

**THE EFFECTS OF CLIMATE CHANGE INDUCED FARMERS-HERDERS
CONFLICT ON FULANI WOMEN'S MILK BUSINESS IN KADUNA STATE,
NIGERIA: AN ASSESSMENT OF CLIMATE CHANGE ADAPTATION
STRATEGIES BY DAIRY FARMERS**

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Abstract

Climate variability has necessitated a resource induced conflict between farmers and herders in Kaduna State, Nigeria as drought and rain variability translates to dairy cattle diseases, shortage of pasture, and heat stress with a resultant decline in milk business of Fulani Women in the State. The inadequate willpower by the government to formulate both kinetic and non-kinetic conflict resolution measures is militating against peaceful coexistence among farmers and herders, while inadequate coping and adaption strategies on climate change by Fulani pastoralists significantly impedes the backward integration policy on dairy sector (5% target on domestic sourcing of raw milk) by the Central Bank of Nigeria (CBN). This necessitates the study to access the effect of climate change induced farmers-herders conflict (proxies as drought and rainfall) on milk business of Fulani women in Kaduna State, Nigeria. A survey research design was used for the study with the instrument of a structured questionnaire administered to 90 Fulani women selected through multi-stage sampling techniques across three (3) Local Government Areas (LGAs) in the State. The data elicited from the field was analyzed through descriptive statistics and a regression analysis with the aid of Statistical Package for Social Sciences (SPSS) 23. The result showed a significant negative effect (-18.3%) of drought on milk business of Fulani women in Kaduna State. Rainfall has a significant positive effect (65.1%) on milk business of Fulani Women in Kaduna State implying that a percentage increase in drought and rainfall will lead to 18.3% decline and 65.1% increase respectively on milk business of Fulani women in Kaduna State, Nigeria. The study concludes that climate change induced farmers-herders conflict has a significant effect on milk business of Fulani Women in Kaduna State and recommends that the Fulani pastoralist should employ measures such as artificial insemination to enhance high milk yielding dairy cattle and adaptation measures to cope with the adverse effect of climate variability.

Keywords: Adaptation Strategies, BBC Framework, Climate Change, Drought, Rainfall.

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Introduction

Climate variability and Global warming in a report by International Panel on Climate Change [IPCC] (2007) will lead to adverse storms, floods, desertification, drought, glacier melt, and increase in the sea level around the globe. Climate variability in prolonged drought and rainfall variability translates in a spiral effect on resource induced contestations among farmers and herders due to shrinking natural resources, decline in water table and soil moisture, and a decline in pasture to sustain the growing population of herd size. Prolonged drought, desertification, rising temperature and heat wave, and decline in rainfall and soil moisture brought about by climate variability necessitates trans-migration of herders in search of pasture and water points, spurning into deadly clashes with sedentary farmers as a result of livelihoods overlap, encroachment of herd size into and damage of crop farms, cattle rustling, and a breakdown of dispute resolution systems (Oruonye et al., 2020; Obaji, 2018; Dary et al., 2017; Okwor, 2016; Stark et al., 2011; Ahmadu, ND; Turner et al., ND).

Around the world, climate change induced conflict has resulted in the displacement of farming and pastoral communities, spurned a humanitarian crisis in the Horn of Africa (HoA), food shortages in the Lake Chad Basin (LCB), and a decline in dairy production around the world (United States Agency for International Development [USAID], 2000; EDC, 2001a). In Africa, drought in the HoA, desertification in the Sahel with adverse effect on an estimated 70 million people (Terminski, 2012), and the shrinking Lake Chad by 93 percent since 1963 with adverse effect on 30 million people (Saldika, 2012) have resulted in trans-migration of pastoralists in search of forage to enhance livestock holdings, which translate to conflict with sedentary farmers. In Yabelo, Ethiopia in 2011, delayed rainfall spurned a resource induced conflict between pastoralists and farmers over shrinking vegetation cover and water points, resulting in a decline in cattle holdings and dairy business. Climate variation with adverse effect on Lake Chad and desertification in the Guinea and Sudan-Sahel Savannah necessitates the transmigration of pastoralists to the Middle Belt Region of Nigeria and Kaduna State beyond the carrying capacity of arable land which generates contestations and conflict with sedentary farmers over limited land and vegetation cover (Adeniran; 2020; Nwakanma & Boroh, 2019; Akerjiir, 2018; Okwor, 2016).

Observation in the study area shows Fulani pastoralist are lagging behind in adaptation and coping strategies to mitigate the adverse effect of climate change on livestock holdings and milk production among the Fulani women in the state. The forgoing inadequate climate adaptation strategies to enhance milk production incentivizes Fulani

pastoralists' to depend on shrinking land entitlement, vegetation cover, and water points which translates into conflict with sedentary farmers.

Various measures (the Grazing Reserve Act of 1964, the 1988 National Agricultural policy, 2019 National Livestock Transformation Plan (NLTP), the Gansu-Modeled water conservation project in Kano State, and the anti-open grazing law) have been undertaken by the Nigerian government and public-private enterprise to mitigate the effect of climate change and the growing farmers-herders conflict. Notwithstanding, farmers-herders conflict is prevalent with an estimated 1,868 deaths in 2018 in Nigeria (Armed Conflict Location and Event [ACLED], 2019) and 141 deaths at Kajaruru, 26 deaths at Karamai in Kajaruru, and 10 deaths at Nanu-Gbok in Sanga in 2019 in Kaduna State (Makinde, 2019) which depicts government inefficiency in harnessing kinetic and non-violent conflict resolution frameworks in curtailing the spread of farmers-herders conflict and the ripple effect on Fulani women's milk business in Kaduna State, Nigeria.

Research Questions

- i. What are the effects of drought on milk business of Fulani women in Kaduna State?
- ii. What are the effects of rainfall on milk business of Fulani women in Kaduna State?

Research Objectives

The main objective of the study is to assess the effects of climate change on milk business of Fulani women in Kaduna State, while the specific objectives are:

- i. To assess the effects of drought on Milk Business of Fulani women in Kaduna State
- ii. To examine the effects of rainfall on milk business of Fulani women in Kaduna State

Research Hypotheses

The research hypotheses are formulated based on the specific objectives, thus;

H_{01} : Drought has no significant effect on milk business of Fulani women in Kaduna State

H_{02} : Rainfall has no significant effect on milk business of Fulani women in Kaduna State

Conceptual Review

Climate Change and Farmers-Herders Conflict

Climate change is the long-term and significant change in the expected patterns of a specific region's average weather for an appropriately significant period of time caused by the accumulation of greenhouse gases (gases facilitate for climate change are CO₂, CH₄ and N₂O) in the atmosphere which leads to global warming (Tadess & Dereje 2018). It is the variation in average weather condition of a region over a long period of time usually 30 years as a result of natural occurrence and anthropogenic activities in the environment. The variation on average weather condition brought about by environmental degradation and the burning of fossil fuel releases gasses (CO₂, CH₄, N₂O, O₃, and Fluorinated gases) that are trapped in the Ozone and radiate heat back to the earth surface in what is known as global warming.

Global warming has altered the average weather condition around the globe through the increase in number of glacial lakes, changes in Arctic and Antarctic ecosystem, increased runoff, changes in thermal structure and water quality, rising temperature, changes in salinity and oxygen level of 0.1 units PH level due to uptake of carbon since 1970 (IPCC, 2007). Global warming has also altered the weather condition in the Horn of Africa (HoA) that metamorphosed into the severe drought and resource induced contestation in the region. Conflict is a struggle over values or claims to status, power, and scarce resources, in which the aim of the conflicting parties are not only to gain the desired values but to neutralize, injure, or eliminate their rival (Coser, 2010).

Climate change and farmers-herders conflict in Kaduna State, Nigeria emanates largely as a result of the dwindling vegetation cover, desertification in the Sahel Savannah, transmigration of herders owing to the shrinking Lake Chad, and the severe drought in the HoA which has led to the overstocking of herd size beyond the carrying capacity of arable lands. Climate change effect in rain variability which alters seasonal rainfall with extreme weather condition such as drought and flood affects farmers' crop yield with a general increase in prices and shortage of staple food in Kaduna State, Nigeria. The decline in crop yield and the general increase in prices of staple food necessitate sedentary farmers to engage in dry season farming around the river banks, water outlet, and *Fadama* areas that are largely the grazing reserves in dry season trans-migration of pastoralists. Farmers also in a bid to enhance economic gains from the staple food inflation encroach further into forest frontiers, fallback areas or previously uncultivated areas which impede pastoralists' access to pasture land, resulting in less feed for cows and low milk yield. The forgoing translates into the tragedy of the common and resource induced contestation

between herders-farmers that has claimed an estimated 1,868 lives in Nigeria in 2018 (ACLEDA, 2019).

Stark et al. (2011) examined climate change and conflict in pastoralist regions of Ethiopia: mounting challenges, emerging responses spanning April 2011 to May 2011 in the regions of Oromo, Somali, and Afar in Ethiopia. The objective was to assess the relationship between climate change and conflict among pastoralists and agro-pastoralist in the three regions of Oromo, Somali, and Afar. The study methodology includes the Climate and Conflict Assessment Framework (CCAF) and Environmental Security Assessment Framework (ESAF) by FESS and Conflict Assessment Framework (CAF) by USAID. The study revealed that the estimated 87 percent of the 10 million pastoralists in Ethiopia that accounts for herders in Oromo, Somali, and Afar regions have contested for pasture lands and water points leading to degrees of conflict and a decline in dairy business and livestock holdings in the regions. Also, it showed that climate change impact in the second quarter of 2011 in Yabelo, Ethiopia led to 42,000 deaths of livestock which resulted in 80 percent decline in livestock holdings and dairy business in the region. More also, the drought in Ethiopia in 2006 led to a sharp decline in 54 percent of cattle which impacted negatively on dairy production and livestock holdings in Ethiopia and has influenced conflict in the region as pastoralists often engage in cattle rustling to restock lost cattle head to adverse effect of climate change. The study recommends water projects development to support pastoralist, promotion of good environmental practices through the productive safety net program, and counter invasive species and bush encroachment with attention on *Prosopis juliflora* to mitigate resource induced conflict and to enhance the growth of livestock holdings.

Okwor (2016) analyzed the political economy of the conflict between farmers and Fulani Herdsmen in the Contemporary Era of Climate Change in Nigeria using Primary data. The findings showed escalation of conflict on one hand to be political and on the other hand to be as a result of climate change, urbanization, and population surge. The study recommended a way forward beyond adopting a response strategy that focus much on the narratives of climate change as the escalating factor.

In a study, interrogating the nexus between climate change and farmer-herder conflicts in Nigeria, Effevottu and Ihuoma (2019) examined the impact of climate change on farmer-herder conflict using secondary data to find climate change as the root cause of farmer-herder conflict in the country. Also, the study finds scarcity of resources to be the proximate factor influencing food insecurity, migration, and inter-communal violence in Nigeria. The study recommends climate adaptation mechanism should be put in place by

the government especially in northern part of the country to mitigate the impact of climate change.

Drought and Fulani Women's Milk Business

Drought is the decrease in underground water level and soil moisture that impedes soil perspiration with vegetation cover loss. It can be seen from the socio-economic aspect as the interplay of a short fall in water supply to meet the various socio-economic demand of water over a long period of time (Mniki, 2009). Drought invasion impact negatively on social economic well-being of the populace with adverse effect on food security and the environment as it translate to loss of crops, livestock, vegetation cover, and the shrinking of runoff water. Keyantash (2002) see drought as the most costly disasters in the world, causing severe damage and affecting more people than any other natural disaster.

The negative effects of drought ranges from resource induced contestation (between farmers and herders and among pastoralists), food shortage, loss of livestock, and a decline in milk production. A report by Huho and Mugalavai (2010) revealed an adverse effect of drought on livestock with the 1974-76 droughts in various regions of Kenya resulting in the loss of 80 percent cattle of the Maisai people. The report revealed further that droughts in 1991-92 in North-eastern, eastern regions and 2006-06 in most parts of the country resulted in the loss of 70 percent and approximately 70 percent livestock respectively among pastoral communities in the country. This resultant ripple effect of drought includes food shortages, humanitarian situation, and a sharp decline in milk production which impedes the well-being of pastoral communities and Fulani women's milk business.

An empirical inquiry: Heat stress in Tunisia, effects on dairy cows and potential means of alleviating it by Bouraoul (2009) showed a sharp decline in the production of milk and overall reproduction decline in cattle, notably in summer as a result of drought induced heat stress.

Andrade et al. (2017) evaluate milk production as an indicator of drought vulnerability of cities located in the Brazilian semi-arid region spanning 2004 to 2014. The objective was to evaluate the relationship between the drought indices and annual milk production in 34 municipalities of the Paperoa Upper Paraiba river basin, State of Paraiba using the hierarchical grouping technique and correlation analysis. The study showed an intense correlation between milk production and the drought indices which may be related to the dependence of the cities' economies on natural resources. The study concludes that most of the cities are vulnerable to drought as farming activities depends largely on natural resources as indicated by the correlation between milk production and drought indices.

Rainfall and Fulani Women's Milk Business

The increase in climate variability induced by natural and anthropogenic factors alters the seasonal rainfall. Adequate rainfall provides sufficient water table and soil moisture to enhance pasture for dairy cattle. Rainfall also leads to a decline in heat stress in dairy cattle which is a proximate factors impeding dairy production around the world (Lamesegn, 2018). Empirical studies abounds that examines the effect of rain variability on dairy production.

Ondieki and Tonui (2021) carried out a study on trends in rainfall variability and their effects on dairy cattle production in Keumbu Division, Kisii County, Kenya using qualitative and quantitative methods spanning 1995 to 2019. The qualitative result revealed 93.2 percent indicates that rainfall variability affects dairy production in the region with 79.5 percent and 68.6 percent indicating an increase in dairy production during the wet season and a decrease in dairy production during the dry season respectively. The study concludes that changes in milk production from high to low milk yield is as a result of dry arid adverse weather, while increased milk yield relates to a favorable weather condition. It recommends adequate measures be put in place to mitigate losses of milk from rain variability and adverse weather condition.

Desalegn (2016) carried out a review on climate change impacts on livestock production to show that heat stress is the leading factor militating against livestock production and milk yield around the globe. The study revealed also that mid lactating dairy cows are the most sensitive to heat with a milk yield decline of (-38 percent) when exposed to heat. More also, it showed that high genetic merit cattle react more to heat stress, with a milk yield decline of 0.2kg per unit increase Thermal Humidity Index (THI) when it exceeds 72. The study concludes that climate change has a negative impact on reproductive performance, health, and genetic of livestock around the globe, and thus recommends immediate adaptation strategies by livestock holders to mitigate the impact of climate change on livestock production.

Coping and Adaptation Strategies of Dairy Farmers on Climate Change

Climate change incidence are fast becoming an annual occurrence in Kaduna State, Nigeria, Africa, and around the globe with variability in rainfall and drought which impact negatively on food security and dairy milk business of Fulani women. In Kenya, Ondieki and Tonui (2021) posit that drought in Keumbu district in Kenya which occurs on 8 years interval has become an annual event that has resulted in a decline in livestock holdings, food, water, and dairy production. The adverse effect of climate variability call for adaptation which IPCC (2007) see as an adjustment in natural or human systems in

responding to actual or expected stimuli or their effects, which moderates harms or exploits beneficial opportunity. In 2013, the Federal Government of Nigeria introduced the Great Green Wall Program to assuage the adverse effect of climate change induced desertification and land degradation in the country (Effevothu & Ihuoma, 2019), while dairy farmers, governments, and academia, among others around the world have undertaken various steps to mitigate the negative effect of climate variability on dairy production and livestock holdings.

De-Vries (2018) examined vulnerability and adaptation strategies of dairy farming systems to extreme climate events in southwest Uganda using Climate Smart Agriculture Participatory Rural Appraisal (CSA-PRA) developed as a method to identify the characteristics, vulnerability, adaptation strategies employed by farmers on climate variability. The scope covered six workshops conducted between May and June 2017 with 103 dairy farmers in the districts of Mbarara, Sheema, Isingiro, and Kiruhura in Southwest Uganda. The study revealed that, the adaptation strategies employed by dairy farmers to mitigate prolonged drought and excess rainfall includes; alternative feeds, rotational grazing, weeding, feeding at night, and renting land to increase availability of feeds and water, and other measures such as the reduction in herd size and migration of cattle. Also, the study revealed that the preferred short term adaptation strategies includes selling of cattle, migrating cattle, alternative feed, and ferrying water with construction of bigger dams as the preferred long term adaptation strategy with options such as clearing farm fields and fencing. The study concluded that dairy farms in Southwest Uganda are affected by climate variability through reduced quantity and quality of feed, water and changes in disease incidence which affects production and reproductive performance of livestock. It recommends the use of prevention and mitigation strategies with the existing coping strategies to enhance dairy production.

Montcho et al. (2021) investigates the perception and adaptation strategies of dairy farmers towards climate variability and change in West Africa with the instruments of Focus Group Discussion and questionnaire administered to 900 dairy farmers across Benin, Burkina Faso, Mali, and Niger in West Africa. Descriptive statistics, Chi-square, multiple correspondence analysis, and hierarchical clustering on principle component analysis were employed to assess the climate change adaptation strategy by dairy farmers in West Africa. The result revealed that dairy farmers perceived increase in annual temperature and dry season with a decrease in rainy season and annual rainfall which has a resultant adverse effect on livestock production. Farmers in Burkina Faso, Niger, and Benin employs adaptation strategies such as transhumance in wetland, animal manure to improve fodder production and quality, while dairy farmers in Mali that invest in fodder production and conservation in the climate zones of Mali used plants to improve milk

production, pasteurization for milk conservation, and veterinary services to enhance livestock holdings under climate variability.

Ranasinghe et al. (2023) investigates climate change adaptation and adaptive capacities of dairy farmers: Evidence from village Tank Cascade System in Sri Lanka. The study was carried out in the Anuradhapura District, North Central province of Sri Lanka with the instruments of questionnaire administered to 200 dairy farmers. The result from ordered logistic regression model revealed that climate change affects dairy farms in Sri Lanka through pasture shortage, decline in milk yield, and growth retardation of livestock. It showed also that a lesser number of dairy farmers implements adaptation strategy to address pasture shortage while majority of dairy farmers implements adaptation measures to reduce climate change adverse effect on physiology of livestock.

Idrissou et al. (2020) examined adaptation strategies of cattle farmers in the dry sub-humid tropical zones of Benin in the context of climate change. The study was carried out in the municipality of Tchaourou and Nikki (Sub-Humid Tropical Zone), Gogounou and Banikoara (Dry Tropical Zone) with the instruments of interview and questionnaire. Chi-Square test and binary logistic regression with Stepwise Backward Elimination of Predictors were used to show the dominant adaptation strategies in Sub-Humid Tropical Zone to be integration of livestock and crop husbandry, reduction in herd size, transhumance, the use of concentrated feed, and forage cropping while the prevailing adaptation strategies in the Dry Tropical Zone includes transhumance, livestock diversification, reduction in herd size, usage of concentrated feed, and integration of livestock and crop husbandry. The study recommends regular sensitization, training, exchange, and knowledge sharing session on future climate adaptation strategies.

Theoretical Framework

The theoretical framework for the study is the BBC Framework developed by Bogardi and Birkman (2004) and Cardona (2001) based on the concepts of vulnerability, human security, and sustainable development with the need to focus simultaneously on social, economic, and environmental sphere (Birkmann, 2013). The framework was developed to address vulnerability within the contexts of social, economic, and environment to enhance sustainable development and stress the need for a livelihood framework within the social sphere. The framework goes beyond an assessment of past vulnerabilities to employing coping strategies needed to lessen the impact of disaster and to enhance a sustainable well-being of disaster vulnerable communities such as pastoral communities in the HoA that are experiencing the adverse effect of climate change. Employing the framework, pastoralist in Uganda adopts coping strategies such as; selling of cattle, migrating cattle,

alternative feed, ferrying water, and construction of bigger dams as to mitigate the adverse effect of drought on dairy production (De-Vries, 2018) while in Benin, common adaptation measures employed by dairy farmers to mitigate the adverse effect of climate change on dairy production in the country includes integration of livestock and crop husbandry, transhumance, the use of concentrated feed, forage cropping, livestock diversification, and destocking (Idrissou et al., 2020).

The framework advocates for two options ($t=0$ and $t=1$) to mitigate vulnerabilities. While the first stress the need for preventive response to vulnerability ($t=0$), the second advocates for prompt responses in the wake of disasters to mitigate vulnerability (Birkmann, 2013).

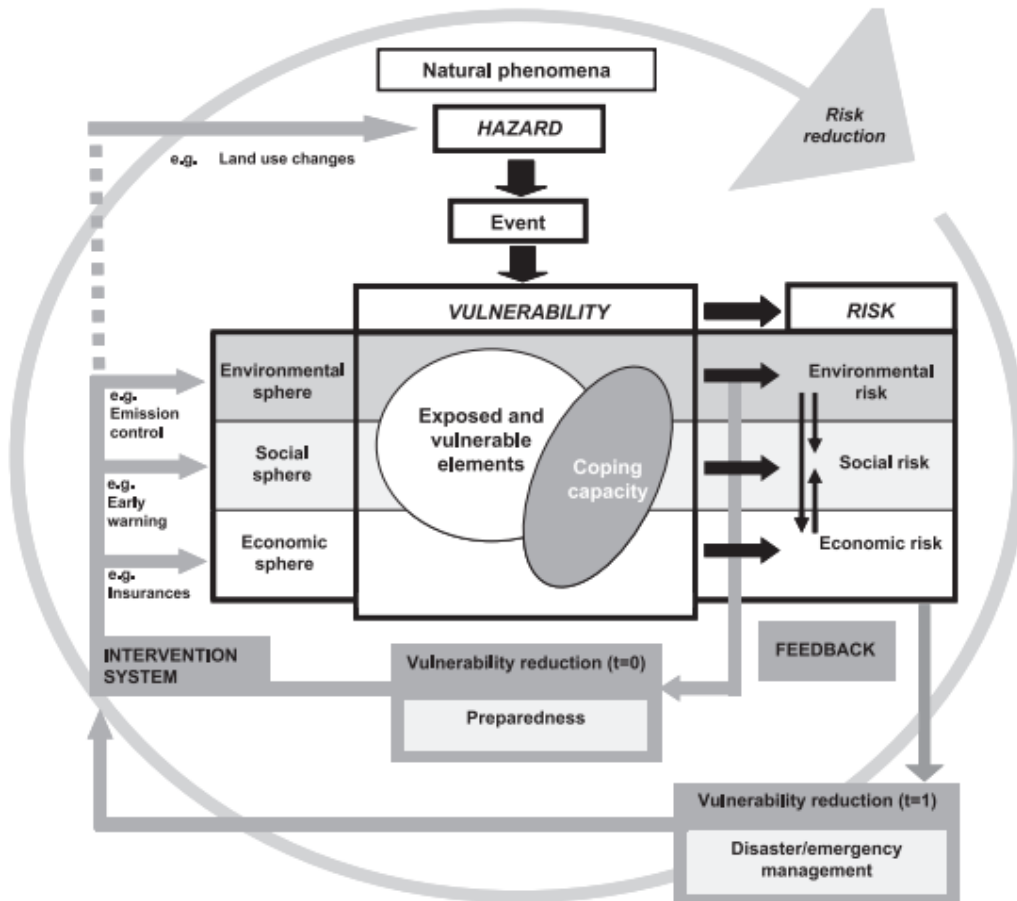


Figure 2.1: The BBC Conceptual Framework

Adapted from Birkmann (2013)

The framework is relevant to the study in showing the pathways for farmers and herders in Kaduna State, Nigeria to adopt coping strategies such as innovative and green farming,

ranching, artificial insemination to enhance high milk yield, cultivation of grasses to supplement dry season feed, and the diversification of means of livelihoods in the wake of climate variability to mitigate resource induced contestations and the attainment of the backward integration policy of the CBN on 5 percent raw milk yield in the country. In this light, it depicts the need to be proactive against climate variability even before it strikes the society, economy, and the environment (Birkmann, 2013).

Methodology

A survey research design was employed for the study. The design is appropriate for the study due to its observatory element and interaction with the participants and the environment. Multi-stage sampling techniques were employed to select the sample size necessary for data collection and analysis. The purposive sampling technique was used to select three (3) LGAs across Kaduna State due to dairy activities and resource contestation between farmers and herders in the LGAs. The stratified random sampling was used to select 30 Fulani women each from one Ruga settlement across the three LGAs on interval of five households. A non-random sampling technique of convenience sampling was employed to administer questionnaires on-the-spot to available Fulani women across the settlements to infer and generate optimum data for the study.

A structured and closed ended questionnaire divided into two sections (socio-economic and demographic characteristics are presented in section one while section two contained relevant information on the effects of climate change induced farmers-herders conflict on milk business of Fulani women in Kaduna State). A five-point Liker-Scale of Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), and Strongly Disagree (SD) was used to assess the relevant information for the study. Both descriptive and inferential statistics were employed to analyze the data sourced from the field. Tables and percentage indexes were applied to the demographic and social-economic characteristics of the respondents while the inferential statistics of Regression Analysis with the aid of Statistical Package for Social Sciences (SPSS) version 23 was used to examine the effect of climate induced farmers-herders conflict on milk business of Fulani women in Kaduna State. The t-statistics and p-value were used to test the stated hypotheses at a five percent level of significance.

Study Area, Population, and Sample Size

Kaduna State has a population of 6,113,503 persons (National Population Commission [NPC], 2006) and a total land mass of 42,481 km². Kaduna State lies between Latitudes 8° 58'N and 11°24'N and longitudes 60°1'E and 8°20'E. The study population comprised of

Fulani women across the three LGAs which is unknown, thus, a stratified random sampling technique was employed to select 90 Fulani women as the sample size across the three LGAs in the state.

Model Specification

The study developed a bivariate model to assess the effect of climate change induced farmers-herders conflict on Fulani women’s milk business in Kaduna State. Thus;

$$MBWF = f(DRHT, RAIN) \text{ ----- (1)}$$

$$DEF = a + \beta_1 DRHT + \beta_2 RAIN + \epsilon \text{ ----- (2)}$$

Where

MBFW = Milk Business of Fulani Women

DRHT Drought

RAIN Rainfall

a Constant

β_1, β_2 are the coefficients of parameter estimate.

ϵ Error term

Presentation of Result and Discussion of Findings

a. Socio-Economic and Demographic attributes of the Respondents

The socio-economic and demographic characteristics of the respondents are presented in tables and percentage index to depict livelihood characteristics and dairy business among the Fulani women in Kaduna State. In all, eighty-three (83) questionnaires were returned for analysis out of 90 questionnaires.

Table 1: Age of Respondents

Options	Frequency	Percentage
15-34 yrs	19	22.9
35-50 yrs	55	66.3
Above 50 yrs	14	10.8
Total	83	100

Source: SPSS 23 (Field work, 2023)

Table 1, show the age distribution of the sample size of the Fulani women selected across the study area. Fulani women between the ages 15-34 years accounts for 22.9% of the sample size, 66.3% are between the ages 35-50 years, while the remaining 10.8% are above 50 years.

Table 2: Average Monthly Income

Options	Frequency	Percentage
Below N 20,000	28	33.7
N 20,000- N 50,000	33	39.8
N 51,000- N 100,000	13	15.7
Above N 100,000	9	10.8
Total	83	100

Source: SPSS 23 (Field work, 2023)

Responses from Table 2 showed 39.8% of the respondents earn a monthly income of ~~N~~20,000 to ~~N~~50,000, 33.7% earn below ~~N~~20,000 as a monthly income, 15.7% earn a monthly income of ~~N~~51,000 to ~~N~~100,000, while the remaining 10.8% earn above ~~N~~100,000 as monthly income from milk business.

Table 3: Number of Milking Cow

Options	Frequency	Percentage
Below 10	46	55.4
10-20	26	31.3
Above 20	11	13.3
Total	83	100

Source: SPSS 23 (Field work, 2023)

From Table 3, 55.4% of the sample size has fewer than 10 milking cows, 31.3% has 10 to 20 milking cows, while the remaining 13.3% has more than 20 milking cows. This show that milk business among the Fulani women in Kaduna State is characterized by low number of dairy cows.

Table 4: Breed of Cattle

Options	Frequency	Percentage
Local breed	55	66.3
Cross breed	23	27.7
Exotic breed	5	6.0
Total	83	100

Source: SPSS 23 (Field work, 2023)

Table 4 show the breed of cattle used in dairy business by the Fulani women in Kaduna State, from which a large percentage (66.3%) uses local breed for dairy production and milk business. Cross breed milking cow accounts for 27.7% in the study with, 6.0% exotic breed among the milk breeding cows in the study. The result shows milk business in Kaduna State is characterized by the tradition milk breeding cows with low milk yield. This is in line with a study by Ugwu (2010) which revealed that dairy production in Nigeria is characterized by low milk production and poor milk hygiene as a result of the indigenous breeds of dairy cattle managed under pastoral production system by Fulani herders which dominate the dairy sub-sector.

Table 5: Daily Milk Yield

Options	Frequency	Percentage
Below 5 liters	51	61.4
5-10 liters	24	28.9
Above 10 liters	8	9.6
Total	83	100

Source: SPSS 23 (Field work, 2023)

Large portion of the respondents (61.4%) produces fewer than 5 liters of milk per day as shown in Table 5. Five to ten liters of daily milk yield accounts for 28.9%, with the remaining 9.6% accounting for a daily milk yield of more than 10 liters. The low milk yield corresponds with the findings in Table 4 which shows milk production in Kaduna State to be a function of traditional dairy cattle with low milk yield.

Table 3.6: Major Dairy Challenges

Options	Frequency	Percentage
Feed	17	20.5
Breed	47	56.6
Veterinary	15	18.1
Others	4	4.8
Total	83	100

Source: SPSS 23 (Field work, 2023)

The result from Table 6 revealed that the biggest challenge confronting the Fulani women’s dairy business in Kaduna State is the use of traditional dairy cows (56.6%) with low milk yield. Feed accounts for 20.5% of the challenges confronting Fulani women’s milk business in Kaduna State, with inadequate access to veterinary products (18.1%), and others challenges not mentioned in the study (4.8%) as the factors militating against Fulani women’s milk business in Kaduna State, Nigeria.

Table 7: Adaptation Strategy

Options	Frequency	Percentage
Destocking	12	14.5
Selling of cows	25	30.1
Mixed farming	40	48.2
Others	6	7.2
Total	83	100

Source: SPSS 23 (Field work, 2023)

To mitigate the adverse effect of climate change, Fulani women in Kaduna State, Nigeria adopts coping strategies such as mixed farming (48.2%), selling of cows (30.1%), destocking (14.5%), and others (7.2%) as adaption measures to enhance milk business in the face of climate variability.

b. Findings on Effects of Drought and Rainfall on Fulani women's Milk Business

Table 3.8 depicts the model summary which shows the relationship between the dependent variable (MBWF) and the independent variables (DRHT and RAIN). The responses elicited were transcribed, computed, and analyzed with SPSS 23 to determine the effect of climate change induced farmers-herders conflict on Fulani women's milk business in Kaduna State, Nigeria.

As observed in Table 8, the R-value of 62.2% shows a significant effect of climate variability on milk business of Fulani women in Kaduna State. The adjusted R-square value of 51.9% shows that drought and rainfall accounts for 51.9% variation in milk business of Fulani women in Kaduna State. Other factors not captured in the model accounts for the remaining 48.1% (100% - 51.9%) of milk business of Fulani women in Kaduna State, Nigeria.

Table 8: Model Summary

Independent variables	Standard Error	Standardized Coefficient (Beta)	t-statistics	P-value	VIF
DRHT	0.059	-0.183	3.653	0.030**	8.335
RAIN	0.058	0.651	11.409	0.000**	8.335
R= .622	Adj R ² = .519	DW= 1.229			

Legend: ** Significant @ 5% Level. **Source:** SPSS 23 (Field work, 2023)

Test of Hypotheses

H_{o1} was formulated and tested at a 5% significance level that drought has no significant effect on milk business of Fulani women in Kaduna State. However, given that the result from Table 8 (significant p-value of 0.03% is less than 0.05% and the absolute t-value is 3), the null hypothesis was rejected and the alternative was accepted that drought has a significant negative effect on milk business of Fulani women in Kaduna State.

H_{o2} was formulated and tested at a 5% significance level that rainfall has no significant effect on milk business of Fulani women in Kaduna State. However, given that the result from Table 8 (significant p-value of 0.00% is less than 0.05% and the absolute t-value is 11), the null hypothesis was rejected and the alternative was accepted that rain fall has a significant positive effect on milk business of Fulani women in Kaduna State.

Discussion of Findings

The negative effect of drought on milk business of Fulani women in Kaduna State shows that a percentage increase in drought will lead to 18% (Table 8) decrease in milk business of Fulani women in Kaduna State as increase in drought translate to increase in diseases and a decline in available pasture to enhance milk production and milk business. In line with the result, empirical studies (Huho and Mugalavai (2010); Bouraoul (2009); Keyantash (2002) show a negative effect of drought on dairy production. The finding on effect of rainfall on Fulani women's milk business shows a significant positive effect of rainfall on Fulani women' milk business which implies that a percent increase in rainfall will lead to a significant 65% (Table 8) increase in milk business of Fulani women in Kaduna State as adequate rainfall leads to increased vegetation cover and pasture for dairy cattle and a decline in heat stress. In line with the finding, empirical study by Ondieki and Tonui (2021) show a positive effect of rainfall on dairy production.

Conclusion

The study concludes based on the findings that climate change induced farmers-herders conflict has a significant effect on milk business of Fulani women in Kaduna State. Increase in drought leads to heat stress and dairy cattle diseases and a decline in pasture which impedes dairy production as the Fulani women depends on available forage as feed to enhance milk yield. Available rainfall on the other hand translates to growth of dairy business as adequate rainfall leads to pasture for dairy cattle and a reduced heat stress, resulting in high milk yield.

Recommendations

The biggest challenge confronting the dairy business of Fulani women in Kaduna State is the use of traditional dairy cattle breed with low milk yield. Effort should be put in place through artificial insemination and the use of exotic breeds by Fulani pastoralists to enhance the milk business of Fulani women and the backward integration policy of 5 percent raw milk yield in the country.

Adaptation measures such as modern ranching with the use of supplementary feed, cultivation of pasture against dry season shortage, and reduction in open grazing should be put in place by Fulani pastoralists to enhance milk production in the country.

The government should engage in kinetic and non-kinetic conflict resolution frameworks to mitigate the increasing farmers-herders conflict in Kaduna State, Nigeria. While kinetic security measures such as the deployment of security units to prevent attacks and reprisals attack should be put in place, emphasis should be placed on positive peace ideologies that will curtail the root cause of conflict.

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