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Herdsmen-Farmer Conflicts and Their Effects on Agricultural Productivity and Rural Livelihoods

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Abstract

The study investigated the causes and effects of herdsmen-farmer conflicts in Ekiti State, Nigeria. The study specifically identifies the perceived causes of herdsmen-farmer conflicts, assesses the impacts of these conflicts on the output and livelihoods of arable crop farmers, and analyzes the determinants of herdsmen incursions into farmlands. Primary data were gathered through structured questionnaires, interviews, and Focus Group Discussions (FGDs). A multistage sampling procedure was used to randomly select 210 arable crop farmers and 70 herdsmen. The data were analyzed using descriptive statistics, Principal Component Analysis (PCA), and probit regression. Findings indicate that the primary perceived causes of conflict among farmers included crop destruction (3.94), uncontrolled grazing (3.85), indiscriminate bush burning (3.79), and contamination of streams by cattle (3.79). Conversely, herdsmen identified encroachment of grazing routes (3.72), language barriers and cultural differences (3.67), crop destruction (3.65), and inadequate grazing reserves (3.64) as major causes. PCA analysis of the perceived effects on arable crop farmers revealed that the conflicts caused decreased farm output, destruction of crops, unsafe farming environments, displacement, insufficient food supply, and erosion of mutual trust, explaining 46.9% of the variance across 21 components. The probit regression model identified farm size, gender, family size, farming experience, educational level, extension contacts, farm fencing, use of guards, kraal proximity, grazing route location, and farm distance as significant factors influencing the probability of herdsmen incursions into farmland. These findings revealed the need for targeted conflict resolution strategies and policies to mitigate the adverse effects of herdsmen-farmer conflicts on agricultural productivity and rural livelihoods in the area.

Keywords: Agricultural productivity, conflict resolution, food security, principal component analysis, probit regression

1. Introduction

Conflicts over resource utilization are common in agriculture, as various groups compete for access to land, pastures, and water. In Nigeria, the tension between herdsmen and arable crop farmers is particularly intense, often leading to violent clashes, destruction, and loss of lives, predominantly among farmers and their families (Ado et al., 2021; Obi, 2023; Akanwa et al., 2023). These conflicts pose a severe challenge to arable crop farmers, who constitute the majority of Nigeria's agricultural workforce, with significant socio-economic repercussions, including poverty and food insecurity (Ogebe et al., 2019; Okeke and Nnamani, 2023; Emerald and Nwafor, 2024). Since 1999, Nigeria has experienced widespread conflicts, leading to instability, homelessness, and unemployment across ethnic and religious communities (Eneji and Agri, 2020; Iwuagwu, 2022; Ogbonna and Ume-Ezeoke, 2023). Among these, the herdsmen-farmers conflict is the most persistent and detrimental to rural stability (Ogebe et al., 2019; Udosen, 2021; Emerald and Nwafor, 2024). Agriculture, which is vital to Nigeria's economy, employs over 70% of the population and contributes more than one-third of the GDP (Yeboua et al., 2022; Okorie and Lin, 2022). Historically central to the sector, small-scale farmers produce 90-95% of the nation's agricultural output (Akinrinde et al., 2021).

Before the oil boom, Nigeria was a global leader in food and cash crop production, with small-scale farmers supplying raw materials for industrial growth (Ogieve, 2003). Arable crop farming remains critical today, with rural farmers contributing 80% of the nation's food production (Chiaka et al., 2022; Obi, 2023). These crops are essential for household consumption and income generation, particularly in a situation where rising populations demand increased agricultural output (Arndt et al., 2023). Agricultural productivity thrives in stable and harmonious communities (Hassan et al., 2023). However, Nigeria's farmer-herdsman conflict has disrupted this equilibrium. The Fulani herdsmen, significant contributors to Nigeria's livestock industry, have traditionally relied on a nomadic lifestyle, moving seasonally to find pasture. This practice was once harmonious, with herdsmen and farmers benefiting mutually from manure and produce exchange (Omotola and Hassan, 2015). The Fulani supply over 90% of Nigeria's livestock, accounting for one-third of agricultural GDP and the majority of the animal protein consumed (Udeh, 2021; Ilori, 2021; Jimoh et al., 2021). However, climate change, desertification, and population growth have intensified year-round migration, straining traditional symbiotic relationships (Ikhuoso et al., 2020; Nawaz et al., 2024; Mosoh et al., 2024).

Herders often graze cattle on farmlands, leading to crop destruction and escalating tensions (Okoli and Addo, 2018; Ado et al., 2021; Obi, 2023; Akanwa et al., 2023). Factors such as land scarcity, climate change, and technological advancements have exacerbated the situation (Integrated Regional Information Network, 2004; Obi, 2023; Akanwa et al., 2023). The conflicts are further fueled by cultural and linguistic differences that alienate the nomadic herdsmen from local communities. Unsupervised cattle movement during the growing season has been identified as a primary cause of clashes (Ado et al., 2021). Government policies, such as those on grazing reserves, have failed to address the crisis adequately. Many herdsmen resort to self-help strategies, often arming themselves for protection, leading to violent confrontations with farmers. These conflicts have caused extensive displacement, food shortages, and economic disruptions (Aliyu et al., 2018; George and Adelaja, 2022; Shemyakina, 2022).

The frequent clashes in agricultural regions, such as Ekiti State, hinder arable crop production and exacerbate food insecurity. The loss of farmland, destroyed crops, and reduced outputs contribute to rising food prices and a growing fear of hunger. Despite the anti-grazing law implemented in Ekiti State, conflict management remains a significant challenge (Ayodeji, 2022; Nnamani et al., 2024). In addition to economic losses, these conflicts disrupt social cohesion and local economies. For instance, the strained relationships between herders and farmers undermine efforts to improve agricultural productivity and sustainable development. Although numerous studies have explored herdsmen-farmer conflicts, there remains a lack of detailed data on their specific impacts on arable crop productivity in Ekiti State (Ilori, 2021; Ado et al., 2021; Obi, 2023; Akanwa et al., 2023). Existing research has addressed topics such as migration, anti-grazing laws, food insecurity, and income distribution among farmers (Ogo-Oluwa, 2017; Olugbenga, 2017; Shemyakina, 2022; Ayodeji, 2022; Adegoroye et al., 2023; Nnamani et al., 2024). However, these studies often overlook how conflicts directly affect agricultural output. The study adds value by providing significant contributions to understanding the dynamics and impacts of herdsmen-farmer conflicts, highlighting its extensive effects on agricultural productivity and rural livelihoods. Unlike previous research which often broadly addressed the socio-economic dimensions, this research delves into specific, quantifiable impacts using advanced statistical tools such as Principal Component Analysis (PCA) and probit regression. This allows for a detailed examination of how these conflicts diminish farm output, disrupt food supplies, and erode social cohesion among communities. The practical applications of the findings will not only benefit the local stakeholders but also provide a model for similar conflict zones globally, thereby extending the relevance and utility of the findings beyond the immediate study area. Based on the background, this study seeks to bridge these gaps by examining the causes and effects of herdsmen-farmer conflicts in Ekiti State, Nigeria. Specifically, the study aims to identify the perceived causes of herdsmen-farmer conflicts; assess the impacts of these conflicts on the output and livelihoods of arable crop farmers; and analyze the determinants of herdsmen incursions into farmlands.

2. Materials and Methods

2.1 The Study Area

The study was conducted in Ekiti State, Nigeria, one of the 36 states in the Federal Republic of Nigeria. Located in the Southwestern part of the country, and is one of the six states in the region. The state is comprised of 16 local government areas and is divided into three geopolitical zones. According to the 2006 population census, Ekiti State has a population of 2,384,212, including 1,212,609 males and 1,171,603 females, and covers an area of 5,435 square kilometres. The state is located entirely within the tropics, positioned between longitudes 4° 5′ and 5° 45′ east of the Greenwich Meridian and latitudes 7° 15′ and 8° 5′ north of the equator. It is bordered to the north by Kwara and Kogi States, to the east by Osun State, and is flanked by Ondo State to both the east and south. The region is predominantly an upland area, rising about 250 meters above sea level, and is underlain by metamorphic rocks of the basement complex. The landscape is generally rolling, featuring old plains interspersed with step-sided outcrops or ridges. The state experiences a tropical climate with two distinct seasons: the rainy season (April to October) and the dry season (November to March). Temperatures range from 21°C to 28°C, with high humidity. The southern part of the state is covered by tropical forests, while the northern areas are dominated

by savannah. The study area was chosen primarily because is a major agrarian region where farmers extensively grow arable crops. Additionally, the state has experienced a high number of herdsmen-farmer conflicts. In Ekiti State, men predominantly engage in arable crop farming, while women are mainly involved in trading. For educated residents who are formally employed, farming remains a significant secondary occupation.

2.2 Sampling Procedure and Sample Size

This study utilized primary data, which was collected through a detailed questionnaire, interview schedule, and Focus Group Discussions (FGDs). A multistage sampling procedure was employed to gather the data. In the first stage, seven local government areas including Ado, Ikole, Ido-Osi, Ekiti East, Ise/Orun, Ilejemeje, and Moba were purposively selected from the total sixteen local governments in Ekiti State. This non-probability selection was made because these seven areas were the most impacted by herdsmen conflicts as reported by the Ekiti State Ministry of Agriculture. In the second stage, three communities were purposefully chosen from each of the seven selected local government areas. This selection was based on the frequent incursions of Fulani herdsmen with their cattle, sheep, and goats, as well as the ongoing issues of farm destruction and loss of lives that have become recurrent problems in these areas. The third stage was the random selection of ten (10) farmers from each of the twenty-one (21) communities or villages while ten herdsmen were randomly chosen from each of the seven local government areas, yielding a total sample size of 280 respondents. A total of 280 respondents comprising two hundred and ten farmers (210) and seventy herdsmen (70) were used for the study.

2.3 Data Analysis

The data collected for this study were analyzed using both descriptive and inferential methods. Descriptive statistics, such as frequency counts and percentages, were used to summarize the data. The probit model was applied for deeper analysis to explore cause-and-effect relationships. These methods were chosen for their suitability in analyzing such relationships flexibly. According to Harefa et al. (2023), the choice of analytical techniques depends on the study's nature and objectives. While basic descriptive statistics like rates, means, percentages, tables, graphs, and frequency distributions may suffice for some studies, more complex analyses are necessary for case studies and surveys involving quantitative data. In this study, a combination of descriptive and inferential tools was utilized.

2.3.1 Descriptive Statistics - Likert Rating Scale

A Likert Rating Scale was utilized to address the second objective of the study. This psychometric scale is commonly employed in research to gauge the extent to which respondents agree or disagree with specific statements. It is widely used in survey research, often referred to interchangeably with the rating scale. In social sciences, a typical example is the 4-point Likert scale, where respondents choose a number that best reflects their opinion or perception of a statement (Alabi and Jelili, 2023). For instance, Oke et al. (2023) used this scale to identify factors influencing farmers' willingness to adopt agroforestry in Ekiti State, Nigeria. This study, a 4-point scale was applied to measure the primary causes of conflict between herdsmen and farmers in the region. The scale ranged from Strongly Agree (4) to Strongly Disagree (1), with intermediate options of Agree (3) and Disagree (2). The mean value of each statement was estimated and used in ranking the statements.

2.3.2 Factor Analysis – Principal Components Analysis (PCA)

The principal component is a specific instance of the broader factor analysis (FA) technique. The purpose of this method is to construct out of a set of variables, Xj's (j = 1, 2,…,k), of new variables (Pi), called principal components, which are a linear combination of the X's:

$$P_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1k}X_k$$

$$P_2 = a_{21}X_1 + a_{22}X_2 + \cdots + a_{2k}X_k$$

$$\begin{array}{cccc} * & * & * & * \\ * & * & * & * \\ * & * & * & * \end{array}$$

$$P_k = a_{k1}X_1 + a_{k2}X_2 + \cdots + a_{kk}X_k$$

The factor loadings are selected to ensure that the principal components satisfy two criteria: (1) they are uncorrelated (orthogonal), and (2) the first principal component (P1) accounts for the maximum possible proportion of the total variation in the dataset, while the second principal component explains most of the remaining variation, and so on (Otitoju and Enete, 2016). To determine significant loadings, a test based on the significance levels (standard errors) of Pearson correlation coefficients is applied. For a sample size greater than 50 (n > 50), a loading is considered significant at the 1% level if its value exceeds ±0.346 (Otitoju and Enete,

2016). The factor analysis (FA) seeks to describe the covariance relationships among multiple variables (constraints) by identifying a few underlying, unobservable factors, which are represented by factor loadings organized in a matrix. The FA model ensures that variables within the same group are highly correlated, while those in different groups have lower correlations (Kyriazos and Poga, 2023). However, this constraint can be relaxed when the objective is to understand the pattern of relationships. Factor analysis was used in this study to evaluate the perceived impacts of herdsmen-farmer conflicts on the productivity and livelihoods of arable crop farmers.

2.3. 3 Probit Regression Analysis

A probit model, or probit regression, is used for analyzing regression where the dependent variable is binary. Following Olutumise (2024), binary outcome variables have two possible results, such as yes/no, positive/negative test results, or single/married. The term "probit" merges "probability" and "unit," and the model estimates the probability of a value falling into one of the two outcomes. In probit regression, the probability's inverse standard normal distribution is modeled as a linear combination of the predictor variables as in Equation (1).

Implicit function: $Y_i = R_i\beta + \varepsilon_i$ …….…… (1)

$Y_i = (1 \text{ if } Yi^* \geq 0; 0 \text{ if } Yi < 0)$

Y_i^* = The observed dichotomous dependent variable takes the value of 1 when an arable crop farmer encounters attacks from herdsmen and 0 otherwise.

$$P(y = 1) = P = \frac{e^{(\beta_0+\beta_1X_1 \ldots\ldots\ldots+\beta_nX_n)}}{e^{(\beta_0+\beta_1X_1 \ldots\ldots\ldots+\beta_nX_n)+1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$P(y = 0) = 1 - P = 1 - \left\{\frac{e^{(\beta_0+\beta_1X_1 \ldots\ldots\ldots+\beta_nX_n)}}{e^{(\beta_0+\beta_1X_1 \ldots\ldots\ldots+\beta_nX_n)+1}}\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

From the Equations (2) and (3) above,

Y_i = Underlying latent variable that indexes farm nomadic attack.

$y = 1$ represents if a farmer encountered an invasion by nomadic herders, and equals P

$y = 0$ represents if a farmer did not experience nomadic invasion, and equals $1 - P$

β = Coefficient

R_i = Row vectors of the independent variables that influence the likelihood of farmers experiencing visits from nomadic herders.

ε_i = The error term is assumed to follow a standard normal distribution. Based on Olutumise (2024), the following specific function was employed for estimation as presented in Equation (4):

$$\ln\left[\frac{Y_i}{1-Y_i}\right] = \beta_0 + \beta_1R_1 + \beta_2R_2 + \beta_3R_3 + \ldots + \beta_{17}R_{17} + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The independent variables are specified as below:

X_1 = Farm size (Continuous: hectares)

X_2 = Farmers' age (Continuous: years)

X_3 = Gender (Dummy: Male=1; Female=0)

X_4 = Household size (Discrete: numbers)

X_5 = Farming experience (Continuous: years)

X_6 = Marital status (Dummy: Married=1; if otherwise = 0)

X_7 = Education (Discrete: years)

X_8 = Secondary occupation (Dummy: Trading =1; if otherwise=0)

X_9 = Extension contacts (Discrete: numbers)

X_{10} = Farm fencing (Dummy: Yes=1; if otherwise=0)

X_{11} = Work hours (Continuous: numbers)

X_{12} = Land terrain (Dummy: Flat=1; if otherwise = 0)

X_{13} = Use of guards (Dummy: Yes=1; if otherwise = 0)

X_{14} = Kraal proximity (Dummy: Far= 1; if otherwise = 0)

X_{15} = Grazing route location (Dummy: Near=1; if otherwise = 0)

X_{16} = Farm distance (Continuous: km)

X_{17} = Farm practice (Dummy: Mono-cropping=1; if otherwise=0)

3. Results and Discussion

3.1 Perceived Causes of Farmers-herdsmen Conflicts

3.1.1 Crop Farmers Perceived Causes of Conflict

The mean scores provide insights into how farmers perceived the various causes of conflicts with herdsmen. These perceptions can influence the formulation of policies and strategies aimed at addressing and mitigating conflicts, ultimately promoting harmonious coexistence between farmers and herdsmen and supporting agricultural productivity and livelihoods in the study area (Table 1). The mean score of 3.94 indicates that, on average, farmers believe that the destruction of crops and farm equipment has a substantial impact on conflicts with herdsmen. This suggests that instances of crop damage and loss of farm equipment are key factors affecting farmers' well-being and livelihoods. The encroachment of grazing routes or tracks received a mean score of 3.58,

indicating that farmers perceive it as a notable factor in causing conflicts. The encroachment of grazing routes or tracks can lead to disputes over land use, affecting farmers' ability to access and utilize their farmland for cultivation.

With a mean score of 3.65, farmers viewed the lack of grazing reserves as significantly contributing to conflicts. The absence of designated grazing areas may result in herdsmen allowing their cattle to graze on farmland, leading to confrontations with farmers. Farmers attributed a lower level of significance to the killing of stray cattle, as indicated by the mean score of 1.53. While this cause may not be perceived as a major factor in conflicts, it can still lead to disputes and losses for farmers. Indiscriminate bush burning received a mean score of 3.79, signifying that farmers see it as significantly contributing to conflicts. Indiscriminate bush burning can lead to land degradation, negatively impacting crop yields and intensifying conflicts. With a relatively low mean score of 1.37, farmers did not consider cattle theft as a major contributor to conflicts. However, incidents of cattle theft can still cause tensions and disputes. Farmers attributed a moderate level of significance to climate change and desertification as causes of conflicts, as reflected by the mean score of 3.45. These environmental challenges can lead to resource scarcity and heightened competition between farmers and herdsmen. The mean score of 3.54 suggests that farmers perceived language and cultural differences as moderately significant in causing conflicts. Misunderstandings arising from these differences can lead to disputes and tensions. With a mean score of 3.34, disregard for traditional authority and non-compliance with rules were moderately significant as causes of conflicts. Conflicts can arise when there is a lack of adherence to traditional norms and established rules governing land use and resource management. Farmers viewed sexual harassment of women by herdsmen as significantly contributing to conflicts, as indicated by the mean score of 3.67. Such incidents can create tensions and animosity between communities, affecting agricultural activities and output.

Table 1. Distribution by Perceived Causes of the Conflicts – Arable Crop Farmer's Perspective

Perceived causes	SA	A	D	SD	Mean
Destruction of crops/farm equipment	206 (98.1)	-	2 (1.0)	2 (1.0)	3.94
Encroachment of grazing routes/tracks	168 (80.0)	3 (1.4)	31 (14.8)	8 (3.8)	3.58
Inadequate or no grazing reserves	179 (85.2)	2 (1.4)	16 (7.6)	13 (6.2)	3.65
Killing of stray cattle	20 (9.5)	7 (3.3)	37 (17.6)	146 (69.5)	1.53
Indiscriminate bush burning	187 (89.0)	6 (2.9)	12 (5.7)	5 (2.4)	3.79
Cattle theft	12 (5.7)	-	41 (19.5)	157 (74.8)	1.37
Climate change/desertification	146 (69.5)	34 (16.2)	9 (4.3)	21 (10.0)	3.45
Language barrier/cultural differences	154 (73.3)	34 (16.2)	4 (1.9)	18 (8.6)	3.54
Disregard for traditional authority/non-compliance with the laid down rules	149 (71.0)	19 (9.0)	7 (3.3)	35 (16.7)	3.34
Sexual harassment of women by herdsmen	174 (82.9)	5 (2.4)	28 (13.3)	3 (1.4)	3.67
Poor land tenure system	32 (15.2)	12 (5.7)	19 (9.0)	147 (70.0)	1.66
Uncontrolled grazing	192 (91.4)	9 (4.3)	4 (1.9)	5 (2.4)	3.85
Harassment of herdsmen by host youths	23 (11.0)	-	34 (16.2)	153 (72.9)	1.49
Contamination of stream by cattle	180 (85.7)	23 (11.0)	-	7 (3.3)	3.79
Indiscriminate defecation by cattle	174 (82.9)	3 (1.4)	31 (14.8)	2 (1.0)	3.66
Population growth	171 (81.4)	2 (1.0)	32 (15.2)	5 (2.4)	3.61
Pilferage from the farmer's farm	172 (81.9)	9 (4.3)	22 (10.5)	7 (3.3)	3.65
Settling of herdsmen on farmland without permission	37 (17.6)	3 (1.4)	22 (10.5)	148 (70.5)	1.66

Source: Field Survey, 2023

3.1.2 Herdsmen Perceived Causes of Conflicts

Table 2 presents the perceived causes of farmers-herdsmen conflicts from the perspective of the herdsmen, along with the mean score for each of the perceived causes. Herders generally agreed that the destruction of crops and farm equipment (Mean = 3.65) contributed significantly to conflicts. This indicates that they acknowledge that conflicts can arise when their livestock damage farmers' crops and equipment. Herders showed a higher level of agreement regarding the encroachment of grazing routes/tracks (Mean = 3.72) leading to conflicts. They may feel that disputes over land use can occur when farmers restrict their livestock's access to traditional grazing areas. Herders agreed that the lack of adequate grazing reserves (Mean = 3.64) contributed to conflicts. This suggests that they see conflicts arise when they do not have designated areas for grazing their livestock. Herders had mixed responses to the killing of stray cattle (Mean = 2.4) as a cause of conflicts. The lower mean score indicates that they may not perceive this cause as significant in contributing to conflicts. Herders showed mixed responses to the idea that indiscriminate bush burning (Mean = 1.54) contributes to conflicts.

This cause was not perceived as strongly significant in their perspective. Herders had mixed responses to the notion of cattle theft (Mean = 2.87) causing conflicts. They may see cattle theft as a potential cause, but it is not overwhelmingly significant from their viewpoint. Herders agreed that climate change and desertification (Mean = 3.45) as one of the main causes of conflicts. They consider this cause as highly significant in contributing to conflicts. Herders generally agreed that language barriers and cultural differences (Mean = 3.67) can contribute to conflicts. This suggests that communication challenges and cultural misunderstandings are recognized as potential causes. Herders showed mixed responses regarding disregard for traditional authority and non-compliance with laid down rules (Mean = 2.1) as a cause of conflicts. This cause is not strongly perceived as a significant factor from their viewpoint. The response from the herders was low to sexual harassment of women (Mean = 1.5). Hence, they did not agree with the statement as a cause of conflict. Herders agreed that a poor land tenure system (Mean =3.0) can contribute to conflicts.

This suggests that disputes over land ownership and usage may arise due to the land tenure system. Herders generally agreed that uncontrolled grazing (Mean = 3.45) contributed to conflicts. This implies that conflicts may arise when their livestock graze on farmers' fields without proper control. Herders generally agreed that harassment of herdsmen by host youths (Mean =3.13) contributed to conflicts. This indicates that they perceive tensions and disputes arising from interactions with the local youths. Herders generally agreed that the contamination of streams by cattle (Mean = 3.04) contributed to conflicts. This suggests that conflicts may arise when cattle activities lead to water pollution. Herders agreed that indiscriminate defecation by cattle (Mean = 3.02) contributed to conflicts. This implies that conflicts may arise when cattle waste affects the environment or farmers' land. Population growth (Mean = 2.0): Herders had mixed responses regarding population growth as a cause of conflicts. This cause is not strongly perceived as significant from their viewpoint. Herders had mixed responses regarding pilferage from the farmers' farm (Man = 2.0) as a cause of conflicts. This cause is not strongly perceived as significant from their viewpoint. Herders showed mixed responses regarding the settling of herdsmen on farmland without permission (mean = 2.43) as a cause of conflicts. This cause is not overwhelmingly significant in their perspective.

Table 2. Distribution by Perceived Causes of the Conflicts – Herdsmen Perspective

Perceived causes	SA	A	D	SD	Mean
Destruction of crops/farm equipment	25(35.7)	25(35.7)	10(14.2)	10(14.2)	3.65
Encroachment of grazing routes/tracks	40(57.1	20(28.5)	5(7.1)	5(7.1)	3.72
Inadequate or no grazing reserves	30(42.8)	20(28.5)	10(14.2)	10(14.2)	3.64
Killing of stray cattle	10(14.2)	12(17.1)	30(42.8)	18(25.7)	2.4
Indiscriminate bush burning	12(17.1)	10(14.2)	18(25.7)	30(42.8)	1.54
Cattle theft	15(21.4)	20(28.5)	20(28.5)	15(21.4)	2.87
Climate change/desertification	25(35.7)	20(28.5)	15(21.4)	10(14.2)	3.45
Language barrier/cultural differences	30(42.8)	30(42.8)	5(7.1)	5(7.1)	3.67
Disregard for traditional authority/non-compliance with the laid down rules	5(7.1)	15(21.4)	25(35.7)	25(35.7)	2.1
Sexual harassment of women by herdsmen	-	-	15(21.4)	55(78.5)	1.5
Poor land tenure system	15(21.4)	15(21.4)	10(14.2)	30(42.8)	3.0
Uncontrolled grazing	30(42.8)	20(28.5)	8(11.4)	2(2.8)	3.45
Harassment of herdsmen by host youths	25(35.7)	20(28.5)	15(21.4)	10(14.2)	3.13
Contamination of stream by cattle	20(28.5)	15(21.4)	17(24.2)	18(25.7)	3.04
Indiscriminate defecation by cattle	22(31.4)	14(20.0)	16(22.8)	18(25.7)	3.02
Population growth	25(35.7)	20(28.5)	13(18.5)	12(17.1)	2.0
Pilferage from the farmer's farm	5(7.1)	10(14.2)	5(7.1)	50(71.4)	2.0
Settling of herdsmen on farmland without permission	12(17.1)	10(14.2)	18(25.7)	30(42.8)	2.43

Source: Field Survey, 2023

3.1.3 Herdsmen- Farmers' Combined Perspectives on Causes of Conflicts

Table 3 shows the combined perspective of both farmers and herdsmen on the causes of conflict in the study area. They both have their area of convergences and divergences. They both strongly agreed that the major and notable causes are the destruction of crops and farm equipment, encroachment of grazing routes or tracks, uncontrolled grazing, inadequate or no grazing reserves, language barrier/cultural difference, climate change/desertification, contamination of stream by cattle and indiscriminate defecation by cattle. In their area of divergences, arable crop farmers strongly considered indiscriminate bush burning, disregard for traditional authority, sexual harassment of women by herdsmen, population growth and pilferage, and land tenure system as part of major and notable causes of the conflicts, while the herdsmen were of the strong opinion that cattle theft, the land tenure system, and harassment of herdsmen by host youth as significantly contributing to conflicts.

Table 3. Distribution by Perceived Causes of the Conflicts – Combined Perspective of Farmers and Herdsmen

Perceived causes	Mean		Overall Mean
	Farmers	Herdsmen	
Destruction of crops/farm equipment	3.94	3.65	3.80
Encroachment of grazing routes/tracks	3.58	3.72	3.65
Uncontrolled grazing	3.85	3.45	3.65
Inadequate or no grazing reserves	3.65	3.64	3.65
Language barrier/cultural differences	3.54	3.67	3.61
Climate change/desertification	3.45	3.45	3.45
Contamination of stream by cattle	3.79	3.04	3.42
Indiscriminate defecation by cattle	3.66	3.02	3.34
Pilferage from the farmer's farm	3.65	2	2.83
Population growth	3.61	2	2.81
Disregard for traditional authority/non-compliance with the laid down rules	3.34	2.1	2.72
Indiscriminate bush burning	3.79	1.54	2.67
Sexual harassment of women by herdsmen	3.67	1.5	2.59
Poor land tenure system	1.66	3	2.33
Harassment of herdsmen by host youths	1.49	3.13	2.31
Cattle theft	1.37	2.87	2.12
Settling of herdsmen on farmland without permission	1.66	2.43	2.05
Killing of stray cattle	1.53	2.4	1.97

Ajibefun (2017) identified crop destruction as the primary cause of conflict. Similarly, Asagidigbi (2017), in a study on the economic impact of conflicts on farmers' output in South-West Nigeria, found that farmers mainly attributed the conflict to crop damage caused by cattle. In contrast, herdsmen pointed to the obstruction of stock routes as the main cause.

3.2 Perceived Effect of Farmers-Herdsmen Conflicts on the Output and Livelihood of Arable Crop Farmers

Table 4 shows the varimax-rotated Principal Components Analysis (PCA) of major perceived effects of farmers-herdsmen conflicts on the arable crop farmers' output and livelihoods. Based on the responses from arable crop farmers, four factors were extracted using the Kaiser criterion to determine the number of fundamental factors or principal components that explain the data. Components with Eigenvalues below one was excluded. Only variables with factor loadings of ±0.346 or higher, which are significant at the 1% probability level and have 10% overlapping variance, were considered for naming the factors, in line with Otitoju and Enete (2016). Variables with factor loadings below ±0.346 or those appearing in multiple perceived effects were excluded. Communalities indicate the relationship between a variable and all others, represented by squared multiple correlations. After rotation, factor 1 explained 11.8% of the variance, factor 2 explained 10.5%, factor 3 explained 8.7%, and factor 4 explained 8.1%. Together, these retained factors accounted for approximately 46.9% of the variance in the 21 perceived effects or variable components.

3.2.1 Factor 1: insecurity Impact on Farming Productivity

The variables or factors with high loadings under Factor 1 were: Decrease in farm output (0.792), Destruction of crops on the field (0.755), and Unsafe environment for farming (0.657). The study identified several impacts: displacement of farming populations (0.601), insufficient food supply to farming communities (0.515), and the erosion of mutual trust (0.472). These findings align with those of Babagana et al. (2019), who reported similar effects from Fulani herdsmen-farmers conflicts, including crop loss, reduced productivity, loss of lives, rising agricultural product prices, and increased poverty. Awotokun et al. (2020) highlighted that these conflicts undermine the global objectives of eliminating poverty and achieving zero hunger. Abanyam (2019) connected the conflicts to food insecurity, rising food costs, deepening hunger, and absolute poverty, along with social and political instability, including the closure of businesses and schools. Additionally, Okoro (2018) noted that the attacks and counter-attacks by Fulani herdsmen and farmers led to human and animal casualties, displacement, destruction of properties, and a breakdown in trust between the groups.

3.2.2 Factor 2: Human and Economic Consequences of Insecurity

Variables that loaded under Factor 2 include the Absence of an agricultural labour force (0.798), Outbreak of hunger and diseases (0.785), The study highlighted several impacts: loss of income (0.655), loss of lives (0.592), and the proliferation of small arms (0.406). Audu et al. (2023) identified similar severe effects of the conflict, including loss of human and animal lives, damage to crops and property, displacement of people and animals, rising anti-Fulani sentiment, and the collapse of peaceful relations with various communities. Mbah et al. (2020) found that in Benue State, the primary impacts of conflicts between crop farmers and herdsmen were loss of lives

and property, as well as food shortages. Hassan et al. (2023) reported that 71% of farmers experience economic losses due to these conflicts. Additionally, Innocent et al. (2017) described the insecurity challenges as highly detrimental, resulting in a lower quality of life, food insecurity, increased food costs, population displacement, business destruction, and the closure or relocation of businesses.

3.2.3 Factor 3: Agricultural Disruption and Social Impact

Loaded variables under Factor 3 include Poor harvest (0.679), Abandonment of crops in the field (0.503), Forced relocation of farms (0.477), increased number of widows, widowers, and orphans (0.467), and longer time spent in the farm (0.427). According to Usman et al. (2020), the primary causes of conflict included cattle destroying crops and crop residues, burning of rangelands, and obstruction of stock routes by crop farmers. The consequences of these conflicts were significant, leading to total income loss (100.0%), complete loss of yield (100.0%), and loss of stored products (64.0%) among crop farmers. Additionally, conflicts intensified insecurity, diminished quality support, eroded self-esteem, reduced social support, and triggered food crises, especially in rural areas, with effects felt nationwide (Okoli and Addo, 2018).

3.2.4 Factor 4: Crop Quality and Post-Harvest Issues

The variables that loaded high under Factor 4 include: Harvesting premature crops (0.612), Issues such as crop rotting in storage facilities (0.579), and inadequate care of crops in the field (0.538) have been identified. Ajibefun (2017) highlighted that conflicts with herdsmen have led to decreased output and income for farmers and nomads, spoilage of stored produce, displacement of farmers, and shortages of agricultural products, particularly affecting vulnerable groups. Similarly, Okwulu et al. (2024) reported that the conflict has caused loss of lives and property, reduced output for both farmers and herders, and displacement of these groups. Ukamaka et al. (2017) noted that among the effects of herdsmen-farmer conflicts in Kogi State, Nigeria, are poor crop management and premature harvesting.

4.5 Determinants of Herdsmen Incursion into Arable Crop Farmers

This section presents the binary probit analysis of the factors that determine the herdsmen incursion among the arable crop farmers in the study area. The model has strong explanatory power given the likelihood ratio statistics ($\chi 2$) of 62.87 which was significant at a 1% level. Again, given the significant values of _hat and _hatsq to be 0.951 and 0.231 at 1% and 10% levels, respectively, the test for specification error showed that the model specification obeyed the rule and hence the model is properly specified. The results of Hosmer and Lemeshow's goodness-of-fit test (4.53) gave a probability of about 0.97 which is consistent with a strong goodness-of-fit of the model. In addition, the percentage of correctly predicted probability is 83%. Therefore, Table 5 reveals that eleven out of the seventeenth variables were statistically significant in addressing the herdsmen incursion in the study area.

Table 4. PCA Results on the Perceived Effect of Farmers-herdsmen Conflicts on Arable Crop Output and Livelihood

Perceived Effects	Components*				Communality
	Factor1	Factor2	Factor3	Factor4	
Decrease in farm output	0.792				0.683
Destruction of crops on the field	0.755				0.647
Unsaved environment for farming	0.657				0.584
Displacement of the farming population	0.601				0.511
Insufficient food supply to the farming community	0.515				0.453
Destruction of mutual trust	0.472				0.311
Absence of agricultural labour force		0.798			0.693
Outbreak of hunger and diseases		0.785			0.636
Loss of income		0.655			0.488
Loss of lives		0.592			0.422
Proliferation of small arms		0.406			0.481
Poor harvest			0.679		0.562
Abandonment of crops in the field			0.503		0.501
Forced relocation of farms			0.477		0.424
Increased number of widows, widowers, and orphan			0.467		0.365
Longer time spent on the farm			0.427		0.461
Harvesting premature crops				0.612	0.548
Rotting of crops in the ban/storage places				0.579	0.402
Lack of proper care of crops in the field				0.538	0.379
Breakdown of law and order in the community**		0.634	0.467		0.651
Late planting**		0.591	0.401		0.571
Percentage (%) of total variance	11.8	10.5	8.7	8.1	

**Perceived Effects that loaded under more than one factor, Source: Computed from Field Survey, 2023.

Farm Size (ha): The coefficient of farm size was negative but statistically significant at a 1% probability level in determining the herdsmen incursion in the study area. This means that as the farmland size increases by one more hectare, keeping other variables constant, the probability of being attacked is decreased by 3.1%. The probable reason might be that farm size is associated with greater wealth (Olutumise, 2023; Olutumise et al., 2024), and it is hypothesized to increase the ability to guide against incursion as a result of a protective mechanism.

Gender (male =1): The coefficient for gender was negative and statistically significant at the 1% probability level. This suggests that male farmers are less susceptible to cattle attacks compared to female farmers, who are often less present on the farm due to substantial domestic responsibilities. This finding is in line with Ajibefun (2017), who reported that the social impact of Fulani herdsmen's activities includes the loss of human life and instances of sexual harassment affecting women in the impacted communities.

Household size (numbers): The coefficient for family size was positive and statistically significant at the 5% probability level. This suggests that households with more family members are more likely to experience herdsmen incursions compared to those with fewer members. Specifically, for each additional family member, the likelihood of encountering such attacks increases by 1%, assuming other variables remain constant. This result is consistent with the findings of Mbah et al. (2020) and Olutumise and Oparinde (2022).

Farming experience (years): The coefficient for farming experience was negative and statistically significant at the 1% probability level. This suggests that households with more farming experience are more likely to experience less of herdsmen incursions compared to those with fewer years of experience. Specifically, for each additional year of experience, the likelihood of encountering such attacks decreases by 2%, assuming other variables remain constant. This corroborates the study of Olubunmi-Ajayi et al. (2023) and Iyere Freedom et al. (2024).

Education (years spent in school): The coefficient for household education level was positive and statistically significant at the 5% probability level. This indicates that as the number of years spent in education increases, the likelihood of experiencing herdsmen incursions also rises. Specifically, as households advance from one educational level to the next, their probability of being attacked increases by an average of 5.3%, assuming other factors remain constant. This finding contrasts with the initial expectation that higher education would correlate with better access to security information, improved technologies, and greater productivity (Olutumise et al., 2024). It suggests that farmers with more education may have multiple income sources, which could lead to less frequent oversight and supervision of their farms (Ogunwande and Akinrinola, 2017).

Work hours:

The coefficient of the number of work hours spent on the farm by farmers was negative and statistically significant at a 10% probability level. A percentage increase in the number of work hours spent by farmers on the farm would decrease the likelihood of herdsmen incursions by 3.1%, all things being equal. This suggests that the more hours spent on the farm per day, the more the nomadic Fulani herdsmen are scared away from the farm environment

Farm fencing (yes=1): The coefficient of farm fencing was negative but statistically significant at a 1% probability level. It indicates that fencing farms have more probability to reduce herdsmen incursion. This means that, if the crop farmer fenced his/her farms, keeping other variables constant, the probability of being involved in herdsmen incursion is reduced by 13.5%.

Use of guards (yes=1): The coefficient of use of guards was negative but statistically significant at a 5% probability level. It indicates that using guards on the farm has more probability of reducing herdsmen incursion. This means that, if the crop farmer guarded his/her farms, keeping other variables constant, the probability of being involved in herdsmen incursion is reduced by 24.5%.

Kraal proximity (Near=1): The coefficient of kraal proximity was positive and statistically significant at a 10% probability level. It indicates that the closer the farmland to the kraal settlement, the higher the probability of cattle incursion. This means that, if the crop farmer is nearer to the kraal settlement, keeping other variables constant, the probability of being involved in herdsmen incursion is increased by 2.5%.

Grazing route location (near=1): The coefficient of grazing route location was positive and statistically significant at a 5% probability level. It indicates that the nearer the grazing route location to the farm, the higher the probability of cattle incursion. This means that, if the crop farmer is neared to a grazing route, keeping other variables constant, the probability of herdsmen incursion is higher.

Farm distance (km): The coefficient of farm distance is negative and statistically significant at a 5% probability level. This indicates that a kilometer increase in the farm distance to the house, the less the probability of being attacked by the herdsmen incursion. This is not in agreement with Ogunwande and Akinrinola (2017) who reported that farmers with farms that are far away from home hardly go to the farm daily and thus are more susceptible to cattle invasion than farmers with farms closer to their home.

Table 5. Results of the Determinants of Herdsmen Incursion using the Probit Model

Explanatory Variables	Coefficient	Marginal Effects	Standard Error	z-value	P-value
Farm size	-0.089	-0.031***	0.007	-4.78	0.000
Age	-0.011	-0.004	0.004	-1.03	0.301
Gender	-0.086	-0.030***	0.006	-5.40	0.000
Household size	0.002	0.001**	0.000	2.05	0.040
Experience	0.005	-0.02***	0.000	5.38	0.000
Marital status	0.046	0.016	0.037	0.43	0.665
Education	0.153	0.053**	0.026	2.05	0.040
Primary occupation	-0.016	-0.005	0.067	-0.08	0.936
Extension contacts	0.090	0.002	0.013	2.45	0.0941
Farm fencing	-0.389	-0.135***	0.030	-4.46	0.000
Work hours	-0.005	-0.032*	0.003	-0.07	0.064
Land terrain	-0.702	-0.243	0.088	-2.77	0.006
Use of guards	-0.707	-0.245**	0.124	-1.98	0.048
Kraal proximity	0.072	0.025*	0.014	1.77	0.078
Grazing route location	0.410	0.142**	0.064	2.21	0.027
Farm distance	-0.002	-0.008**	0.004	-2.14	0.034
Farm practice	-0.018	-0.006	0.117	-0.05	0.958
Constant	1.175				

Log likelihood = -103.787; LR chi2 (17) = 62.87; Prob > chi2 = 0.000; Pseudo R2 = 0.2325; Number of observations = 210; Dependent variable (Herdsmen Incursion = 1 and 0, otherwise)
Note: ***, **, and * are significant at 1%, 5%, and 10%, respectively.
Source: Computed from Field Survey, 2023.

4. Conclusion and Recommendations

This study underscores the prevalence and significant impact of herdsmen-farmer conflicts on agricultural productivity and rural livelihoods in Ekiti State, Nigeria. The findings revealed that the primary perceived causes of these conflicts, reported by both farmers and herdsmen, include crop destruction, uncontrolled grazing, and language barriers. The conflicts have led to decreased farm output, displacement of farming populations, and the erosion of mutual trust among stakeholders. Key socio-economic factors; such as farming experience, education level, credit access, and farm size, were identified as critical determinants influencing crop output. Additionally, factors such as farm size, gender, family size, farming experience, educational level, extension contacts, farm fencing, use of guards, kraal proximity, grazing route location, and farm distance were found to significantly influence the likelihood of herdsmen incursions into farmlands.

The study highlights that cattle invasions of farmlands not only result in significant crop losses but also lead to economic hardship and loss of lives. To address these challenges, a comprehensive, multi-stakeholder approach is essential. The Federal Government, in collaboration with state and local authorities, community leaders, farmers, and herdsmen, should promote the adoption of modern ranching practices as an alternative to traditional herdsmen migration, thereby reducing conflict risks. Furthermore, establishing effective conflict resolution and mediation mechanisms is critical for addressing disputes promptly and amicably.

Specific recommendations include encouraging farmers to adopt preventive measures, such as farm fencing and the use of guards, to mitigate damages caused by stray cattle. Awareness campaigns and sensitization programmes should be conducted to foster mutual understanding, tolerance, and peaceful coexistence between farmers and herdsmen, addressing cultural differences and building trust. Farmers should also be guided to locate their farms at safe distances from kraal settlements and grazing routes.

Sustainable land-use planning, including the establishment of designated grazing reserves and routes for herdsmen, is vital to minimizing conflicts arising from farmland encroachment. The government should ensure easy access to financial support for affected farmers, including compensation for losses, to help them recover their farm capital. Encouraging the formation of farmer cooperatives could enhance access to funding, improve information sharing, and foster collaborative conflict management strategies.

Lastly, public enlightenment campaigns, seminars, and symposia should be organized to raise awareness among farmers and herdsmen about the negative effects of conflicts on agricultural productivity and rural development. By implementing these measures, it is possible to mitigate the adverse effects of herdsmen-farmer conflicts and ensure sustainable agricultural development and peaceful coexistence in the region.

Further Studies

The further research should involve a longitudinal study to evaluate the sustainability and long-term economic, social, and environmental outcomes of conflict mitigation strategies such as community policing, legal reforms, and the establishment of designated grazing areas. Again, future research could extend this study's findings by conducting comparative analyses of herdsmen-farmer conflicts in different geopolitical zones within Nigeria. This

would help in understanding regional variances in conflict causes and effects, potentially leading to more tailored conflict resolution strategies.

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