

Effects of climate change on agro-pastoralists' economy and adaptation strategies used in Southeast, Nigeria

Abstract

This study examined the effects of climate change on agro-pastoralists in Southeast, Nigeria. It specifically ascertained agro-pastoralists' perception of climatic changes, effects of climate change on pastoralists' economy and the strategies adopted by agro-pastoralists to withstand shocks from climatic changes. A total of 120 agro-pastoralists were selected randomly from three states (Imo, Abia and Enugu). Questionnaire and oral interview were used to collect the data that was analyzed descriptively. A mean (M) response of 2.50 was used to determine agreement with observed changes in climate. Results showed that the respondents had a positive perception of climate change as seen in their response that the amount of rainfall reduced (M=3.15), rainfall increase sometimes (M=3.01), increase flooding (M=2.90), changes in wind blowing pattern (M=3.31) among others. Climate changes have led to loss of animals due to migration (M=2.84), unexpected death of animal (M=3.30), starvation of pastoralists (M=3.15), changes in herbage quality (M=3.21), total loss of crops due to drought (M=3.01), dryness of water sources (M=2.74) among others. The following adaptation measures were taken -supplementing livestock feed, livestock migration and diversification, sale of animals before bad times, digging of water holes for animals among other strategies. We recommend that government should provide the enabling environment for modern grazing and ranching of animals for the agro-pastoralists to continue their business.

Keywords: climate change, agro-pastoralists, adaptation, farming, agriculture

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Godson-Ibeji CC, Ibe MN, Chikaire JU, Aminu GO

Department of Agricultural Extension, Federal University of Technology, Owerri, Nigeria

Correspondence: Aminu, G.O, Department of Agricultural Extension, Federal University of Technology, Owerri, Imo State, Nigeria, Tel 08065928862, Email akjamin2010@gmail.com

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Introduction

The world's climate is changing rapidly. Model forecasts for this century suggest that worldwide, surface temperature is likely to increase from 1.4 to 5.8 degrees celsius by 2100.¹ However, the effects of climate change are anticipated to be widely diverse in terms of location. Precipitation will most likely increase in temperate land areas, but it will decrease in some areas in the tropics and subtropics.¹ At the same time, weather variability is expected to rise across the board.

Climate change is projected to have an especially negative impact on Africa. Nearly a third of the planet's 1.3 billion poor people live there, and 60% of these poor people are dependent on livestock for some part of their livelihoods.² The great majority of these people live in smallholder, rainfed mixed and pastoral systems.

Poor livestock keepers and the ecosystems on which they rely are projected to be severely impacted by climate change. Changes in the productivity of rainfed crops and pasture, lower water and more widespread water shortages, and changes in the intensity and distribution of key human, livestock, and crop diseases are only a few of the potential consequences. Overall, heat and drying are expected to diminish crop yields by 10 to 20% by 2050, but there are some areas where yield and net primary output losses could be substantially more severe.³ Furthermore, beyond the consequences of changes in mean variables alone, increased frequency of heat stress, drought, and floods events will have negative effects on agricultural and livestock productivity.¹

Livestock systems in developing countries are changing rapidly in response to various drives of the environment. Globally, human population is expected to increase to about 9.2 billion by 2050.⁴

More than 1 billion of these will be in Africa. Rapid urbanization will continue in developing countries and the demand for livestock products will follow suit in the coming decades to fill the need for protein deficiency. The potential impact of these drives of change on livestock systems and the resource-poor people who depend on their survival is considerable. These impacts will be influenced by both the supply-sale shifts in natural resource use as well as in market-led demand changes. A group of people likely to be affected by the above scenario are those who depend on cropping and animal rearing, otherwise called the agro-pastoralists.

Agro-pastoralists are therefore vulnerable to predicted changes in climate since they are impoverished and heavily dependent on natural resources. This is because, they occupy less productive lands which are often poorly developed land and are faced with severe environmental degradation, shrinking resources and reduced/ dangerous transhuman mobility routes (Mwakajo, 2013).⁵

World over, literature have it that they have employed several traditional management practices to cope with and adapt to climate change. Such as migration, herd splitting rapid destocking, gifts and loans etc. Newer strategies such as increased crop activation (Snorak et al, 2014) and adjustment of herd composition⁶ have also been reported.

A wide range of possible adaptation options exists, from technological changes to increase or maintain productivity, through to learning, policies and investment in specific sectors and risk reduction options, which may increase the adaptive capacity of poor livestock keepers. Farmers already have a wealth of indigenous knowledge on how to deal with climate variability and risk. However there is still a need to assess these adaptation options in relation to reducing

vulnerability of humans and ecosystems, particularly options associated with livestock, with the object of maintaining or increasing food security, incomes and resilience while maintaining key ecosystem functions. Such assessment needs to be done in conjunction with well-targeted capacity building efforts to help farmers deal with changes in their systems that go beyond what they have experienced in the past.

Farming systems, including smallholder and pastoral systems can be regarded as human activity systems.⁷ The ways these systems are managed, and farmers' production strategies, are of importance not only for production success but also for system resilience.⁸ The management practices used by farmers depend on their decision-making, which again is influenced by the kind of information they take into account and how they process this information for creating knowledge.⁹ Assessing the attitudes and knowledge of agropastoralists will therefore help in identifying their production and coping strategies. These coping strategies are context specific, and can be found at different levels, e.g. the management of soil, plant and animal resources, as well as social and institutional regulations. Recent studies¹⁰⁻¹² have shown that agro-pastoralists make use of spatial heterogeneity to cope with temporal heterogeneity. Their ability to buffer climatic variation depends on the diversity in the production system. Furthermore, improving the learning process and learning cycles of agro-pastoralists is a critical element in increasing the adaptive capacity of agricultural systems.¹³⁻¹⁵

There are a variety of possible adaptation options available, ranging from technological changes to increase or maintain productivity to learning, policies, and investment in specific sectors, as well as risk reduction options, all of which can help poor livestock keepers increase their adaptive capacity. Farmers already have a wealth of traditional knowledge about how to manage with climate change and risk. However, these adaptation alternatives must be assessed in connection to lowering human and environmental vulnerability, particularly options related to livestock, with the goal of maintaining or enhancing food security, incomes, and resilience while maintaining essential ecosystem services. Such an assessment should be carried out in tandem with well-targeted capacity building measures to assist farmers in dealing with changes in their systems that are beyond their control.

Human activity systems include farming systems, including smallholder and pastoral systems.⁷ Not only for production success, but also for system resilience, how these systems are handled and farmers' production techniques are critical.⁸ Farmers' management techniques are influenced by their decision making, which is influenced by the type of information they consider and how they process it for knowledge creation.⁹ Assessing agropastoralists' attitudes and knowledge will thus aid in determining their production and coping techniques. These coping techniques are context dependent and can be found at several levels, including soil, plant, and animal resource management, as well as social and institutional regulations.

Agropastoralists exploit geographical heterogeneity to cope with temporal heterogeneity, according to recent research.¹¹⁻¹² The diversity of the production system determines their ability to buffer climate change. Furthermore, boosting the adaptive capacity of agricultural systems requires strengthening agropastoralists' learning processes and cycles.¹³⁻¹⁵ Agro-pastoralists turn to cope with climate changes, they engage in other forms of livelihood for survival. However, in the study area, little is known on the specific strategies used by pastoralists living in southeast to cope with and adapt to climate changes. Thus lack of information on adaptive strategies, together

with limited information on observed changes in climate changes, hampers management decisions from a conservation and development perspective. This paper focused on filling the gap created by the above situation. The main objective of this paper is to ascertain effects of climatic changes on agro-pastoralists in Southeast, Nigeria. The specific objectives are:

- To identify changes in climate conditions as observed by the agro-pastoralists.
- Examine perceived impacts on agro-pastoralists economy.
- To identify strategies used for adaptation by agro-pastoralists in the zone.

Methodology

This study was conducted in Southeast agro-ecological zone made up of five (5) states-Abia, Anambra, Ebonyi, Enugu and Imo in Nigeria. The zone occupies a total land mass of about 10, 952, 400 hectares with a population figure of about 35,381,729 persons in 2021 projected from 2006 National Population Commission Census figure (NPC, 2006). The 2-stage sampling technique was adopted in the process of sample selection. The first stage was the purposive selection of three states from the Southeast agro-ecological zone with heavy presence of agro-pastoralists (Abia, Enugu and Imo). The second stage involved the random selection of 120 agro-pastoralists from the list of 1200 agro-pastoralists in the three states. Both primary and secondary data sources were used. Objective 3 was analyzed using percentages presented in tabular forms. While a four (4) point Likert type scale of Strongly Agreed, Agreed, Disagreed and Strongly Disagreed, assigned values of 4 to 1 respectively was used to achieve objectives 1 and 2 which is mathematically represented as

$$\frac{4+3+2+1}{4} = \frac{10}{4} = 2.50$$

Therefore, a mean of 2.50 was adjudged okay and acceptable while any value below 2.50 was not accepted.

Results and discussion

Climate change perception of agro-pastoralists

Table 1 showed that the agro-pastoralists have observed climate variability over the years in the study area. With a mean response of 2.50 and above, the following observed changes were seen: the amount of rainfall is reducing (M=3.15), sometimes rainfall increases (M=3.01), no one can predict rainfall pattern (M=2.67), changes in mind blowing pattern (M=3.31), prolonged cold season (M=2.90), increase flooding (M=2.90) and increase hotness of the environment (M=3.24). During oral discussion with the respondents they observed that natural and man-made factors are responsible for the change in climate. Heavy rainfall washes earth surfaces away leading to flooding while man's activity of change vegetation for settlement and farming in fragile environment exposes the land to unnecessary hotness environment exposes the land to unnecessary hotness which increases evaporation of the scarce moisture in the soil.

The above agrees with the Maasai pastoralist, who believed that in their over 30years of pastoralism, amount of rainfall is reducing and rainfall is becoming unpredictable (Bobadoye et al, 2016). Again, the respondents reported that fog has decreased in amount and duration. They also said once the cloud changes colour, you will think it is rain, before long it will disappear again. Rains fall unexpectedly.

Table 1 Agro-pastoralists climate change perception

Climate change perception	Mean	Standard deviation
Amount of rainfall reducing	3.15	0.81
Sometimes, rainfall increases	3.01	0.64
No one can predict rainfall pattern	2.67	0.78
Changes in wind blowing pattern	3.31	0.66
Prolong cold season	2.9	0.85
Increase flooding	2.9	0.85
Increase hotness of environment	3.24	1.04

Mean = 2.50

Effects of climate change on pastoralists' economy

All the agro-pastoralists indicated that climate change has impacted their economic life. The impacts are recorded in Table 2 as follows: unexpected death of livestock (M=3.30), having the highest mean score, changes in herbage growth (M=3.01), total crop loss due to drought (M=3.01), lack of grains for the animals (M=2.89), loss of animals due to long migration (M=2.84), changes in herbage quality (M=2.78), this happens because there are no rains to support and fasten the growth of grasses/legumes. Severity of livestock diseases/pests (M=2.89) observed due to emergency of new disease/pest variants, failing prices of livestock (M=2.65), cut/reduction in income (M=2.71), severe and sudden dryness of pasture/grasses (M=2.81), dryness of water pounds (M=2.74), animals become weak due to long trekking (M=2.81), this could lead to death, incessant wild fires (M=2.63) especially during the dry seasons affect livestock production, which is the homestead of the nomads.

Table 2 Impacts on Agro-pastoralists economy

Shock situation	Mean	SD
Loss of animal due to migration	2.84	0.66
Unexpected death of livestock	3.3	0.5
Lack of grains for animals	2.89	0.77
Starvation of pastoralists	3.15	0.77
Changes in herbage growth	2.78	0.63
Changes in composition of pastures	3.21	0.81
Changes in herbage quality	3.24	0.49
Nutritional stress for livestock	3.01	1.01
Severity of livestock diseases/pests	2.89	0.94
Failing prices of livestock	2.65	0.82
Major cut/reduction in pastoralist income/savings	2.71	0.74
Severe/sudden dryness of pasture	2.01	0.64
Incessant welfare outbreaks	2.63	0.54
Total crop loss due to drought	3.01	1.04
Animals become weak due to long trekking	2.81	1.02
Dryness of water/water sources	2.74	0.68

Mean score = 2.50

Herrero et al.,¹⁶ observed that climate change variability negatively affects herd dynamics, stocking density, milk and meat production. Others are changing climate frequencies of extreme weather events such as flooding will affect certain disease/pest occurrence too, such as the outbreak of Rift valley fever in certain parts of Africa. Again, in Kenya, households reported on the impact of climate change with regard to the availability of feed sources for livestock, In general feed availability is not constant during the whole year, but appears in some months say August to October. Again, 36% of the households said the feed resources appeared and disappeared because of drought which happened as a result of environmental changes and climate change impacts.¹⁷

Adaptation strategies in agro-pastoral systems

Adaptation to climate change means the adjustment to actual or expected climate and its effects in order to moderate reduces harm and exploit beneficial opportunities.¹⁸ Historically, agro-pastoralists have adopted various strategies to counter the effects of climate change as shown in Table 3. These include.

- a) Supplementing livestock feed (89.2%). The agro-pastoralists said they feed their animals on purchased or harvested fodder, crop residues and also commercial feeds got near the major town where they operate. They also said, they purchase corn, chaff and flour from local women who brew maize drinks.
- b) Livestock migration (99.2%). This is their traditional practice, to ensure survival, especially during stress. They migrate in search of water, grasses and look for better environment devoid of pests/diseases attack. They migrate to avoid attacks, look for new breeding ground, food on lush green succulent grasses and legumes.¹⁹
- c) Livelihood diversification (95%). Agro-pastoralists respond to shocks in different ways by diversifying livelihood options, supplementing incomes etc. Diversification helps to cope with drought and increasingly restrict mobility. They have undertaken alternative livelihood options such as charcoal burning, crop farming, petty trading and casual labor.
- d) Livestock diversification (91.6%). The use and introduction of other animals, aside livestock becomes a strategy for adaptation. These animals include donkey, goats, sheep, among others.
- e) Increase in water supply to animals (87.5%). Animals drink often both in ponds, lakes, streams, rivers and at any water body seen. Thus is the practice with good weather and adequate rainfall everywhere. But with changing climates drying rivers and lakes up, the agro-pastoralist now provide water constantly to the animals to avoid the deaths of the animals. Water is provided frequently to aid good health digestion and optimum performances of farms and work animals.
- f) Use of indigenous cattle species (78.3%) and local knowledge to produce weather (78.3%). The local breeds of cattle are known to withstand harsh environmental situations/stress being a native of Africa. It is sturdy, hard, strong and can tolerate local conditions. The agro-pastoralists introduced them to continue in their business. The results of their cross breeds are excellent in size, meat, and ability to work. Agro-pastoralists great knowledge underpins long standing traditional practices for using resources and managing bad weather conditions. These practices are part of their social and cultural existence. The movements and positions of stars, sun, moon, animal appearances, bird songs, termite

flowers/trees during certain times of year signifies something great to the people looking around

- g) Other strategies include sale of livestock before bad weather or disaster (90%), sharing and loaning animals (87.5%), development of water sources (86.6%). Animals are sold off in order not to run a total loss during the emergency periods. The proceeds are kept for future use. Some also share their animals, loan out or gift out to other farmers who will in turn give them back during good times. Water wells/basins have been dug by some farmers as alternative sources of water. These are made of mud or cement to retain water.

Table 3 Climate-related adaptation measures of agro-pastoralists

Adaptation Measures	*Frequency	Percentage
Supplementing livestock feed	107	89.2
Livestock migration	119	99.2
Livelihood diversification	114	95
Sale of livestock before bad weather	108	90
Increase in water supply to the livestock	105	87.5
Use of indigenous cattle species	94	78.3
Livestock diversification	110	91.6
Sharing/loaning/gifting of animals	84	70
Use of local knowledge to protect weather	94	78.3
Development of new water sources	104	86.6
Turn to forest for fodder	113	94.2
Use tubers as feeder	109	90.8
Start/increase farming business	87	72.5
Doing casual labor	94	78.3

*Multiple responses

Other farmers use forest fodder (94.2%) to feed their animals as they harvest these from bushes and forests, and tubers (90.%) as fodder to feed animals, such as yam tubers, cassava, cocoyam etc as well as peels from food items to keep the animals going. The doing casual labor (78.3%) and starting farming crop (92.3%) became an option too. The farmers plant certain areas of land and use the fodder of crops as feed for animals.

The above findings agreed with Worku, Pretzseh, Kassa and Aveh,²⁰ who opined that pastoralists and agro-pastoralists in Ethiopia move to Montana forests to cope with climatic changes. They collect gum and resins from dry forests during/ after drought events, which they sell and in turn use the money to buy food for themselves and feed for animals. The forests provide firewood, medicine, fruits, building materials and many more.^{21,22-26}

Conclusion

The impacts of climate change within the livestock section among agro-pastoralists have been devastating over the years. The agro-pastoralists have lost a large number of cattle. The agricultural productivity declined also. The adaptation strategies employed have kept them going. These include migrating to another location, diversifying livelihood, digging holes, increasing farming among

other things. Infrastructures for modern grazing and ranching should be provided for the agro-pastoralist to do their business.

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Conflicts of interest

Authors declare that there is no conflict of interest.

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