessa, et al., 2008). Although, in sub-Sahara Africa, farmers adopted different adaptation strategies to climate change but such adaptations are affected by factors such as credit constraints, poor extension outreach, farm size, educational level, level of knowledge of climate change, household size, membership of cooperatives and government intervention (Mustapher 2009, Ozor and Cynthia, (2011) Henry, et al., 2013). This study tends principally to assess the effect of the farmers' socio-economic characteristics on adoption of climate change adaptation coping strategies and the effects of variability of climate change elements on sheep and goat production, as there is paucity of information on that in the study area. This study is justified in many ways, include det ermination of socioeconomic factors affecting the adoption of climate change adaptation strategies coping by farmers could go a long way in aiding policy makers of concerned government agencies and extension planners for further modifications of the system in order to maximized substantially farmers production and productivity. Furthermore, the study could further serve as source of research information for scholars for further studies in related subjects and also provides useful information for agricultural extension agents for effective dissemination of information to farmers.

Specifically, the objectives of the study are to describe the sheep and goat farmers' socio-economic characteristics, det ermine the effect of the farmers socio-economic characteristics on adoption of climate change adaptation coping strategies, ascertain the effects of variability of climate change elements on sheep and goat production and identify the factors limiting farmers' adaptation to climate change in the study area.

MATERIALS AND MET HODS

Ivo Local Government Area (LGA) of Ebonyi State, Nigeria is the study area. The LGA is located bet ween latitude 5^0 36, 6^0 59 E of Equator and longitude $7^0$31 and $7^0$41N of Greenwich Meridian. The LGA comprises of autonomous communities, towns and villages with

Isiaka as its administrative headquarter. Ivo Local Government Area covers an area of 3,506 sq km^2 with population of 220, 919 people (NPC, 2006). Ivo Local Government Area is bounded in the North by Ohaozara and Agwu Local Government Areas, in the South by Bende and Afikpo south Local Government areas, in the least by Aniniri Local government Area and in the West by Umunneochi and Isuikwuato Local Government Areas of Abia State. It has rainfall range from 1,500 - 2,500mm, moderate relative humidity of 65%.

Its inhabitants are mainly agrarians and prominent in the production of rice, okra, yam, cassava, garden egg, sweet potatoes, cocoyam, okra and fruited pumpkin. The animals reared are goat, sheep, broiler, layers and pig. The other economic activities of the people are hunting barbing, potty trading, mechanic, salon and sewing (Table 1).

Table 1 Definition of Variables Used in the Empirical Analysis

Variables	Definition Value/Measure	Expected Sign
Age of household head	Number of years of Head of Household	-
Farming experience	Farming experience number of years	+
Extension services	Access to extension services Access to extension services	+
Temperature	Hotness and coldness of body °C	±
Farming experience	Farming experience number of years	+
Farm_size	Farm size in hectares	+
Educational Level	Number of years of schooling	+
Membership of cooperative	1=yes and 0=no	+
Rainfall	Amount of precipitation Mm	±
Wind	Movement of air, Velocity	±

Source, Field Survey, 2017

Multi- stage random sampling techniques was used to select communities, village and respondents. Stage 1 involved the random selection of three (3) communities out of five (5) autonomous communities that made up the area. In stage 2, two (2) villages were randomly selected from the selected autonomous communities. This brought to a total of six (6) villages. In stage 3, ten (10) sheep and goat farmers were randomly selected from each of the selected village and this gave a total of sixty (60) respondents for det ailed study.

A structured questionnaire was used to collect information on primary data in respect to farmers' socio-economic characteristics (gender, age, marital status, household size, education level, output farming experience), climate change variables and limitations to farmers' adaptation to climate change such as irregular rainfall, high temperature, poor extension contact et c. Secondary data was obtained from literatures, journals proceedings, textbooks and other periodicals.

Data collected were analyzed using descriptive statistics such as percentages and frequency distribution table, relevant inferential statistics and factor analysis in order to achieve the specific objectives.

Model Specifications

The multiple regression model can be implicitly represented as:

$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_{6+} b_7x_7 b_8x_{8+} b_9x_9 + e$ ...(1).

The four functional forms (linear model, exponential model, double log and semi log of production function were and explicitly represented as:

Linear function

$Y = b_0 + b_1 x_1 b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + ei$ ……. (1)

Double log function:-

$\ln(y) = \ln b_0 + b_1\ln x_1 + b_2\ln x_2 + b_3\ln x_3 + b_4\ln x_4 + b_5\ln x_5 + ei$ …… (2)

Semi log

$Y = \ln b_0 + b_1\ln x_1 + b_2\ln x_2 + b_3\ln x_3 + b_4\ln x_4 + b_5\ln x_5 + ei$ …… (3)

Exponential function

$\ln Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + ei$……..…… (4)

Where:

Ln = Natural Logarithm

Y = Output Variables (kg) ie (sheep and goat)

B_o = Constant term (y)

B_1 = Regression C0-efficient

X_1 = Age of farmers (years), X_2 = Gender of the farmers (male = 1, otherwise = o), X_3 = Education level (years), X_4 = Farming experience (years), X_5 = Farm size (ha), X_6 = Annual income (₦), X_7 = Household size (N), X_8 = Marital status (Married = 1, otherwise = 0)

Also, multiple regression analysis used in det ermining the effects of variability of elements of climate on the production of sheep and goat in the study area is expressed as;

$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + e$…….(4)

X_1 = Temperature (0^c), X_2 = Rainfall (mm), X_3 = Relative humidity (%)

X_4 = Wind(v)

N/B. This choice of the best functional form was based on the magnitude of R^2 value, the high number of significance size and signs of the regression co-efficient as they confirm to a appropriate expectations.

RESULTS AND DISCUSSION

Table 2 showed that 73.3% of the respondents were males, while 26.7% were females. This implies that males dominated sheep/ goat rearing and this could be associated with males being used to proper animal husbandry and management than females. (Alamer, 2009). Additional, 28.3% of the respondents were within the age range of 20-40 years, 50%; 41-61 and 21.7%; above 61 years of age. This indicated that aged people dominated sheep and goat production in the study area and capable of noticing the change in weather, since climate change is long time scenario of 35 years, hence only the aged could notice it (Aganga et al., 1989). This contradicted Dessa, et al., (2008), whom youth dominated his study. He opined that youths are likely to know more about new practices to avert climate change with the willingness to bear risk due to their wide planning horizon. Furthermore, most of the respondents were married (48.36). This implies that they have likelihood of having household members who could help to carry out activities involved in animal production aimed at averting the effects of climate change (Ume et al., 2012). Table 2 showed that most 70% of the respondents had household size of 7-12 persons, followed by 16.7% of the respondents having 1-6 persons, while 13.3% had 13-18 persons. Household members' engagement in off- farm income could help to augment household heads' income in purchasing the needed farm inputs in order to curtail maximally climate change effects in their animal production and productivity (Magombo, et al., 2011).

Also, 94.3% of the respondents had formal education, while only 6.7% had no formal education. The educated characteristic of the farmers is very good for agricultural development, since It enhances ease of extension agents' dissemination and adoption of technology on climate change by farmers (Mendelson, 2006). More so, 50% of the sampled farmers had goat and sheep rearing experience of 22-32 years, followed by 25% that had 11-21 years and the least 8.3% were 1-10 years. The number of years of farmers' rearing experience helps to cushion the effects of climate change in his/her production, since climate change is a yearly recurring decimals (Ozor and Cynthia, 2010).

Table 2 Distribution of Respondents According to Socioeconomic Characteristics

Variable	Frequency	Percentage
Gender		
Male	44	73.33
Female	16	26.67
Age		
20 – 40	17	28.3
41 – 61	30	50
62 and above	13	21.7
Marital Status		
Single	20	33.3
Married	29	48.3
Divorced	4	6.7
Widower	7	11.7
Household Size		
1 – 6	10	16.7
7 – 12	42	70
13 – 18	8	13.3
Educational Level		
No formal Education	4	6.7
Primary Education	6	10
Secondary Education	31	51.7
Tertiary Education	19	31.7
Farming Experience		
1 – 10	5	8.3
11 – 21	15	25
22 – 32	30	50
33 and above	10	16.7
Extension Services		
Yes	20	33.3
No	40	66.7
Membership of Organisation		
Yes	40	66.7
No	20	33.3

Source: Field Survey, 2016

Moreover, most (66.7%) of the respondents had no contact with extension agent, while only 33.3% had contact. This result indicated poor extension outreach in the study area. This may not avail farmers with necessary information regarding to climate change and consequently exposing their animals to threats of climate change (Ezeano, et al., 2017). Additionally, 66.7% of the respondents were members of organization, while only 33.3% were members of organization. Social net work can make members to be resilient and adaptive to environmental changes (Ume, et al., 2017).

Table 3 shows that 93.3% of the sampled farmers curtailed the effects of heat stress on their animals through provision of shade. Mature trees provide excellent shade (shelter) and are usually the least-cost alternative. When trees are used in shading, it helps to reduce ammonia emission by physically capturing both the ammonia – laden dust particles as well clean air by capturing carbon dioxide (a green house gas), storing the carbon in the wood and releasing oxygen back into the air for animal use (Al – Haidenry, 20004). Studies showed that shade do not only increase animal welfare but improve weight gain, milk production, and reproduction. (Alami; et al., 2011). Nevertheless, where natural shelter is not available, many sheep and goat producers use quonset huts, plastic calf hutches, polydomes, and/or carports to provide shelter for grazing animals (Henry et al., 2013).

Table 3: Distribution of Respondents According to Adaptation Strategies

Adaptation Strategies	Frequency	Percentage (%)
Use of nutrient-dense diet s	38	63.3
Heat resistant roofing material	22	36.7
Destocking	35	58.3
Extensive rearing	17	28.3
Enough drinking water	54	90
Using heat-resistant animal	25	41.7
Planting of tree as shade	56	93.3

Source: Field Survey, 2016

*Multiple Response

In addition 90% of the total respondents opined that they used fresh drinking water as an adaptation coping strategy to climate change in their animal during heat stress as

result of climate change. Alamer (2009) reported that plenty of clean, cool, and fresh water is paramount to preventing heat stress and help in met abolism in sheep and goat. Researches showed that goat has lower water intake when compared to sheep and other animals. This could be because of the adaptation process of goats to situations of limited water availability and their greater ability to reduce water loss through faeces and concentrated urine (Aganga, et al., (1989). On-average, a sheep or goat will drink 1 to 2 gallons of water per day. In relation to age, older animals drank more water than the younger ones. This could be perhaps, because the older animals had larger body size and consequently required more water for proper digestion and feed utilization. Also, female animals tend to drink more water than males (Aganga, 1992). During periods of extended heat and humidity, it may be necessary to provide extra water and clean and change water more often

Furthermore, 63.3% of the respondents used nutrient – dense diet s in checkmating menace of climate change in their sheep and goat production. More nutrient-dense diet s are usually preferred during periods of high heat and/or humidity. This is because animals generate more body heat when they digest poor quality feed. Though grains (e.g. corn) are considered "hot" rations in other respects, less body heat is produced when livestock digest grain as compared to forages, especially poor quality forages. Nevertheless, fats generate highest amount of heat compares to other feed supplement (Kemausuor, et al., 2011). Furthermore, 58.3% of the sampled farmers opined that they used destocking as management practice in cushioning effects of heat stress on their small ruminants. Stocking densities in sheep and goat according to Dhakal, et al., (2013) should be reduced to 85 per cent of of stocking capacity to ensure good air flow bet ween the animals

The result of the effects of climate change variables on sheep and goat production is shown in Table 4 using regression model analysis. Linear functional form was chosen as the lead equation based on coefficient of multiple det erminations (R^2) value, number of significant variables, Durbin Watson value and F-value. The R^2 was 0.695, which indicates that 69.5% of the variations of the independent variables in the model is due to variation of independent variable included in the model, the remaining 30.5% were due to error term. The overall effect of the independent variables on the dependent variables as shown by F-ratio (3.885) was significant at 1% level significant. This implies that the forecasting power of the explanatory variables is very high since relevant variables were not omitted in the regression model. Thus, implies that the model is good fit.

The coefficient of temperature had direct relationship with the dependent variable at 95% confidence level. This implies that change in temperature effected the production of sheep and goat in the study area. For instance, when temperature increases more than the upper critical temperature of the range above 90ºF/32.2ºC, the animals begin to suffer heat stress, resulting in reduction in; feeding, reproduction (lack of libido(sexual desire)and affects semen development in ram, less tolerant to diseases and opportunistic infestation, det rimental to embryo survival and fet al development and death at critical stage (Abdet a and Oba, 2007).On disease infestation, Adger, et al (2003) reported that temperature increases could accelerate the growth of pathogens and/or parasites that live part of their life cycle outside of their host. However, If temperature falls to certain level, there is often risk of acidosis or bloat as sheep and goat feed on early morning forages (Kandemir, et al., 2013).

The coefficient of Rainfall was positive and significant at 1% alpha level. Rainfall ensure availability of water for animal use and in controlling the environmental temperature (Holness, 2007). Furthermore, in contrary, Abdet a (2011) reported that global warming and changes in precipitation affect the quantity and spread of vector-borne pests such as flies, ticks, and mosquitoes in animal production. As well, the coefficient of relative humidity was positive and significant at 5% level of significance indicating that the relative humidity affects the production of sheep and goat in the area. High humidity helps to minimize the sun intensity on the animal (Sidaimed, 2008). Conversely, high relative humidity reduces the animal feed intake and building up of pests and diseases as reported by Abdet a,and Oba (2007). Surprisingly, the coefficient of wind was negative and significant at 1% probability level. The sign identify of the variable could be linked to the destruction of animals' pens at extreme situations. This finding is not synonymous with Kanes and Tobenyi, (1992), who reported that wind helps in ensuring proper ventilation of the animal pen to in order to avoid odour and disease and pests building up in animals' pen.

The result of multiple regressions in the Table 5 shows that the linear functional form was chosen as the lead equation based on R^2 value, number of significant variables and agreements with a prior expectation.

Table 4. Effects of Variability of Weather Elements on Sheep and Goat Production

Variable	Linear	experiential	double log	semi log
Constant	3.681	4.692	5.646	5.266
	(-4.713)	(6.256)***	(1.803)*	9.287
Temperature	-0.267	-0.732	-0.787	-0.846
	(2.727)**	(-6.25)**	(-6.611)*	(-9.017)*
Rainfall	-0.520	-0.343	-1.106	-0.397
	(3.378)***	(-1.897)**	(-1.464)*	(-2.548)**
Relative humidity	0.145	0.178	0.023	0.039
	(2.107)**	(2.405)**	(0.073)	(2.101)
Wind	0.041	0.045	0.115	0.015
	(-3.514)***	(0.477) *	(0.295)*	(0.826)*
R^2.	0.695	0.337	0.436	0.484
F – ratio	3.885	8.142	0.671	15.006
Durbin Watson	3.885	8.142	0.671	15.006

Source: Field Survey, 2016

*,** and *** Implies significant at 10%, 5% and 1% respectively.

The functional form had R^2 value of 0.785, indicating that 78.5% variation in the dependent variable was influenced by the independent variables included in the regression model. The low value of Durbin Watson constant which was below 2.5 indicates absence of auto correlation in the regression model. The coefficient of age was positive in line with a *priori* expectation and statistically significant at 1% level of significant. This implies that as the farmer advances in age, there is likelihood that his/her coping strategies to climate change adaptation will increase. This assertion concurred with Ozor and Cynthia (2010), who observed that aged farmers usually have experienced many years of climate changes and through experimentations, could adopt the best coping strategies at minimal risks and resources limitation. As expected, the coefficient of level of education was positive and statistically significant at 1% alpha level. Educated people have access to information, especially on the best adaptation coping strategies to climate change to choose (Dressa,

2007). Also, farming experience was statistically significant at 10%level of probability and its coefficient is positively signed. Years of farming experience may give an indication of the practical knowledge farmers have and this could help to overcome intricacies involved in adopting of coping strategies of climate change adaptation for maximization of their outputs (Ume, et al 2016). The coefficient of house hold size was negative and statistically significant at 5% probability level. This implies that large household size serve as source of labour availability especially at the peak period of farming when labour is scare and expensive in executing activities involved in coping strategies to climate change adaptation in the animal production (Obisha, 2008).

As usual the coefficient of membership of cooperative had direct relationship with the dependent variable at 99% confidence level. Cooperative as reported by Ume, et al., (2016) enables members to have access to information on improved innovations on climate change adaptation coping strategies, material inputs of the technology (fertilizer and chemicals), credit for payment of labour, capacity building and training on climate change and met hods of averting or alleviating the menace. Several studies (Sidehmed, 2008; Ozor and Cynthia, 2010; Mandleni and Anim, 2011) made similar findings. As estimated, the coefficient of extension services was positive and concurred with Mustapher, (2009), who reported the importance of extension in alleviating farmers' coping strategies to climate change adaptation or enhanced productivity through dissemination of information on climate change, enhance access to credit and agricultural inputs.

The poor access to credit (83.4%) by the farmers as contain in Table 5 could be linked to ignorance of credit facilities availability by the farmers and location of banks in the urban areas far away from the farmers' residence. (Ezeano, et al., 2017). Ume, et al., (2017) reported similar findings. The limitation to credit as reported by Dhakal, Et al., (2013) hinders generally livestock industry development in most developing countries of sub Saharan Africa. More so, limited access to information on climate change was reported by 81.6% of the respondents. Information is capable of guiding farmers in production decision making, making comparative decisions among alternative sheep and goat management practices and enhancement of rational choice on the right coping strategies to adopt for optimal result to ensue (IPCC, 2006). Additionally, poor access to improved sheep and goat breeds was encountered by 70% of the total respondents. It's imperative to affirm that most of improved and high prolific variet ies in most developing countries have poor adaptability to extremely high temperatures that are often associated with the tropics, while the local breeds such as West Africa dwarf WAD) sheep and goat that are heat- tolerant but are typified by low lambing number and small body size(Alamer, 2009).

Table 5. Effects of Farmers' Socio-economic Characteristics on Adoption of Climate Change Adaptation Coping Strategies.

Variables	Linear	Exponential	Double-log	Semi-log
Constant	4.307	8.145	4.730	5.969
	(10.260)***	(16.515)***	(9.091)***	(11.799)***
Age	0.314	0.527	0.151	0.178
	6.336)***	(-7.252)***	(1.970)*	(1.970)*
Gender	-0.053	0.050	0.155	0.153
	(-3.666)***	(0.447)	(1.315)*	(1.175)*
Education	0.023	-0.042	-0.117	-0.269
	(4.655)***	(-0.669)*	(-1.786)*	(-3.723)
Experience	-0.065	-0.086	0.014	-0.048
	(-2.668)**	(1.528)*	(0.243)*	(0.465)
Household size	-0.093	-0.368	-0.400	-0.474
	(-2.110)***	(-6.316)***	(6.517)**	(-8.524)***
Marital Status	0.029	0.103	-0.108	-0.071
	(0.626)	(1.860)*	(-1.856)*	(-1.799)*
R^2	0.785	0.582	0.692	0.584
F - ratio	11.174	19.332	31.130	19.515
Durbin Watson	0.771	0.770	1.832	1.460

Source; Field Survey, 2016

*, ** and *** implies significant at 10%, 5% and 1% respectively

Poor access to extension services was complained by 51.7% of the sampled farmers. The wide ratio bet ween the extension personnel - farmers and negative attitude of extension agents to their duties constituted bottlenecks to extension delivery in most developing

countries (Ezeano, et al 2016). Finally, a poor government involvement in tackling effects of climate change was reported by 50% of the respondents in the study area. Although, many governments programmes and policies aimed to tackle climate change and the effects exist. yet their activities are yet to be perceived tangibly in farm level by the farmers compare to what are obtainable in the media (printing and printing) (Ume, Et al., 2018)

Table 6: Factors Limiting Farmers' Adaptation Strategies

Variable	Frequency	Percentage
Poor access to credit	50	83.4
Land tenure problem	13	17.0
High cost of input	10	16.7
Poor access to information	49	81.6
improved sheep and goat breeds	42	70.0
Poor access to extension services	31	51.7
Poor government involvements	30	50.0

Source, Field Survey: 2016
*Multiple Responses

As conclusion and recommendation, the result of the socioeconomic characteristics of sheep and goat farmers revealed that males dominated sheep and goat production, aged people dominated the rearing population and were well educated. Also, the adaptation coping strategies adopted by the farmers were use of shade, Use of nutrient-dense diet s, destocking and enough drinking water. Furthermore, the farmers' socio-economic characteristics that affected their adaptation of climate change coping strategies in sheep and goats production were level of education, farming experience and age of the farmers. In addition, rainfall, temperature and relative humidity were the weather elements that effected sheep and goat production in the study area. Finally, the factors limiting farmers' adaptation coping strategies were poor access to credit, poor access to information, poor access to extension services and poor government involvements. Based on the findings, the following recommendations were proffered: (1) Ensure farmers' access to credit access through micro credit institutions and other financial institutions. Such credit will help farmers

to offset costs accruing in purchasing material inputs to be used to abate climate change effects in the farm. (2) Extension agents should be adequately motivated and equipped with climate change information in order to aid farmers in abating the negative effect of climate change through information dissemination and technical assistance. (3) There is need to expose the farmers to education programme such as seminars, workshops and adult education in order to enhance farmers' technically with skills and knowledge of averting maximally the effects of climate change in the sheep and goat farms. (4) Aged and young farmers should be encouraged by government and non governmental organizations through provision of inputs and technical assistance to enable them remain in the business, no matter the crushing effects of climate change in their environments. 5) The animals should be provided with shade, good drinking water, low –fatty nutrients in order to control their heat stress

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