# The impacts of equal access to land and farmer-herder conflicts on household food insecurity and production decisions in Nigeria

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A thesis

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by

Amaka Precious Nnaji

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# Declaration

This work was completed under the supervision of Assoc. Prof. Nazmun N. Ratna, Professor Alan Renwick and Assoc. Prof. Wanglin Ma at Lincoln University, New Zealand. Four analytical chapters of this work have been published in Agricultural Resource and Economics Review, International Journal of Social Economics and European Review of Agricultural Economics. To the best of my knowledge, the thesis is original and contains no materials previously written or published by any other persons except as acknowledged in the text.

Amaka Precious Nnaji

Abstract of a thesis submitted in partial fulfilment of the
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by

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Food insecurity remains a key challenge in most developing countries, especially in Sub-Saharan Africa. Among others, the threats to food security include unequal access to productive resources like land and increasing resource-use conflicts over scarce land resources. Several studies attempted to understand how access to productive resources affects the food security of rural households and what this implies for female-headed households. Studies have highlighted the main causes of the increasing farmer-herder conflicts over land resources. However, few empirical studies have sought to understand the mediating effect of access to land on the influence of gender on food insecurity. There is also a lack of knowledge regarding the immediate and long-term influence of farmer-herder conflicts on the livelihoods and food security of rural households. This thesis, therefore, contributes to these strands of literature by investigating (1) the impact of gendered access to land on food insecurity; (2) the direct and indirect implications of farmer-herder conflicts on rural households' production decisions and food security; and (3) the factors that influence the risk perception of farmer-herder conflicts.

This thesis includes seven chapters. Chapter 1 provides a general introduction. Chapter 2 presents an overview of the data and empirical strategies adopted to address the research questions. Chapter 3 examines the mediating effect of land access on the effect of gender of the household head on household food insecurity using a logistic regression model and secondary data from the Nigeria General Household Survey. Chapter 4 determines the influence of the incidence and severity of farmer-herder conflicts on the food insecurity of rural households' using primary data from 401 rural households in Nigeria and employs a two-staged predictor substitution instrumental variable analysis. Chapter 5 investigates the effect of the risk perception of farmer-herder conflicts on rural households' production decisions using simultaneous equation regression analysis. Chapter 6 explores the factors influencing the risk perception of farmer-herder conflicts using ordinary least squares and seemingly

unrelated regression analysis. Finally, the last chapter provides a general conclusion and discusses policy implications.

The empirical results show that even though female-headed households are more food insecure than male-headed households, with extra access to one acre of farmland, they are 16% less likely to be food insecure compared to male-headed households. Results also reveal that both the incidence and severity of farmer-herder conflicts increase the food insecurity status of rural households; although, the severity of farmer-herder conflict has a larger impact than its incidence. Regarding rural households' risk perception of farmer-herder conflicts and household production decisions, results indicate that the risk perception of farmer-herder conflicts exerts negative effects on the likelihood of adopting fertilisers, investment in fertilisers, and the degree of participation in the land rental market. In addition, rural households' risk perception of farmer-herder conflicts exerts a positive and statistically significant impact on their time allocation for farm work. The results also indicate that farming experience of household head, farm size, crop and livestock diversity, migration status, number of languages spoken, ownership of formal title to farmland, settlement density, and household location are primary factors influencing the risk perception of farmer-herder conflicts.

The findings of this thesis call for the development of policies that tackle unequal gendered access to land. Initiatives that facilitate procurement and enforcement of formal land titles to improve tenure security can reduce the perceived risk of farmer-herder conflicts. Finally, all results highlight the importance of dealing with the root cause of farmer-herder conflicts by facilitating policies that promote more sustainable herding practices to curb the likelihood of these types of conflicts.

**Keywords:** Land access; gender; farmer-herder conflict; food security; production decisions; households; Nigeria.

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# Table of Contents

# List of Tables

# List of Figures

# Chapter 1

# General Introduction

## 1.1 Motivation and Problem Setting

In developing countries, where the majority of the population is primarily involved in agricultural production, land is a vital economic resource. Since most rural dwellers are largely engaged in agricultural activities, access to land is important for their livelihoods and subsequent well-being. While studies have shown that improved access to land increases the food security prospects for agrarian households (Jayne et al., 2003; Muraoka, Jin, & Jayne, 2018; Rammohan & Pritchard, 2014), there is evidence that households headed by women have less access to land than men (Adekola et al., 2013; Ankrah, Freeman, & Afful, 2020; Lambrecht, 2016; Moyo, 2017; Pindiriri, 2021; Tripta & Mehta, 2009; Twum et al., 2020; Wineman & Liverpool-Tasie, 2017). In addition, existing studies show that male-headed households are more food secure than female-headed households (Akadiri, Nwaka, & Jenkins, 2018; Choithani, 2020; Gebre et al., 2021; Joshi & Joshi, 2017; Kassie, Ndiritu, & Stage, 2014; Larson, Castellanos, & Jensen, 2019; Ma et al., 2021; Shin, 2020; Tibesigwa & Visser, 2016).

Also, increased timely access to arable land by female-headed households has been found to improve their poverty status, especially if it targets landless households and those with less than three acres of land (Pindiriri, 2021). However, a gap still exists in the literature in understanding how and to what extent increased access to land resources influences the food security status of female-headed households. There is a lack of empirical evidence illustrating the mediating effect of land access on the impact of gender on household food security.

Gendered access to land, however, is no longer the immediate problem for developing countries prone to conflict, especially those involving farmer-herder (FH) conflicts. The problem becomes greater than a gender issue. Although FH conflicts have always existed, studies show that the cause of the recent

increase in FH conflicts is the recurrent drought[1] and consequent increased competition for land resources by herders and crop farmers. Extant literature also shows that there are other causes of FH conflicts, including the blockage of cattle grazing routes by crop farmers, destruction of crops by cattle, scarcity, and competing use of freshwater (Audu, 2013; Dary, James, & Mohammed, 2017; Umar, 2002; Usman, Bakari, & Abdullahi, 2017). All these have detrimental consequences for the livelihoods of both parties, for example through the loss of yield and income by both farmers and herders (Usman et al., 2017). There is a dearth of empirical studies investigating the impact of the occurrence and severity of FH conflicts on rural households' food security. Hence, there is a need to empirically determine the influence of FH conflicts on the food security of rural households.

In addition, the literature shows that farm households react to uncertainty in a conflict situation even without having physically experienced conflict (Arias, Ibáñez, & Zambrano, 2019). Likewise, Rockmore (2020) found that the risk of conflict affects crop and livestock portfolios negatively. However, a gap exists in the knowledge of how farming households react to the threats of FH conflicts. The impact of the risk perception of FH conflicts will become one of the biggest issues in countries with higher climate vulnerability. Therefore, there is a need to empirically investigate the impact of the risk perception of FH conflicts on rural households' production decisions and behaviour.

Furthermore, determining the socioeconomic and demographic factors that influence how the risk of FH conflicts is perceived becomes essential to aid understanding of the behavioural process of farmers in a conflict. In addition, an awareness of what attributes impact farmers' perception of the threat of FH conflicts will aid policymakers and other stakeholders in the agricultural sector in facilitating strategies that will be effective in promoting agricultural production and improving the welfare of rural dwellers.

This thesis contributes to the gendered land access and FH conflict literature by filling these research gaps indicated above. Using both secondary data from the 2015/2016 Nigerian general household

[1] Moderate to severe historical droughts occurred in Nigeria between 1914, 1924, 1935, 1943, 1951-1954, 1972-1973 and 1991-1995 (Federal Ministry of Environment, 2018)

survey and primary data from rural households in Nigeria's North Central and South-East geopolitical zones. Nigeria is selected in this thesis as the study area for several reasons. First, it is the most populous country in Africa, with an annual population growth rate of about 2.6%, and the bulk of its population is primarily involved in agricultural activities (NBS, 2021a). Second, there has been a recent increase in the occurrence and frequency of FH conflicts in Nigeria (Madu & Nwankwo, 2020). The detrimental effects of these conflicts have been exacerbated by the rapid population increase, rising temperatures, and the resultant increase in drought and desertification in the Sahelian region (Day & Caus, 2020b). These make the choice of Nigeria appropriate for examining the dynamics of FH conflicts, land access, and how these influence rural households' food security and livelihoods.

## 1.2 Background

Food insecurity persists despite numerous efforts to curtail it. According to the Food and Agricultural Organisation (FAO), just under nine per cent of the world's population are undernourished, while 26 per cent lack regular access to sufficient nourishing food in 2019 (FAO et al., 2020). The agricultural sector plays a vital role in improving food availability and subsequent food security, especially in developing countries. Prior evidence has shown that adoption of improved farm technologies, extension services, and improving value-added food systems help increase the productivity of smallholder farmers, contributing to food security at both national and global levels (Brander, Bernauer, & Huss, 2021; Gebru, Brhane, & Gebremedhin, 2021; Huss et al., 2021; Otsuka, 2013; Pawlak & Kołodziejczak, 2020).

The share of agriculture in the global gross domestic product (GDP) has been stable at about four per cent since 2000 (FAO, 2020). In Africa, the share of agriculture in GDP increased one and a half per cent over the 2000-2018 period. For most developing countries, especially in the sub-Saharan Africa (SSA) region, the share of the agricultural sector in total GDP is increasing (FAO, 2020). In Nigeria, for example, it increased from 17.2 per cent in 2000 to 22.4 per cent by 2018 and now employs about 19.5 million people (FAO, 2020). Although the share of employment in agriculture has declined globally,

agriculture remains the second-highest employer of labour after the services sector (FAO, 2020). Africa has the highest share of employment in agriculture (around 49 per cent of the total population), implying that for most countries in Africa, agricultural production is the mainstay of their economy. Therefore, advancement in agriculture can establish the foundation for the progress and growth of developing countries, especially in SSA. Improved agricultural production will offer stable and improved access to safe and nutritious food leading to increased food security (FAO et al., 2020; OECD/FAO, 2016; Otsuka, 2013).

Despite the significant role of agriculture in ensuring economic growth and food security in developing countries, several factors are challenging the sustainability of agricultural sectors. These include climate change and the resulting adverse weather events, freshwater scarcity, limited access to arable land, soil fertility deterioration, limited market access, and the subsequent post-harvest losses (Jellason, Robinson, Chapman, et al., 2021; Jellason, Robinson, & Ogbaga, 2021; Shuaibu & Nchake, 2021). In SSA, perhaps the greatest challenge of the agricultural sector is poor infrastructure including irrigation systems, transportation networks, access to power, as well as storage facilities (Jellason, Robinson, & Ogbaga, 2021; OECD/FAO, 2016). These challenges have contributed to the dwindling productivity of the agricultural sector.

In SSA, one of the major obstacles to enhanced agricultural production is insufficient access to arable land (OECD/FAO, 2016). For instance, even though most of the land in rural SSA is under-utilised, the majority of its rural population are smallholder farmers in densely populated areas facing land shortages (Chamberlin, Jayne, & Headey, 2014; Jayne, Chamberlin, & Headey, 2014). Because a shortage of land negatively affects food security and rural household welfare, finding ways to increase access to land for smallholder farmers is a crucial developmental concern (Jayne et al., 2014).

Subsumed in the challenge of limited land access in developing countries, is the issue of inadequate access to land resources for women. Historically, women have been disadvantaged in terms of access to productive resources like land, in most cases having use rights rather than ownership (Agarwal, 1994, 2003; Dokken, 2015; Odeny, 2013). Even when women have access to land, they may have

insecure tenure and consequently cannot use the land as collateral to access credit to improve agricultural investment and productivity (Dokken, 2015; Doss, Summerfield, & Tsikata, 2014; Khalid, Nyborg, & Khattak, 2015). This is a noteworthy problem considering women contribute significantly towards global food availability by their direct participation in agricultural production (Doss et al., 2018; Fonjong & Gyapong, 2021). Studies have shown that increased availability of land resources can increase household welfare and make the difference between a food secure and food-insecure household (Goli, Rammohan, & Reddy, 2021; Muraoka et al., 2018; Rammohan & Pritchard, 2014). Thus, since women contribute significantly to their households' welfare and food security (Agarwal, 2003), the unequal access to land resources for agrarian households headed by women may inadvertently lead to a decline in the welfare of such households. Empirical evidence of this impact is key to informing policies that encourage more equitable access to arable land.

However, in a conflict situation, the problem becomes much worse. Conflicts may occur because of terrorism (e.g., Boko Haram insurgency in Nigeria or Al-Shabab insurgence in Somalia) or the resource-use conflict between herders and farmers. In this study, the focus is on conflicts resulting from resource-use problems between farmers and herders. Historically, there have been ongoing conflicts between herders and crop farmers over scarce land resources (Mbih, 2020). However, in recent times, these resource-use clashes have been on the increase due to rising temperatures, and erratic rainfall initiating recurrent droughts and floods in the Sahel (Ahmed & Kuusaana, 2021; Benjaminsen et al., 2012; Day & Caus, 2020a). In most SSA countries, this had led to conflicts between farming communities and pastoralists because of unresolved cases of encroachment into grazing routes by farmers or crop damage by herders (Benjaminsen & Ba, 2019; Jones-Casey & Knox, 2011; Shettima & Tar, 2008).

In Nigeria, farmer-herder (FH) conflicts have been increasing in both number and severity and now cause more fatalities than conflicts from armed groups like the "Boko Haram" insurgents (ICG, 2018). Between 2016 and 2018 alone, FH conflicts led to the death of around 1,500 people and the displacement of about 300,000 (ICG, 2018). Being the most populous country in Africa, FH conflicts in

Nigeria are more prevalent because of the large populace and the resulting intensification of agricultural production to meet the rising food demand. Women and girls are also more vulnerable during FH conflicts. In patriarchal societies like Nigeria, the loss of male breadwinners during FH conflicts frequently leave women vulnerable and unable to support themselves and their families. Women suffer the most in conflict-prone areas with unequal access to productive resources and economic opportunities (Day & Caus, 2020a; Pindiriri, 2021). Understanding how these conflicts influence rural livelihoods and food security is therefore essential to help guide and inform policy aimed at tackling the problem.

### 1.2.1 Economic Conditions in Nigeria

With a population of about 206.1 million people and a gross domestic product (GDP) of US$440.9 billion, Nigeria is a lower-middle-income country (World Bank, 2021). According to the World Bank, Nigeria is ranked the 27$^{th}$ largest economy in the world and 24$^{th}$ with respect to purchasing power parity. Nigeria has the largest economy in Africa, with a debt-to-GDP ratio of 18.82 per cent as of 2020 and a Gini inequality index of 35.1 in 2018 (World Bank, 2021). In 2020, Nigeria had a GDP per capita of US$2139.1 with an annual decrease of 0.7 per cent, 0.4 per cent, and 4.2 per cent from 2017, 2018 and 2019, respectively. The real GDP growth in Nigeria increased 1.9 per cent in 2018 and 2.2 per cent in 2019, but reduced by three per cent in 2020 (AfDB, 2021; Nam, 2020). The statistics above show that even though the Nigerian economy is growing, as shown by the increasing GDP, there is a sustained decline in per capita income which is reflected in the increased poverty rate and high Gini index. Currently, Nigeria's economy is in a recession due to the COVID-19 economic lockdown measures, as well as the decline in crude oil prices (World Bank, 2021).

Formerly a large exporter of agricultural produce, Nigeria currently imports some of its food products to meet domestic demand. Its agricultural sector has not grown to keep pace with its rapid population growth (NBS, 2021a; World Bank, 2021). Other reasons for the declining levels of national food sufficiency are smallholder agricultural cultivation, market constraints, overreliance on rain-fed agriculture, poor access to productive inputs like fertilisers, and a poor agricultural extension system.

### 1.2.2 Overview of the Agricultural Sector in Nigeria

Agriculture is the major source of livelihood for most Nigerians, with the agricultural sector employing greater than 35 per cent of the labour force, according to the international labour organisation (ILO, 2019). The agricultural sector is dominated by smallholder farmers, accounting for about 90 per cent of agricultural produce. The agricultural sector contributed 23.78 per cent to Nigeria's aggregate real GDP in the second quarter of 2021, decreasing 0.87 per cent from the same quarter in 2020 (NBS, 2021b). For the past decade, the agricultural sector's share in Nigeria's total budget has been less than three per cent, which is substantially lower than 10 per cent, the specified amount in the Maputo Declaration on Agriculture and Food Security (Olowe, 2021).

The food crop subsector in Nigeria, which includes the production of cassava, rice, millet, tomatoes, cocoa, yams, groundnut, etc., remains the main driver of growth in the Nigeria agricultural sector, accounting for 89.13 per cent of the sector's real GDP share in the second quarter of 2020 (NBS, 2020b). On the other hand, the livestock production subsector accounted for about 7.38 per cent of the Nigerian agricultural sector's real GDP share in the second quarter of 2020 (NBS, 2020b).

Despite the importance of the agricultural sector, its contribution to national GDP has declined consistently from 37.5 per cent in 2002 (Urama & Yuni, 2018) to about 22 per cent in 2020 (NBS, 2020b). The Nigerian government introduced several policies and initiatives to boost agricultural productivity and enhance local trade and exports. These policies include the Agricultural Transformation Agenda (ATA) 2011-2015, the Agricultural Promotion Policy (APP) 2016-2020, and the agricultural sector food security and nutrition strategy 2016-2025 (Ecker & Kennedy, 2019). This set of policies aim to improve agricultural production to meet local food demand amidst the rapid population increase, and convert the sector from subsistence to commercial and export-oriented production (Ecker, Hatzenbuehler, & Mahrt, 2018; Ecker & Kennedy, 2019). Notwithstanding these interventions, the agricultural sector remains constrained. The low productivity of both cash and staple crops has contributed to the dwindling performance of agriculture and is due largely to an overreliance on rain-

fed agriculture, market constraints, poor access to credit, and low use of productive inputs such as fertilisers (OECD/FAO, 2016; Urama & Yuni, 2018).

Furthermore, the incidences of conflicts between nomadic herders and farming communities have also increased in recent years, exacerbating crop failure, death of livestock, loss of output and property. Despite the increased frequency of these conflicts with the resulting reported adverse consequences (ICG, 2018), nothing concrete has been done to resolve this problem sustainably. Therefore, these justify the need to empirically examine the consequences of the ongoing FH conflicts and ultimately stimulate policy action towards tackling the problem to ensure the safety of rural dwellers and protect their livelihoods.

### 1.2.3 Food Insecurity in Nigeria

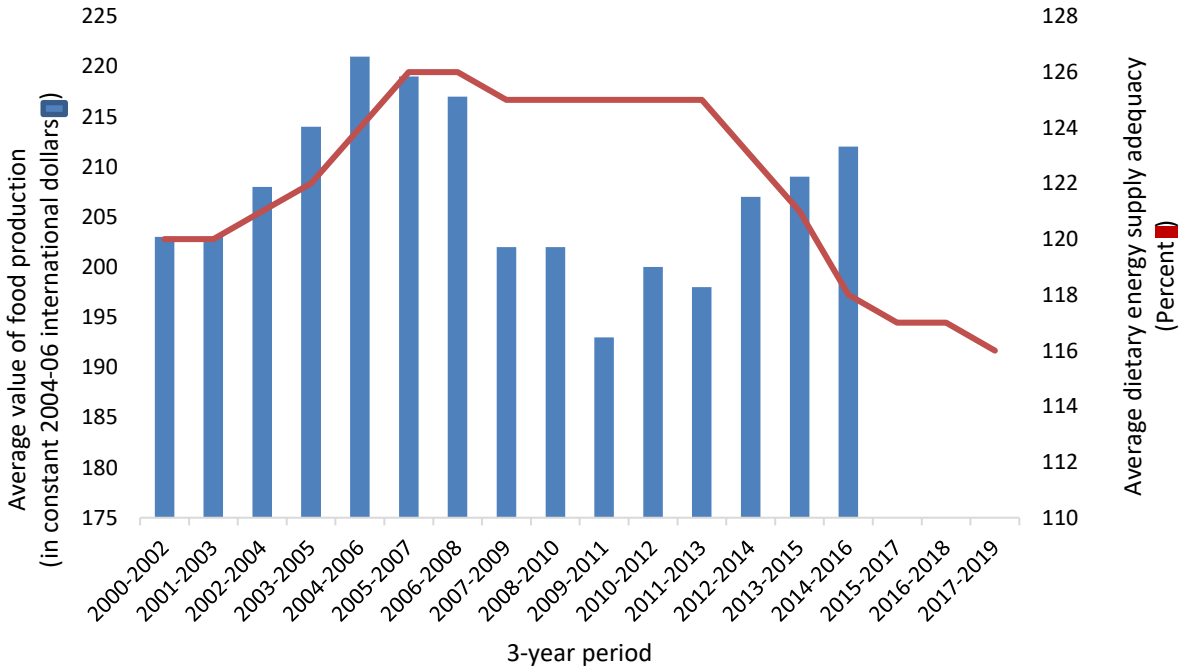
The second sustainable development goal (SDG2) is to achieve zero hunger, attain food and nutrition security, and promote sustainable agriculture. Food security exists when all people have adequate social, physical, and economic access to safe, sufficient, and nutritious food at all times to meet their dietary preferences and needs to facilitate a healthy and active life (FAO, 1996). This multidimensional definition is centred on four pillars, namely: food availability which captures food supply adequacy; food accessibility or affordability; food stability which depicts adequate food supply without seasonal shortages or fluctuations; and food utilization. Indicators for food and nutrition security include domestic production, the percentage of under-five children who are underweight and stunted, and domestic food price volatility.

In Nigeria, food security indicators reveal a food insecurity problem. Figure 1.1 illustrates the average food production and dietary energy supply for 3-year periods.[2] This figure illustrates that even though mean food production was increasing over the last couple of periods, the average dietary energy supply is on the decline. This is because of the rapid disproportionate increase in the national

[2] FAO's approach to estimating energy adequacy has been criticised as not giving enough information on dietary energy consumption of nutritionally vulnerable population within countries. Nonetheless, it is an important indicator of whether a country's food supply is sufficient to meet its aggregate population needs.

population that puts more pressure on food resources. The inability of local agricultural production to meet domestic food requirements in terms of quantity and quality is a consistent problem that has yet to be rectified. Several agricultural initiatives enacted to improve national self-sufficiency in food production by improving the food supply of smallholder farmers in Nigeria have failed (Iwuchukwu & Igbokwe, 2012; Obot et al., 2021).

According to the Food and Agricultural Organisation, in 2020, over 9 million people in Nigeria faced food insecurity due to the negative impacts of COVID-19, armed conflicts, and climate change (WFP & FAO, 2021). This figure is expected to increase to 12.8 million in 2021, with the majority situated in conflict-affected States if nothing is done to prevent it.




Source: FAO (2021)

**Figure 1.1 Average food production and dietary energy supply**

### 1.2.4 Farmer-Herder Conflicts in Nigeria

As was described in the background section, conflicts between nomadic herders and farming communities, hereafter called farmer-herder (FH) conflicts, are currently a significant cause of concern in Nigeria. Historically, FH conflicts have always occurred in Nigeria, especially over land resources and

damage to cropland, but recently, their frequency and intensity have increased (Hussein, Sumberg, & Seddon, 1999; Lenshie et al., 2020). This has mostly been attributed to increasing temperatures and recurring drought and desertification in the Sahelian regions of Nigeria, as a result of climate change and the resulting increase in the migration of nomadic herders southwards in search of pasture for their animals (Day & Caus, 2020a; ICG, 2017). This migration leads to disputes with crop farmers over the conflicting use of scarce land resources.

Ethnic and religious divisions have also been found to worsen these FH conflicts. In Nigeria, about 90% of nomadic herders comprise Fulani's and are predominantly Muslim (ICG, 2018). On the other hand, most farming communities of varying ethnicities are predominantly Christian. The rise in the tribal militia in both communities combined with the ineffective government response has increased violence between both parties. According to the International Crisis Group, the escalation of violence and insecurity due to FH conflicts led to the displacement of over 300,000 people from their homes and the death of about 1,500 in 2018 alone (ICG, 2018).

The Nigerian government responded to the surge in incidences of FH conflicts by proposing several initiatives like establishing Cattle colonies and creating Rural Grazing Areas (RUGA) (ICG, 2021). These policies were vehemently resisted by groups in the southern part of the country, stating the lack of multi-stakeholder consultation in their establishment. Also, the policies were perceived as a ruse by the government to enforce herding routes across agricultural land and a land-grab for herders (ICG, 2021). In response, some State governments instituted laws that outrightly prohibited open grazing leading to dramatic increases in FH conflicts within those states (Day & Caus, 2020b). The Cattle colonies and RUGA establishment policies were eventually suspended.

Finally, the National Livestock Transformation Plan was initiated to tackle this increased tension between nomadic herders and sedentary crop farmers in 2019 (Day & Caus, 2020b). It involved establishing new ranches and restoring grazing reserves to ease competition between herders and farmers over land and water resources (ICG, 2021). To be implemented in stages, the Livestock Reform Plan has met with several political and administrative challenges. Amid all these, rural households from

both sides who are dependent on these resources for their livelihoods are suffering the adverse effects of these FH conflicts.

## 1.3 Research Questions and Objectives

This thesis is therefore undertaken to examine the impacts of gendered land access on household food insecurity and to investigate the implications of FH conflicts on rural food security and livelihoods in Nigeria. Specifically, the thesis is aimed at answering the following questions:

1. What is the moderating effect of land access on the influence of gender of household head on household food insecurity status?
2. What are the direct and indirect impacts of FH conflicts on rural households' livelihoods and food security?
3. What factors influence how rural households perceive the risk of FH conflicts?

Using the above questions to guide the research, the research objectives are defined as follows:

1. Determine the joint effect of gender of household head and land access on household food insecurity;
2. Examine the differential impacts of the incidence and severity of FH conflicts on rural household food insecurity;
3. Investigate the impact of the risk perception of FH conflicts on rural household production decisions;
4. Evaluate the socioeconomic and demographic determinants of rural households' risk perception of FH conflicts.

Figure 1.2 outlines the analytical framework of this thesis.

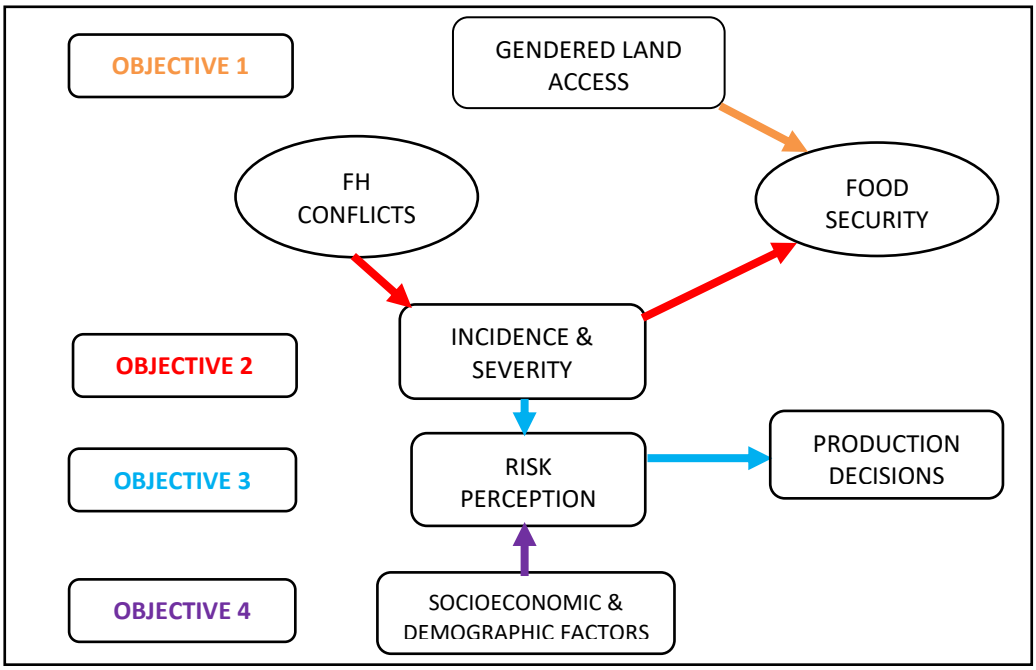



**Figure 1.2 Analytical framework**

This thesis adopts different empirical strategies to achieve the above objectives. An overview of the different empirical strategies is discussed in the next chapter. Secondary data is used to achieve objective 1. Output from objective 1 informs the primary data collection for objectives 2, 3, and 4. Figure 1.3 summarizes the methods used to examine each research objective empirically and outputs.

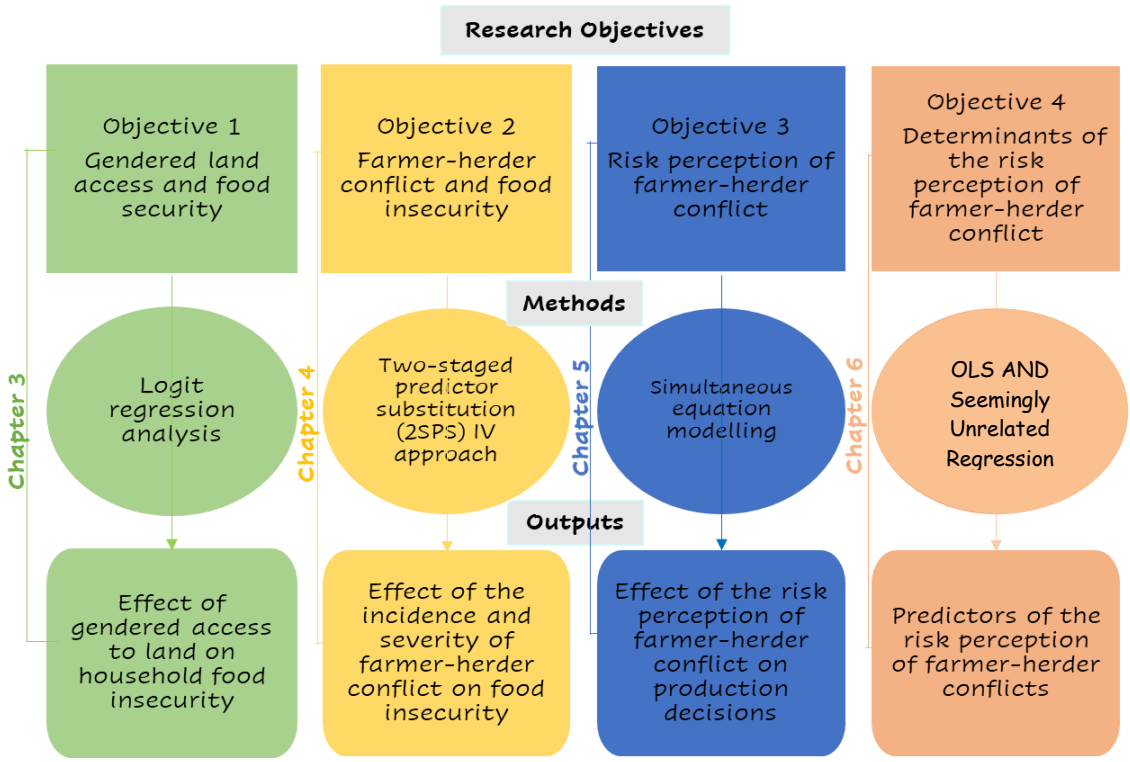



**Figure 1.3 Methods and outputs: A summary**

## 1.4 Significance of the Study

Since this study is the first to provide a comprehensive understanding of the impact of gendered access to land on food security as well as the empirical impact of FH conflicts on rural household welfare and livelihoods in Nigeria, the findings of this study could have significant implications for policymakers in their effort to improve rural livelihoods and sustainable agricultural production. In general, the findings of this thesis can assist policymakers in their efforts to design and implement laws, regulations, policies, and initiatives that promote efficient agricultural production, food security, and improved rural livelihoods.

More specifically, the moderating effect of access to land on the impact of gender on household food security has important implications for policymakers. Such information will inform policymakers of the need to enact need-based policies and initiatives to improve access to land resources for women. This, in the long run, may lead to a more inclusive distribution of land resources. Investigating the nexus between the incidence and severity of FH conflicts and food insecurity of rural households will improve understanding of the nutritional and welfare implications of these resource-use conflicts. Information about the extent of the impact of FH conflicts on rural food insecurity will inform policymakers of the need to facilitate policies that prevent the onset of these conflicts and initiatives that limit the adverse impacts of these conflicts. For instance, evidence of the higher negative impact of the severity of FH conflict will show the need for the provision of more immediate safety nets like food aid to alleviate the suffering of the affected households or the establishment of conflict resolution mechanisms to prevent or curb the likelihood of severe FH conflicts.

In addition, evidence of the impacts of rural households' perceived risk of FH conflicts on their production decisions have vital implications for food systems in conflict-prone areas. Considering agricultural productivity is a function of the production decisions made (Bello, Baiyegunhi, & Danso-Abbeam, 2021; Zhang, Mishra, & Zhu, 2021), understanding how the risk perception of FH conflicts affects household production decisions will provide proof of the indirect effects of these conflicts on

rural households' productivity. This will further provide insights to policymakers and other stakeholders in their establishment of policies to promote agricultural productivity. Insight into socioeconomic factors that influence how rural households perceive the risk of FH conflicts is relevant for risk management policy decisions. Knowledge of the factors that influence rural households' risk perception of FH conflicts will inform policymakers of what matters most regarding the risk behaviour of rural dwellers concerning FH conflicts, as well as aid the designing of effective risk management projects and initiatives.

## 1.5 Structure of the Thesis

This thesis is organised into seven chapters and is structured in a thesis-by-publication format. Chapter 1 of the thesis presents the general introduction. Chapter 2 describes the empirical strategies adopted in this thesis, the methodological framework, secondary and primary data used in the study. Chapter 3 to Chapter 6 address the four research objectives presented as journal articles (Figure 1.3). Specifically, Chapter 3 examines the joint impact of gender of household head and land access on household food insecurity. Chapter 4 investigates the differential impact of the incidence and severity of FH conflicts on rural households' food insecurity. Chapter 5 evaluates the impact of the risk perception of FH conflicts on rural households' production decisions. An examination of the social, economic, and demographic factors that influence rural households' risk perception of FH conflicts is presented in Chapter 6. The final chapter, Chapter 7, summarises the results and suggests policy implications based on the findings of the thesis.

# Chapter 2

# Data and Methods

This chapter presents an overview of the data and methods used in this thesis. This chapter is structured as follows. First, the secondary data used for Chapter three are introduced. Second, the primary data used for empirical analyses in Chapters four, five, and six are discussed. It covers information such as an introduction of the study areas, sampling procedure, and approaches to addressing human ethics concerns. Finally, the chapter concludes with a summary of econometric methods used in each of the analytical chapters.

## 2.1 Secondary Data

In this thesis, secondary data were mainly used for empirical analysis in Chapter 3. In Section 2.1.1, I introduce the secondary data. Then, in Section 2.1.2, I summarise the procedures of secondary data cleaning.

### 2.1.1 Introduction to the Secondary Data

The secondary data used in Chapter 3 were derived from the third wave of the Nigerian general household survey (GHS) panel, conducted by the Nigerian Bureau of Statistics (NBS) and collected in 2015/2016. The survey collected data from about 5,000 households from the larger cross-sectional GHS consisting of 22,000 households. It was designed to be representative at the national and zonal levels (NBS, 2016a). The purpose of collecting the Nigerian GHS panel data is to develop an innovative model for collecting agricultural data, inter-institutional collaboration, and comprehensive analysis of welfare indicators and socio-economic characteristics. The NBS used a two-stage probability sampling design in selecting households to be included in the survey. In the first step, 500 Enumeration Areas (EAs) were selected using the probability proportional to size (PPS) of the total EAs in each state and Abuja, the federal capital territory, and the total households registered in the EAs.[3] In the second step,

[3] The Enumeration Areas are the primary sampling units or clusters of the GHS-Panel survey.

a systematic random selection of 10 households per EA was made, making a total of 5,000 households.[4] The survey collects rich information on personal and household-level characteristics, social-economic and demographic characteristics, agricultural production and marketing activities, household income, expenditure, and consumption activities (NBS, 2016a). Data collection was implemented in two household/community visits: the post-planting and the post-harvest visits. The GHS-Panel wave 3 administered three questionnaires: household, agriculture and community questionnaires. The household questionnaire captured household demographics, labour, food and non-food expenditure, food security and shocks, safety nets, assets, housing condition, and income-generating activities. The agricultural questionnaire captures information on farmland ownership, size, and use, input use, farm labour, irrigation, crop, and animal holdings. The community questionnaire solicits information on community organisations, infrastructure, resource management, and local retail price.

The rich information covered in the Nigerian GHS data has allowed scholars working in the fields of agricultural and development economics to explore various research questions (Adeosun & Owolabi, 2021; de Brauw & Herskowitz, 2021; Gibson & Alimi, 2020; Jaiyeola & Choga, 2021). For example, Adeosun and Owolabi (2021) analysed used the 2015–2016 wave of the Nigerian GHS to examine the determinants and outcomes of gender equality in Nigeria. They found that geographical area has a higher effect on earnings disparity and is pronounced among women, while higher levels of education contribute to increased wages for women. de Brauw and Herskowitz (2021) investigated evolving dietary patterns in Nigeria using the first three waves of the Nigerian GHS panel data. They provide evidence of no increase in the consumption of highly processed food over this period.

In Chapter three of the thesis, I only use the post-planting round of the GHS-panel wave three (2015-2016) for two key reasons. First, given the focus of the investigation is on food insecurity, it was important to focus on the post-planting period when availability of food is lower. Second, the key

[4] Households were not chosen using replacements, hence the number of successfully interviewed households was less than 5,000.

explanatory variables (e.g., educational level of the household head and the number of respondents) used in Chapter 2 at the time of analysis were only available in the third wave of the GHS data.

### 2.1.2 Secondary Data Cleaning

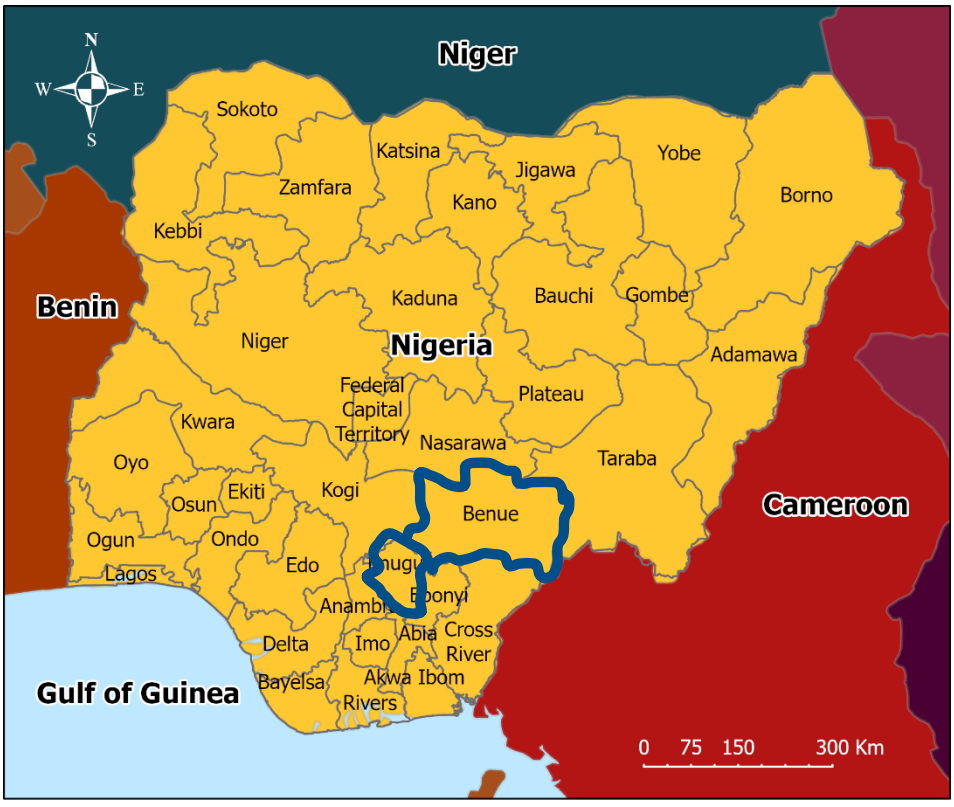
The data cleaning involved several steps. First, the analysis focused on data from the post-planting visits. This is to particularly capture household food insecurity in the lean months before harvest. Although Gibson and Alimi (2020) showed that low correlation between both rounds of the second (2010-2013) wave of the GHS dataset and argue that there may be a mismeasurement in the food and agriculture module of the survey, we stick to the post-planting round of the 2015-2016 GHS survey. This is because one of the key variables for this analysis, the food insecurity measure, is a self-assessment consumption index that captures if households in the sample had to reduce the size of meals eaten in their households at least once because of insufficient food in a 7-day recall period. The food insecurity measure captures household behaviour as a result of inadequate food availability and doesn't directly capture the annual household food and non-food consumption. Second, data files were merged based on key variables included in the analysis. For example, individual data files containing socioeconomic characteristics of household members were collapsed and merged with the sum of cultivated land for each household after generating other key control variables like household size, and amount of remittance received amongst others. This process effectively reduced the number of observations from about 22,000 individuals to about 2,869 households. Similarly, when selecting key variables to be included in the food insecurity model specification in Chapter 3, many observations were dropped because of missing values. For instance, after selecting for the educational level of household heads, the number of observations in the sample was reduced from 1,878 to 1,096 households. Finally, 1,096 households were used to address research question 1 in Chapter.

## 2.2 Primary Data

Primary data were collected from rural Nigeria to support the empirical analyses in Chapters 4, 5 and 6. Section 2.2.1 introduces the survey area. Section 2.2.2 discusses the primary data sampling procedure and section 2.2.3 presents the methods of addressing the human ethics concerns.

### 2.2.1 Study Area

The study area is Nigeria; it is the most populous country in Africa, with a population of above 206 million (NBS, 2021a). It is located on the coast of West Africa, between latitudes 4° to 14° North and longitudes 2° 2′ and 14° 30’ East, occupying about 927,768 square kilometres of land (Aregheore, 2009). It is bounded by Niger in the North, Benin in the West, Cameroon in the Southeast, and the Gulf of Guinea in the South. Administratively, Nigeria has six geopolitical zones which are made up of 36 states and one capital territory (see Figure 2.1).




Shapefile source: ESRI (2018) and HDX (2017)

**Figure 2.1 Map of Nigeria highlighting the Study Area**

The Nigerian labour force makes up more than 52% of the total population, of which about 29.5% of males and 19.6% of females are employed in agricultural activities (NBS, 2020a). The share of men and

women engaged in agricultural activities is higher in rural areas (41.5% and 28.1%) compared to urban areas (9.9% and 5.4%). Hence, men are more engaged in agricultural activities. According to the 2020 Nigeria Living Standards Survey, an average household in Nigeria has 5.06 members and a dependency ratio of about 0.97 (NBS, 2020a). On average, 18.8% of households are female-headed, and this share is lower in rural areas (17.1%) and higher in urban areas (21.4%) (NBS, 2020a).

The primary data were collected from the North Central and South-East geopolitical zones in Nigeria. The Northcentral geopolitical zone comprises of six States and the federal capital territory (FCT). It is also referred to as the "Middle Belt" because it longitudinally stretches across central Nigeria, creating a transition zone between northern and southern Nigeria. The North Central zone is an agrarian region with more than half of its population involved in agricultural activities and where most of the food consumed in the country is grown (Aregheore, 2009). Women spend more time doing agricultural activities than men on average (NBS, 2019) and agricultural activities here include farming, livestock rearing and fishing. The predominant crops grown in this region include cassava, yam, maize, cowpea and sorghum. The North Central zone consists of a multitude of ethnic groups and has been the site of countless conflicts ranging from ethno-religious clashes to farmer-pastoralist conflicts (Akov, 2017; Higazi, 2011).

Conversely, the South East geopolitical region is made up of five States and is located towards the south of the Benue valley and east of the lower Niger (Okali, Okpara, & Olawoye, 2001). Some of the main agricultural products in this region are cassava, rice, cocoyam, oil palm, rubber etc (Ndaeyo, Umoh, & Ekpe, 2001). Apart from agriculture, the South East zone is known for its commercial and trading activities comprising of mainly small and medium sized businesses. The population in this region consist of mainly of people of the Igbo ethnic group (Okali et al., 2001). The sampling of both zones was done purposively as a result of preliminary results from the secondary data described in section 2.1 above. Specifically, the North Central region was found to be the most food-secure while the South East was food insecure. Benue and Enugu States were purposively selected as a result of the

occurrences of FH conflicts in those state. This was done to increase the likelihood of capturing conflict incidences. FH conflicts in these states have increased in recent times (Madu & Nwankwo, 2020).

### 2.2.2 Sampling Procedure of Primary Data

The primary data were collected in North Central and South-East geopolitical zones between May and June 2019. A multistage sampling procedure was adopted in selecting households for the survey. In the first stage, the North Central and South-East geopolitical zones were purposively selected based on previous occurrences of FH conflicts and food security status.[5] Second, two states in each geopolitical zone and five local government areas (LGAs) were selected purposively based on a previous occurrence of FH conflicts. In the third stage, two towns in each LGA and two villages in each town were randomly sampled. Table 2.1 presents the list of the randomly sampled towns and villages in the survey and the number of households also randomly selected in each village. Finally, about ten households in each village were randomly selected, and the household head was interviewed, contributing to a total of 401 farm households, 24% of which are female-headed. Although a stratified random sampling in the third and fourth stages would have been ideal to account for population bias and ensure an equal probability of all households in the study area being selected, it was not possible in this case. This is because of a lack of reliable data on the exact population size of the selected towns and villages, leading to an inability to confidently classify every household into subgroups. If there are significant differences within groups (like the gender of the household head, ethnicity, and religion), this might introduce sampling bias, leading to an inaccurate representation of the population under study. To correct this potential problem, we include a rich set of variables in our analysis. For example, location variables are included in the model to control for unobserved region-specific characteristics such as institutional arrangements, social-economic conditions, cultures, ethnicity, religion, and climate conditions. Structured questionnaires were used for primary data collection. A pilot study was carried out to test the efficiency and reliability of the questionnaire. Also, feedback on the questionnaire was sought and gotten from research analysts at the International Food Policy Research

[5] Based on preliminary analysis of data from the 2015/16 Nigerian general household survey, the North Central zone was food secure while the South East zone was food insecure.

Institute (IFPRI), Nigeria Office. The survey collected information on household and household head characteristics (e.g. age, gender, education, off-farm work participation. household size, income, and consumption), farm-level characteristics (e.g., farm size and soil types), FH conflicts, and production decisions for the previous planting season (see Appendix for the survey questionnaire). Sampling bias from nonresponse from respondents was mitigated through follow-up field visits by enumerators to track non-responders and reduce the likelihood of attrition in the sample.

**Table 2.1 List of Towns and Villages in the Survey**

| Zone (State) | LGAs | Towns | Villages | Households |
|---|---|---|---|---|
| North Central (Benue State) | Agatu | Ogbaulu District | Ogbaulu | 10 |
| | | | Olegabulu | 10 |
| | | Odugbeho District | Odugbeho | 10 |
| | | | Odejo | 10 |
| | Buruku | Shorov District | Tyowanye | 10 |
| | | | Garagboghol | 10 |
| | | Adi-Etulo | Ugye | 10 |
| | | | Agia | 10 |
| | Guma | Mbaduem District | Tse-Akenyi | 10 |
| | | | Torkula | 10 |
| | | Udei District | Ingbian | 10 |
| | | | Yelewatta | 10 |
| | Gwer West | Raav District | Udam | 10 |
| | | | Akume | 10 |
| | | Mbakpa District | Borkem | 10 |
| | | | Tse-Tor | 10 |
| | Makurdi | Mbalagh District | Adigbe | 10 |
| | | | Anter | 10 |
| | | Kyundo-Usha District | Bam-Bam | 10 |
| | | | Ijaha | 10 |
| South East (Enugu State) | Uzo-uwani | Nimbo | Ekwuru | 10 |
| | | | Ugwuachara | 10 |
| | | Ojor | Umuitodo | 10 |
| | | | Umuasaba | 10 |
| | Enugu East | Nike District | Edem Nike | 10 |
| | | | Ibagwa Nike | 10 |
| | | Ugwuogo District | Umunagbo | 10 |
| | | | Utazi | 10 |
| | Udi | Eke | Ogui Agu Eke | 10 |
| | | | Amankwo Eke | 10 |
| | | Ebe | Umuavulu | 10 |
| | | | Amagu | 11 |
| | Nkanu West | Ozalla | Enugwueagu | 10 |
| | | | Obeagwu | 10 |
| | | Akegbe Ugwu | Amagu | 10 |
| | | | Omokwo | 10 |

| | | | | |
|---|---|---|---|---|
| | Ezeagu | Akama Oghe | Imama | 10 |
| | | | Isiokwe | 10 |
| | | Awha Imezi | Ikenga Awha Imezi | 10 |
| | | | Ogwofia Agha Imezi | 10 |
| Total | | 20 | 40 | 401 |

Note: An extra household was interviewed in Amagu village of Enugu state making a total of 401 households in the sample.

The survey was implemented with the aid of trained enumerators. These enumerators were selected based on their multiple survey experiences with IFPRI, Nigeria, and more importantly, their ability to speak the local languages, which helped facilitate effective data collection. They were trained on the correct ethical behaviour on how to collect data safely and efficiently. Before entry into each community, a visit to the chief or custodian of the community was undertaken to inform them of our purpose and presence in their community. The enumerators were supervised and accompanied throughout the data collection process to ensure the survey was implemented efficiently. Figures 2.2, 2.3, and 2.4 provide pictures of respondent interviews conducted in Nkanu West, Buruku, and Agatu LGAs.

**Figure 2.2 Interview with a respondent in Nkanu West LGA in Enugu State, South East Region, Nigeria**

**Figure 2.3 Interview with a respondent in Bururku LGA, Benue State, North Central Region, Nigeria**

**Figure 2. 4 Interview with a respondent in Agatu LGA in Benue State, North Central region, Nigeria**

### 2.2.3 Approaches to Addressing Human Ethics Concerns

Personally identifiable socioeconomic information was obtained from rural households in our primary data collection. As such, a human ethics clearance application was made and obtained from the Lincoln University Human Ethics Committee. Before the start of the survey, respondents were informed of the purpose of the research and assured of the confidentiality of the information provided. Both verbal and written consents were sought from each selected respondent. They were also informed of their ability to withdraw from the survey at any time voluntarily. The contact details of the lead supervisor were made available to respondents to authenticate the purpose of the research further, or in case they wanted to withdraw from the survey. A copy of the human ethics approval letter obtained from the Lincoln University Human Ethics Committee is presented in Appendix B.

## 2.3 Methods

Several econometric approaches have been adopted based on their suitability for answering the

specific research questions addressed. The approaches used in each chapter are discussed in the subsections below.

### 2.3.1 Chapter Three: Logistic Regression Model

Chapter 3 addresses the first research question by examining the joint effect of gender of household head and land access on household food insecurity. In our analysis, the key outcome variable, food insecurity, is an indicator that takes the value of 1 if households reduced at least one meal eaten in the household in the last seven days and 0 otherwise. A linear probability model (LPM) can be used to estimate linear regression with a binary dependent variable (Betts & Fairlie, 2001; Gazoni & Brasileiro, 2021; Reiley, 2006). The LPM has a major setback that assumes the conditional probability function to be linear, and hence, does not restrict the expected value of the outcome variable to between 0 and 1. The binary logit regression model corrects for this inefficiency. Therefore, a logistic regression model is employed due to the dichotomous nature of the self-reported food insecurity variable. It is estimated with a maximum likelihood estimator to maximise the log-likelihood function under the assumed statistical model. The maximum likelihood estimators are consistent, asymptotically normal, and efficient if the assumption of holds. It estimates the probability of the household's being food insecure as a non-linear function of a vector of control variables. The binary logistic regression has been used in various studies where the dependent variable is binary (Abonazel & Ibrahim, 2018; Aliyu, Bashar, & Usman, 2021; Kharisma & Abe, 2020).

Furthermore, given research question one, the non-linear interaction effect of the gender-land interaction variable is analysed following Norton, Wang, and Ai (2004). Norton et al. (2004) and Ai and Norton (2003) show that the full interaction effect for non-linear models like the logit model is not equal to the coefficient or marginal effect of the interaction term. Consequently, the correct interaction effect of the gender-land interaction term is estimated by calculating the cross partial derivative of the expected value of food insecurity with regards to the gender of household head at different levels of covariates (Norton et al., 2004).

### 2.3.2 Chapter Four: Two Staged Prediction Substitution Models

In Chapter 4, the differential impact of the incidence and severity of FH conflict on rural households' food insecurity is investigated. Based on a constrained utility maximisation problem, the study defines a conceptual framework in the form of a food consumption demand model to describe how FH conflicts may affect rural households' food insecurity. Two hypotheses based on the conceptual model are then tested.

There is a well-established reverse causality bias between conflict and food insecurity in the literature (Martin-Shields & Stojetz, 2019). This implies that FH conflicts may not be random and are more likely to occur in communities with particular attributes. For example, agrarian communities may be more prone to FH conflicts because of herders' need to graze their animals. Similarly, how severe a FH conflict is may not be random as households with more arable land and assets may be more likely to be targeted by herders. The study accounts for the endogeneity bias introduced by employing a two-staged predictor substitution (2SPS) control function instrumental variable (IV) approach following Nie, Ma, and Sousa-Poza (2020) and Wan et al. (2015). The choice of a 2SPS approach instead of the two-stage least squares (2SLS) approach is because of the proportional nature of the severity of the FH conflict variable. This is to apply alternative methods of estimating the first and second stage models. In the case of the severity of FH conflict, the first stage equation would be a fractional regression model, and the second stage equation will be an ordinary least square model (OLS).

This IV approach estimates a two-stage model and addresses endogeneity issues of the FH conflict variables, which will render the ordinary least squares estimates inconsistent and biased. In the first stage, the FH conflict variables are regressed against a vector of control and instrumental variables.[6] After which, the conflict variables are predicted and included in the second stage food insecurity model. The predicted FH conflict variables control for endogeneity and improve the effectiveness of model estimations. Robustness checks were carried out using the conditional mixed process (CMP) models in accounting for possible sample selection bias. Also, using 2SPS models, three additional

[6] The instrumental variables passed the falsification test to check their validity and effectiveness.

analyses were performed using alternative FH conflict and food insecurity variables. This is done to further our understanding of the association between these two concepts.

### 2.3.3 Chapter Five: Simultaneous Equation Models

Chapter 5 addresses a part of the second research question by exploring the indirect effects of FH conflict on rural households' livelihoods. Specifically, the chapter investigates the influence of the risk perception of FH conflict on rural households' production decisions. Here, a theoretical model of resource use conflict is developed by extending the classic farm household model with the inclusion of a shock in the form of the risk perception of FH conflict. Three hypotheses were derived to assess the influence of the risk perception of FH conflicts on (i) fertiliser use and investment, (ii) area of cropland rented-in, and (iii) household time allocation for farm work. The risk perception of the FH conflict index was constructed by modifying the risk ranking method adopted by Smith, Barrett, and Box (2000) and Doss, McPeak, and Barrett (2008). The risk perception of FH conflict index constructed is also split into three groups to capture households exhibiting the different stages of risk behaviour (risk-loving, risk-neutral, and risk-averse). The influence of being in each risk group on their production decision was also determined.

Extant literature shows that farmers make production decisions concurrently (Höhler & Müller, 2021; Savikhin & Sheremeta, 2013). To account for this joint decision-making process, the hypotheses made were empirically tested using a system of simultaneous equations and implemented following the Conditional mixed process (CMP) framework (Chege, Andersson, & Qaim, 2015; Ntakirutimana et al., 2019; Roodman, 2011). Robustness checks were carried out using logit, Tobit and fractional regression models to account for various production decision variables. Furthermore, additional analyses using objective FH conflict variables were carried out to enhance understanding of the relationship between FH conflicts and production decisions of rural households.

### 2.3.4 Chapter Six: Ordinary Least Squares and Seeming Unrelated Regression Models

Chapter 6 addresses research question three by examining the social, economic, and demographic determinants of rural households' risk perception of FH conflicts using ordinary least squares regression analyses. This chapter used exploratory factor analysis to construct a holistic FH conflict risk perception index from nine risk items. To determine the joint effect of FH conflict occurrence and gender of household head on rural household's FH conflict risk perception, a gender-FH conflict interaction term is included as an explanatory variable. The study then checks the robustness of the main results by including controls for the household local government areas to capture location-based fixed effects for lower levels of geographic disaggregation.

Afterwards, the study probes the sources of perceived risk and differences in risk judgement in more detail by splitting the holistic FH conflict risk perception index into two sub-indices capturing FH conflict risk perception regarding food production and supply on the one hand and physical insecurity and wellbeing on the other hand. Considering that both sub-indices are most likely related to a particular household but, depending on inherent socioeconomic characteristics that may differ across multiple households, there is a possibility that the error terms of the sub-indices single equations are correlated. This may be because of household-specific unobservable factors associated with the FH conflict risk perception subindices. To account for the possibility of correlated error terms in the estimation, the study employs a seeming unrelated regression equation (SURE). Here, the regression coefficients are simultaneously estimated by using Aitken's generalised least squares to the system of equations to account for correlated error terms. It is more efficient than single-equation least squares estimators (Srivastava & Giles, 2020; Zellner, 1962). The SURE model differs from the simultaneous equation because all independent variables are assumed exogenous. Subsequently, the study tests the hypothesis of correlated residuals by implementing a Breusch-Pagan test of independence.

# Chapter 3

## Gendered Access to Land and Household Food Insecurity: Evidence from Nigeria

This chapter fulfils objective one and is based on the published journal article below:

Nnaji, A., Ratna, N., & Renwick, A. (2021). Gendered access to land and household food insecurity: Evidence from Nigeria. *Agricultural and Resource Economics Review*, 1-23. doi:10.1017/age.2021.13. (ABDC ranking: B)

**Chapter 3 – Statement of Authorship**

| | | |
|---|---|---|
| Title of Paper | Gendered access to land and household food insecurity: Evidence from Nigeria | |
| Publication status | ■ Published | ☐ Accepted for Publication |
| | ☐ Submitted for Publication | ☐ Unpublished and Unsubmitted work written in manuscript style |
| Publication Detail | Nnaji, A., Ratna, N., & Renwick, A. (2021). Gendered access to land and household food insecurity: Evidence from Nigeria. *Agricultural and Resource Economics Review*, 1-23. doi:10.1017/age.2021.13. | |

**Principal Author**

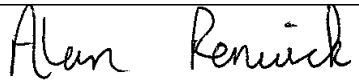
| | | | |
|---|---|---|---|
| Name of Principal Author (Candidate) | Amaka Precious Nnaji | | |
| Contribution to Paper | Conception and design of the study; data acquisition, analysis and interpretation; drafting of the manuscript; and reviewing the manuscript critically for significant intellectual content. | | |
| Overall percentage (%) | 65% | | |
| Certification: | This paper reports on original research conducted during the period of my Doctoral study and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper. | | |
| Signature |  | Date | 28/10/2022 |

**Co-Author Contribution**

By signing the Statement of Authorship, each author certifies that:

1. the candidate's stated contribution to the publication is accurate (as detailed above);
2. permission is granted for the candidate to include the publication in the thesis; and
3. the sum of all co-author contribution is equal to 100% less the candidate's stated contribution.

| | | | |
|---|---|---|---|
| Name of Co-Author | Assoc. Prof. Nazmun N. Ratna | | |
| Contribution to the Paper | Supervising the development of the study, contributing to drafting the manuscript and revising the manuscript critically for important intellectual content. | | |
| Signature |  | Date | 16/11/2022 |

| | | | |
|---|---|---|---|
| Name of Co-Author | Prof. Alan Renwick | | |
| Contribution to the Paper | Supervising the development of the study, contributing to drafting the manuscript and revising the manuscript critically for important intellectual content. | | |
| Signature |  | Date | 15/11/2022 |

**Abstract**

In this article, we examine the joint influence of land access and gender of household head on household food insecurity by employing a logit model and using data from the 2015/2016 Nigerian General Household Survey. Our results show that female-headed households (FHHs) are more food insecure than male-headed households. However, with a 1-acre increase in their access to land, FHHs are 16 per cent less likely to be food insecure. This finding provides policy insights into how improving access to arable land for land-poor FHHs can enhance food security in Nigeria.

Keywords: food security, gender, households, land access, Nigeria.

## 3.1 Introduction

Food insecurity remains a major concern in most developing countries. Although more food is produced than the world's population needs, close to half of it ends up as food waste (FAO, 2011a; Lundqvist, de Fraiture, & Molden, 2008), while millions of people are left without adequate food, especially in sub-Saharan Africa (FAO et al., 2017; Lundqvist et al., 2008). This is even worse for female-headed households (FHHs) in developing countries, who have unequal access to productive resources (Adekola et al., 2013; Twum et al., 2020). It is accepted that timely access to arable land is an important way to decrease hunger and poverty, especially in developing countries (Pindiriri, 2021; Tekwa, 2020). Target 5A of the fifth Sustainable Development Goal (SDG 5) identifies the need to undertake changes to provide women with equal rights and opportunities to financial services and productive resources, like land, in accordance with the current national laws. Several studies in developing countries find that women having more access to productive resources will have a positive effect on the well-being of their household members as well as their own health and education (Adereti, 2005; Doss, 1997; Duflo & Udry, 2004; Handa, 1996; Kennedy & Peters, 1992; Pindiriri, 2021; Rogers, 1996). Unfortunately, in most developing countries, women experience more barriers when accessing land than men (Brück & Schindler, 2009; Dokken, 2015; Khalid et al., 2015; Murugani et al., 2014; Wineman & Liverpool-Tasie, 2017). Often this obstacle is not just the area of the land itself they can access, but also it's quality and how productive they can make it (Gill, 1988; Quisumbing et al., 1998).

With the increasingly significant role of women in securing the nutritional status of their households (FAO, 2011b; Karl, 2009; Levin et al., 1999; Quisumbing et al., 1998), determining the influence of gender-specific access to land on food security is crucial. In addition, the impact of gendered access to land on the food security of households is necessary to aid in understanding the factors affecting agricultural production and the ways it can be improved. This study will also inform the facilitation of policies for ensuring food security and improving the livelihoods of rural dwellers.

A growing number of studies have identified the differences between the food security status of male- and female-headed households (Akadiri et al., 2018; Choithani, 2020; Joshi & Joshi, 2017; Ma et al.,

2021; Mallick & Rafi, 2010; Shin, 2020; Tibesigwa & Visser, 2016). Others have examined the differences in access to land by male- and female-headed households (Adelman & Peterman, 2014; Khalid et al., 2015; Lambrecht, 2016; Pindiriri, 2021; Tran et al., 2013; Wineman & Liverpool-Tasie, 2017), but the literature on how and to what extent gendered access to land affects food insecurity remains scant. Understanding the nexus among gender, land access, and food security is important for implementing agricultural policies in low income and lower middle-income countries.

The main objective of this study is to examine the joint effect of gender and access to land on households' food insecurity, which to the best of our knowledge, is the first study to address the research gap on gender-land access-food insecurity literature. In this paper, we use data from the 2015/16 Nigerian General Household Survey (GHS). A logistic regression model is used to analyse the data. In Nigeria, most studies on food security are confined to certain states and districts and not the entire country (Amaza et al., 2006; Arene & Anyaeji, 2010; Iruonagbe, 2011). Furthermore, most of the studies in Nigeria fail to empirically determine the association between gender, access to land, and food security (Adekola et al., 2013; Chikaire et al., 2016). Given the importance of land resources as well as the significant role women play in the well-being and nutritional status of their families, it is important to understand how, and to what extent, access to land can influence the effect of gender of household head on food insecurity.

The main finding of the study is that a one-acre increase in land accessed by female-headed households reduces their likelihood of being food insecure by 16% compared to male-headed households. This implies that female-headed households are so constrained in their access to arable land that additional access to land results in a greater impact on their food insecurity status in comparison to male-headed households. Existing literature has shown that women are disproportionately disadvantaged in terms of land access. This is as a consequence of structural inequalities, traditional and socio-cultural gender-roles that deny women the same economic opportunities as men. This is most probably the reason why increased access to land by female-headed households has a disproportionate ability to improve their food security compared to male-headed households. Findings of this study highlight the need for

polices in support of target 5A of SDG 5, which is to facilitate reforms to ensure women have equal rights to economic resources in addition to control over, and ownership of, land and other financial services.

This paper makes several contributions to the literature. First, we go further than the current literature by quantifying the joint impact of land access and gender of household head on the food insecurity status of households. Therefore, we test whether increasing access to land for female-headed households will influence their food insecurity status. Second, the study enhances understanding of the mediating effect of land access on the influence of gender of household head on food insecurity. Finally, the findings from this study will provide significant insights into agricultural policies that focus on enhancing food availability.

The remainder of this article is organised as follows: The next section presents a summary of the relevant literature on gendered land access and food security. After which, a conceptual model linking household and household head characteristics to food insecurity and an empirical model are presented. A detailed descriptive analysis of the data is then reported. The subsequent section reports the estimated results, followed by a discussion of the results, before the concluding remarks are presented.

## 3.2 Literature Review

### 3.2.1 Food Security and Access to land

Food security occurs when people have access to adequate, healthy, and nutritious food that meets their nutritional needs and preferences at all times (FAO, 2006; FAO et al., 2017; Sasson, 2012). Food insecurity is of great concern in both developed and developing countries, although it is worse in the latter (Sasson, 2012). In sub-Saharan Africa, insufficient food production as a result of the adverse effects of climate change is the major cause of food insecurity, although conflicts and soaring food prices are contributing factors (Day & Caus, 2020a; Xie et al., 2021).

Increases in access to land are found to have a positive influence on households' food security (Jayne et al., 2003; Muraoka et al., 2018; Rammohan & Pritchard, 2014), although income from owned land is found to be higher than that from rented land (Abdulai & Goetz, 2014; Abdulai, Owusu, & Goetz, 2011; Ali, Abdulai, & Goetz, 2012; Muraoka et al., 2018). Tenure security influences households' rights to use, manage, and control land and its resources (Holden & Ghebru, 2016). This has a clear and positive impact on land rights, agricultural productivity and hence, household food security (Deininger & Jin, 2006; Ghebru & Holden, 2013; Holden & Ghebru, 2016). If total food production is a key factor affecting the food security of developing countries (Sasson, 2012), then security of tenure and the resulting area of land accessed is key in determining the influence of land access on the food security of households in these countries. Disparities in access to productive resources like land can be the difference between a food secure and a food insecure household (Tekwa, 2020), while variation in the ability of the different genders to access land will have a further influence on their food security.

### 3.2.2 Gender and Food Security

Many previous studies have sought to determine the influence of the gender of household head on the household's food security status. Male-headed households (MHH) are found to be more food secure than female-headed households (FHH) in Nigeria, Ethiopia, Nepal, Kenya and South Africa (Akadiri et al., 2018; Joshi & Joshi, 2017; Kassie et al., 2014; Larson et al., 2019; Maharjan & Joshi, 2011; Shin, 2020; Tibesigwa & Visser, 2016). On the other hand, in a study by Mallick and Rafi (2010) in Bangladesh, no significant difference between the food security of male- and female-headed households is found. The authors suggest that the lack of evidence of a difference could be as a result of a lack of socio-cultural restrictions among indigenous ethnic groups, permitting women more freedom to participate in the labour market. In addition, they suggest that another reason is that female-headed households are given priority during food redistribution by informal institutions, for example, '*Khiang*' in indigenous communities. The authors also use a subjective measure for food security, i.e., perception of respondents about their households' food security, which can be a potential limitation given the evidence of gender-based differences in perceptions about food security (Lutomia et al., 2019).

Some of the main reasons given for variations in the food security status of female-headed households in comparison to their male counterparts are inadequate access to productive resources, over-reliance on household food production, lower assets, and off-farm income (Iruonagbe, 2011; Joshi & Joshi, 2017; Pindiriri, 2021; Tibesigwa & Visser, 2016). Kassie et al. (2014) also find that land quality and social capital have a positive influence on female-headed households' food security. Belonging to a farmers' group and being connected with more traders in their neighbourhood increases the likelihood of food security for female-headed households. These farmer groups may provide financial support, access to improved inputs and extension services, which, in turn, increases the productivity of female farmers.

## 3.3 Conceptual Framework

Figure 4.1 presents our conceptual framework on the gender-land access-food security nexus. It illustrates that social and demographic factors like age, education of household head, and social networks influence household food security (Akadiri et al., 2018; Brück & Schindler, 2009; Joshi & Joshi, 2017; Kassie et al., 2014; Rammohan & Pritchard, 2014). Material assets of the household (Joshi & Joshi, 2017), farm income (Akadiri et al., 2018; Joshi & Joshi, 2017), off-farm income (Tibesigwa & Visser, 2016), location of the household (Tibesigwa & Visser, 2016), as well as the infrastructure available to households, also influences food security.

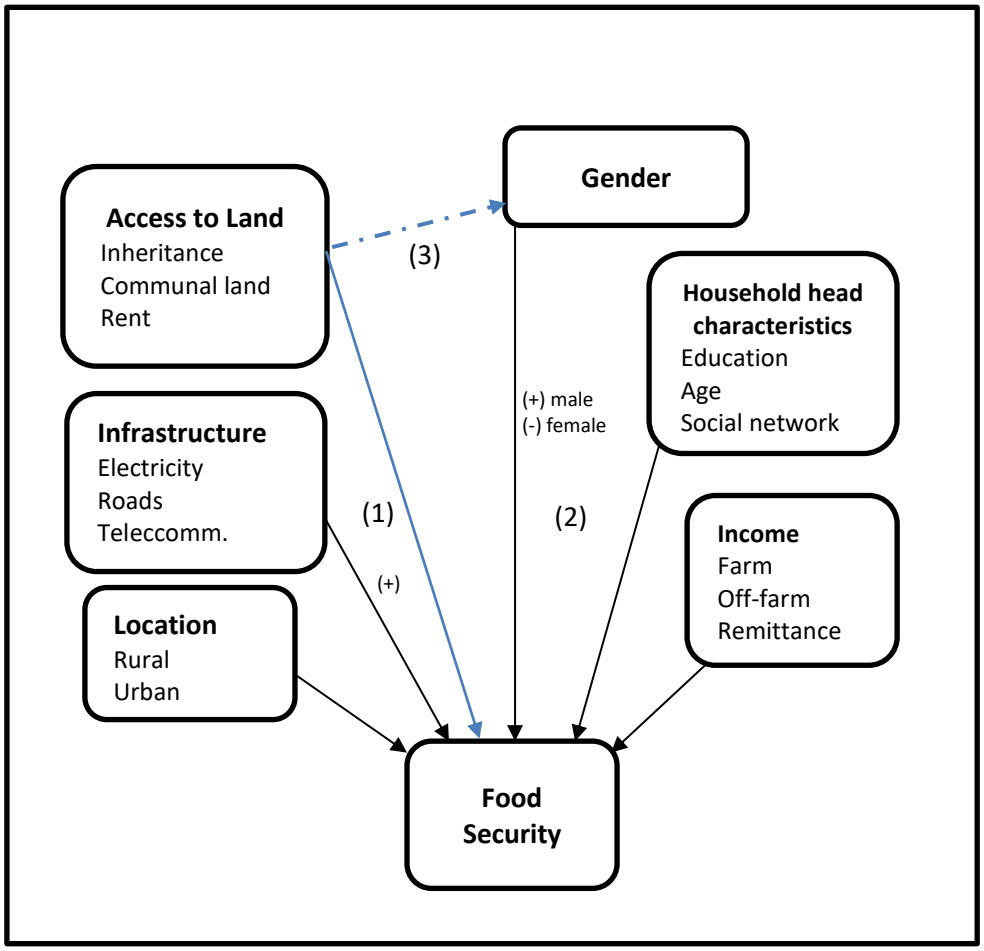



**Figure 3.1 Conceptual framework linking household and household head characteristics with food security**

The most important determinant for food availability is land access (Kassie et al., 2014; Muraoka et al., 2018), which is the focus of this paper and is depicted by arrow 1 in Figure 3.1. We identify three ways to access land: inheritance, communal land, and rent. Among the household characteristics, we consider gender one of the most important determinants of food security (arrow 2, Figure 3.1). In most low income and lower-middle income countries, female-headed households are usually disadvantaged in comparison to their male counterparts in the access and use of productive resources such as arable land (arrow 3, Figure 3.1) (Adekola et al., 2013; Agarwal, 2003; Brück & Schindler, 2009; Lambrecht, 2016). This is mainly because of cultural norms that impede women from gaining equal access to land. Some communities, especially patriarchal ones, do not allow women to inherit land, and women only have access to land through their husbands and (or) male relatives (Chikaire et al., 2016; Khalid et al., 2015). Sometimes, existing norms and culture inhibit women from having adequate

access to land. For example, in some parts of Ethiopia, it is taboo for women to plough (Dokken, 2015). Murugani et al. (2014) report that married women have more secure land access than single women, although most times, they do not own the land themselves (Iruonagbe, 2011). In developing countries, especially in patriarchal societies, women achieve access to land through their husbands when they are married and, if unmarried, through their male relatives (father, brother, etc.). In the case of communal land, although it is in collective ownership, women are often disadvantaged in the allocation of such land (Iruonagbe, 2011). Land accessed through a third party usually has insecure tenure and can be reclaimed at any time (Murugani et al., 2014). This can have negative implications for their finances, as land use without full rights cannot be used as collateral for credit facilities. In turn, this can lead to adverse consequences for their food security, as access to productive resources, like land, will have an effect on their scale of production as well as on productivity and output.

Figure 3.1 also reveals that three characteristics of household heads: education, age, and their social network, influence households' food security. This indicates that households with educated heads tend to be more food secure (Akadiri et al., 2018; Rammohan & Pritchard, 2014). With a higher level of education, the household head will have more human capital, information, and the skills to use the right inputs; and therefore, increase productivity. This may also improve participation in off-farm work and hence, they can generate more income to purchase food. Social networks are found to increase household food security (Kassie et al., 2014).

We also include the farm size and the availability of infrastructure as determinants of household food security. Farm size and land quality are found to improve female-headed households' food security status (Kassie et al., 2014), while distance to the market has a negative effect on food security (Akadiri et al., 2018; Kassie et al., 2014). Those further away from markets may be more limited in terms of both their information about the prevailing prices and also their ability to sell and purchase food in the absence of efficient transport infrastructure. Access to electricity also has a positive influence on household food security (Faridi & Wadood, 2010). This can also be an indicator of the households'

welfare and subsequent access to other resources. For example, the availability of electricity makes automated irrigation possible.

In our conceptual model, we also include household location as a determinant of food security. Tibesigwa and Visser (2016) report that the gap between the food security of both male-headed households and female-headed households is much wider in rural areas than in urban areas. This implies that female-headed households in rural areas, with unequal access to land, are more susceptible to food insecurity as their number of off-farm opportunities is greatly reduced. They rely on land for sustenance to a greater extent.

## 3.4 Empirical Model

In this study, we capture food insecurity as a dummy variable that specifies households that had to reduce meal sizes as a result of lack of food.[7] Given the dichotomous nature of the dependent variable, we specify a binary logit model to determine the impact of gendered access to land on household food insecurity. The conditional probability of being food insecure ($Y$) is given as follows:

$$P(Y = 1|\boldsymbol{X}) = 1/(1 + e^{\alpha+\tau Gender+\eta Land+\gamma Gender*Land+\boldsymbol{\beta X}}) \quad (1)$$

where *P* is the conditional probability of a household being food insecure; *Y* is a dummy variable that indicates whether or not households have reduced meal sizes over the last seven days because they do not have enough food and represents the likelihood of the household being food insecure; *Gender* is a dummy variable that indicates the household head is female; *Land* denotes the area of land households access for cultivation; *Gender*Land* is an interaction variable which captures the mediating effect of land access on the influence of gender of household head on household food insecurity status; ***X*** is a vector of household, household head and farm-level explanatory variables; while $\alpha$, $\tau$, $\eta$, and $\boldsymbol{\beta}$

[7] This self-assessed measure of food insecurity is used because the 2015/2016 Nigerian General Household Survey does not have information that can be used to construct food insecurity indices like HFIAS or DDS.

are estimated coefficients. Norton et al. (2004) show that for non-linear models, the full effect of the interaction variable is not equal to its coefficient (γ), nor can its statistical significance be efficiently determined by just a *t*-test. Rather, the interaction effect is the discrete difference with respect to land access of a single derivative with regards to the gender of household head. This implies that the sign, magnitude and statistical significance of the interaction effect must be estimated from the cross-partial derivative of household food insecurity and not the coefficient of the gender-land interaction variable in Equation (1). Following Norton et al. (2004), we estimate the correct interaction effect of the gender-land interaction variable by calculating the cross-partial derivative of the expected value of household food insecurity at different values of covariates as follows:

$$\Delta\frac{\delta P(Y=1|\boldsymbol{X})}{\delta Gender}_{\Delta Land} = (\tau+\gamma)(P\{(\tau+\gamma)Gender+\eta+\boldsymbol{\beta X}\}\times(1-P\{(\tau+\gamma)Gender+\eta+\boldsymbol{\beta X}\})-$$
$$\tau[P(\tau Gender+\boldsymbol{\beta X})\{1-p(\tau Gender+\boldsymbol{\beta X})\}] \quad (2)$$

Equation (2) shows that the full interaction effect of the gender-land interaction variable is conditional on the independent variables. Also, the interaction effect of the gender-land interaction variable may have different signs for different values of covariates, because there are two additive terms which could be negative or positive. Consequently, the sign of the coefficient of the gender-land interaction variable in Equation (1), γ, does not necessarily indicate the sign of the interaction effect.

Table 3.1 presents the definitions and summary statistics of the variables in the model. Following the main premise of this paper, a gender-land interaction term is included in the food insecurity model to capture the intervening impact of land access on female-headed households' food insecurity status. All analyses are carried out using the STATA 15 statistical software.

**Table 3.1 Variable definition and summary statistics**

| Variable | Definition | Mean | SD | Min | Max |
|---|---|---|---|---|---|
| Food insecurity | 1 if household is food insecure, 0 otherwise | 0.314 | 0.464 | 0 | 1 |
| Farm size | Size of total cultivated farmland (acres) | 2.208 | 3.524 | 0 | 36.792 |
| Gender | 1 if household head is female, 0 otherwise | 0.066 | 0.248 | 0 | 1 |
| Gender*land | Interaction term between gender and farm size | 0.032 | 0.301 | 0 | 8.084 |
| Age | Age of household head (years) | 50.971 | 12.924 | 23 | 103 |
| Age squared | Squared age of household head | 2,764.99 | 1,407.19 | 529 | 10609 |
| Household size | Number of household members | 6.932 | 3.154 | 1 | 22 |
| Location | 1 if household is located in a rural area, 0 otherwise | 0.848 | 0.360 | 0 | 1 |
| Electricity | 1 if household is connected to the national electricity grid, 0 otherwise. | 0.467 | 0.499 | 0 | 1 |
| Education | 1 for no education, 4 for tertiary education | 2.179 | 0.970 | 1 | 4 |
| Non-farm income | Household income from non-farm sources (NG₦1000) | 32.128 | 103.597 | 0 | 2,247.5 |
| Farm income | Household income farm sources (NG₦1000) | 192.700 | 366.166 | 0 | 5,050 |
| Remittance | 1 if household received remittance, 0 otherwise | 0.961 | 0.192 | 0 | 1 |
| Extension officer visits | Number of extension officer visits in the last cropping season. | 0.159 | 1.081 | 0 | 20 |
| Land title | 1 if household has formal land title to farmland, 0 otherwise | 0.06 | 0.238 | 0 | 1 |
| Fertiliser use | 1 if household used fertiliser, 0 otherwise | 0.634 | 0.673 | 0 | 1 |
| Soil quality | 1 if soil quality of farmland is good, 0 otherwise | 0.835 | 0.371 | 0 | 1 |
| Distance to market | Distance from household to closest market (km) | 68.31 | 37.57 | 0.9 | 214.3 |

**Note**: NG₦ is Nigerian currency; US$1 = NG₦380.50 in 2021; SD is Standard Deviation

## 3.5 Data, Variable Measurements, and Descriptive Statistics

### 3.5.1 Data

We use data from the third wave of the Nigerian General Household Panel Survey (GHS) conducted in 2015/16 (NBS, 2016b). Data collection included three questionnaires (agriculture, household and community) for the post-planting and post-harvest periods. The GHS-Panel sample is selected from the 2010 GHS sample and comprises about 22,200 households from 2220 Enumeration Areas (EA) and 60 Primary Sampling Units (PSU). For the panel component, 5,000 households from 500 EAs are chosen. Some key variables like the educational level of household head are missing from the first and second waves of the GHS-Panel, so this study makes use of the third wave alone. In the third wave of the GHS-Panel, only 4,581 households completed the questionnaire. After data cleaning, transforming, and selecting for key variables, the sample for this study is reduced to 1,096 households from both urban and rural areas.

### 3.5.2 Variable Measurements

In this study, we use a self-assessment measure of household food consumption as a proxy for food insecurity. This food insecurity measure is an experiential indicator that is measured using days of food shortages. Household heads are asked if they had to reduce the size of meals eaten in their households because of insufficient food. The choice of this measure is informed by our focus on the food availability pillar of food security. It is a binary variable that takes the value of one when households report they had to reduce the portion sizes of meals in their household over the last week (food insecure) and zero otherwise (if food secure) (Li & Yu, 2010). Land access is captured by a household's farm size, which is their total area of cultivated land measured in acres. We use the sex of the household head to examine gender differences influencing food insecurity. The gender variable takes the value of 1 for female-headed households and 0 for male-headed households.[8] The gender-land

[8] The study does not capture possible intra-household impacts of gender. This may be a limitation of the study because women in male- and female-headed households may face different challenges (Doss & Morris, 2000).

interaction variable is included to establish the intervening effect of land access on the influence of gender of household head on household food insecurity status is a product of the gender and land access variables.

Control variables were included in the model to control for other household and farm-level characteristics influencing household's food insecurity. The *age* variable measures household heads age in years. The *agesquared* variable is included to determine the quadratic impact of age of household head on household food insecurity. The *location* variable captures whether the household is located in a rural area. The *education* variable measures the educational attainment of the household head, while household farm and non-farm income is measured in terms of Naira, the Nigerian currency. The *remittance* variable captures those household's that received remittances and controls for their effect on household food insecurity. The interaction with extension officers, defined by *extension officer visits*, is measured as the number of visits from extension officers in the preceding year. This controls for the positive influence of the adoption of improved technologies resulting from contact with extension agents (Bogale, 2012; Gebrehiwot & van der Veen, 2014; Tefera & Tefera, 2014). The *land title* variable, included as an indicator for tenure security, is measured as households that have legal title and certification for their farmland. In the literature, tenure security has been found to improve household food security (Ajefu & Abiona, 2020; Ghebru & Holden, 2013).

The *fertiliser* variable, a dummy variable, captures households that use fertiliser for agricultural production. This controls for the positive effect of productive input use on production and subsequent food availability (Jena et al., 2021). It may also account for the gender-based inequity in accessing agricultural input (Ankrah et al., 2020). The *soil quality* variable is included as an indicator for land quality and measures if the soil quality of household farmland is good. In the literature, women have been shown to be more likely to access farm plots with lower soil quality compared to men (Burke &

This suggests that obstacles women in male-headed households face in accessing land and other productive resources may be different from what women in female-headed households experience and this will have consequences for their food security.

Jayne, 2021). Accounting for soil quality will control for the possibility of female-headed households only having access to lower quality land and the effect this will have on household food insecurity. Finally, we control for household access to markets by including a variable that captures the distance from household to the closest market (*distance to market*). Distance to input and output markets have been found to significantly influence household food security negatively (Aragie & Genanu, 2017; Kassie, Ndiritu, & Shiferaw, 2015; Mengistu, Degaga, & Tsehay, 2021).

### 3.5.3 Descriptive Analysis

Table 3.1 presents descriptive statistics for the variables included in Equation (1). In our sample, about 31 per cent of households are food insecure and cultivate an average of 2.21 acres. Less than 10 per cent of households are female-headed, while average household size is about 10. The mean age of household head is 51 years, with about 85 per cent of households located in rural areas. The average annual household farm income is ₦192,700 (equivalent to 507 USD), while mean annual off-farm income is ₦32,061 (equivalent to 84 USD). Households in our sample had an average of two extension officer visits, are located about 68 kilometres from the nearest market on average, with a majority receiving remittances (96%). On average, about 47 per cent of households are connected to the national electricity grid, 6 per cent have formal land titles to their farmland, about 84 per cent reported good soil quality of their farmland, while 63 per cent used fertiliser for cultivation.

Table 3.2 presents the mean differences in key variables by gender of household head. On average, male-headed households are significantly less food insecure, have higher access to land, higher farm income, more household members, and are located farther away from the market than female-headed households. Female household heads are also significantly older and less educated than male household heads on average. There were no significant differences in terms of the location of household, non-farm income, remittance receipt, extension officer visits, land title and soil quality.

**Table 3.2 Mean difference in key variables by gender of household head**

| Variables | Male | | Female | | Difference |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | (*t*-stat) |
| Food insecurity | 0.30 | 0.46 | 0.47 | 0.50 | -2.78*** |
| Farm size | 2.33 | 0.11 | 0.49 | 1.08 | 10.84*** |
| Age | 50.58 | 12.97 | 56.56 | 10.91 | -4.43*** |
| Household size | 7.09 | 3.12 | 4.63 | 2.65 | 7.54*** |
| Location | 0.85 | 0.36 | 0.81 | 0.40 | 0.93 |
| Education | 2.19 | 0.98 | 1.97 | 0.84 | 2.14** |
| Non-farm income | 32.69 | 105.32 | 22.53 | 73.57 | 1.10 |
| Farm income | 202.04 | 376.20 | 59.93 | 97.48 | 8.65*** |
| Remittance | 0.96 | 0.19 | 0.94 | 0.23 | 0.66 |
| Extension officer visits | 0.14 | 0.91 | 0.38 | 2.42 | -0.81 |
| Land title | 0.06 | 0.24 | 0.06 | 0.23 | 0.18 |
| Fertiliser use | 0.65 | 0.67 | 0.39 | 0.64 | 3.35*** |
| Soil quality | 0.83 | 0.37 | 0.83 | 0.38 | 0.04 |
| Distance to market | 69.45 | 37.76 | 52.08 | 30.62 | 4.57*** |

Note: *, **, *** represent significance at 10%, 5%, and 1% levels, respectively.

Source: Authors' calculation from the 2015/16 Nigerian GHS data

Table 3.3 indicates that about 93 per cent of the sample are male-headed households, with about three-quarters of them being food secure. In comparison, about 57 per cent of the female-headed households were food secure, with a greater share of these households residing in rural areas (Table 3.4). Table 3.3 reports that about 24 per cent of male-headed households and 43 per cent of female-headed households in our sample were food insecure. The gender variable has a statistically significant positive correlation with the food insecurity variable (0.090) at the 1% significance level (Table 3.A1 in the appendix). This implies that female-headed households are more likely to be food insecure in comparison with male-headed households.

**Table 3.3 Mean distribution of households by demographic characteristics and food insecurity status**

| Gender | Age | Food insecurity | | | | Total | |
|---|---|---|---|---|---|---|---|
| | | No | | Yes | | | |
| Male | 50.57 | 781 | 76.27% | 243 | 23.73% | 1024 | 93.43% |
| Female | 56.55 | 41 | 56.94% | 31 | 43.06% | 72 | 6.57% |
| Total | | 822 | 100% | 274 | 100% | 1096 | 100% |

Source: Authors' calculation from the 2015/16 Nigerian GHS data

**Table 3.4 Mean distribution of characteristics of male- and female-headed households**

| Gender | Rural (N) | Urban (N) | Land size (acres) | Non-farm income | Farm income | Household Size |
|---|---|---|---|---|---|---|
| Male | 871 | 153 | 2.33 | 32.69 | 202.04 | 7.09 |
| Female | 58 | 14 | 0.49 | 22.53 | 59.93 | 4.62 |

Source: Authors' calculation from the 2015/16 Nigerian GHS data

Female household heads are older than their counterparts on average and also have much lower access to land.[9] One reason for the difference in age maybe because a majority of the female heads are either divorced or widowed in comparison with the male heads; hence, they are more likely to be older.[10] Similarly, Milazzo and Van de Walle (2015) and Ruwanpura and Humphries (2003) also find female heads to be older, with the main cause of female headship being widowhood and divorce. Household size of female-headed households are almost 50 per cent lower, on average than those of male-headed households. Oginni, Ahonsi, and Ukwuije (2013) and Milazzo and Van de Walle (2015) also find that male-headed households are larger than female-headed households.[11]

Table 3.4 shows that, on average, male-headed households have about 3.4 and 1.4 times more farm and non-farm income than female-headed households, respectively.[12] One reason for the large difference in farm income between both types of households is that female-headed households generally have less access to agricultural land. Even in cases where they do have similar access, they may not have enough family labour, access to markets and inputs to cultivate their land productively.

[9] Tibesigwa and Visser (2016) also found female household heads to be older on average.

[10] In our sample, about 87% and 67% of widowed and divorced household heads, respectively, are females.

[11] Milazzo and Van de Walle (2015) also report female-headed households have a higher dependency ratio than male-headed households, contrary to the findings of Oginni, Ahonsi, and Ukwuije (2013).

[12] Agrees with the findings of Kennedy and Peters (1992) and Akadiri, Nwaka, and Jenkins (2018).

Table 3.5 illustrates that most household heads had a primary education, with relatively few male- or female-headed households having a tertiary education.

**Table 3.5 Distribution of households by educational attainment and gender**

| Education | Gender | | | | | |
|---|---|---|---|---|---|---|
| | Male | | | Female | | |
| | n | % | % total HH | n | % | % total HH |
| No education | 287 | 28.03 | 26.19 | 22 | 30.56 | 2.01 |
| Primary education | 374 | 36.52 | 34.12 | 34 | 47.22 | 3.10 |
| Secondary education | 241 | 23.54 | 21.99 | 12 | 16.67 | 1.09 |
| Tertiary education | 122 | 11.91 | 11.13 | 4 | 5.56 | 0.36 |
| Total | 1,024 | 100 | 93.43 | 72 | 100 | 6.57 |

Note: HH denotes Household

Source: Authors' calculation from the 2015/16 Nigerian GHS data

Table 3.6 shows descriptive statistics by geopolitical regions in Nigeria. Households in the northeast and the North Central zones were found to have the largest access to land compared to households in the South East and South South geopolitical zones. Figure 3.2 illustrates that the northern region makes

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Source: Ekong et al. (2012)

**Figure 3.2 Map of Nigeria showing the geopolitical zones**

up about two-thirds of the landmass of Nigeria, even though most of the population is situated in the southern region. Consequently, households in the northern regions have more access to land than those in the south, as illustrated in Table 6. Households in the northern geopolitical zones, on average, also have more household members than those in the south. In agrarian regions, this could signify more family labour, which will reduce costs and increase productivity. But, on the other hand, this could also imply more mouths to feed and a subsequent lack of food. The average age of household heads is lower in the northern regions than in the southern regions (Table 3.6). On average, households in the South East zone have the highest age for household heads, smallest land sizes, and the second to smallest household sizes.

**Table 3.6 Demographic characteristics of households by geopolitical zone**

| Zone | Mean | | | |
|---|---|---|---|---|
| | n | Age (years) | Land size (acres) | Household size |
| North Central | 140 | 47.87 | 3.63 | 7.58 |
| North East | 181 | 47.32 | 4.66 | 8.69 |
| North West | 272 | 47.69 | 2.14 | 8.31 |
| South East | 206 | 57.54 | 0.32 | 5.18 |
| South South | 186 | 51.98 | 0.55 | 5.82 |
| South West | 111 | 54.95 | 2.80 | 4.95 |

Source: Authors' calculation from the 2015/16 Nigerian GHS data

## 3.6 Results and Discussion

### 3.6.1 Gendered Access to Land and Food Security

We estimate equation (1) using a maximum likelihood estimator and present the results in Table 3.7. The estimated coefficients in Column 2, Table 3.7 indicate that the gender of household head, area of land accessed, and educational level of household head is statistically significant at the 5% level. Total farm income, fertiliser use, and soil quality are significant at the 1%, level while the gender-land interaction variable is significant at the 10% level. Of the significant variables, the area of land accessed, gender-land interaction, educational level, fertiliser use, and soil quality negatively influence food insecurity, while the gender of the household head has a positive influence.

**Table 3.7 Estimation result of the food insecurity model**

| Explanatory variables | Food insecurity model | |
|---|---|---|
| | Odds ratio | Marginal effect |
| Farm size | 0.938 (0.028)** | -0.012 (0.006)** |
| Gender | 2.008 (0.659)** | 0.138 (0.064)** |
| Gender*land | 0.299 (0.197)* | -0.239 (0.129)* |
| Age | 1.001 (0.006) | 0.000 (0.001) |
| Age squared | 1.000 (0.000) | 0.000 (0.000) |
| Household size | 0.975 (0.024) | -0.005 (0.005) |
| Location | 1.076 (0.209) | 0.014 (0.038) |
| Electricity | 1.054 (0.161) | 0.010 (0.030) |
| Education | 0.833 (0.066)** | -0.036 (0.016)** |
| Non-farm income | 1.000 (0.000) | -0.000 (0.000) |
| Farm income | 1.000 (0.000)*** | -0.000 (0.000)*** |
| Remittance | 1.900 (0.779) | 0.127 (0.081) |
| Extension officer visits | 0.960 (0.078) | -0.008 (0.016) |
| Land title | 0.948 (0.289) | -0.011 (0.060) |
| Fertiliser use | 0.682 (0.076)*** | -0.076 (0.022)*** |
| Soil quality | 0.611 (0.108)*** | -0.097 (0.034)*** |
| Distance to market | 0.997 (0.002) | -0.001 (0.000) |
| Constant | 1.167 (0.636) | |
| Sample | 1096 | 1096 |
| P > $chi^2$ | 0.000 | 0.000 |
| *R*-squared | 0.0701 | 0.0701 |

Note: *, **, *** represent significance at 10%, 5%, and 1% levels, respectively; SE in parenthesis.

Dependent variable equals 1 if household is classified as food insecure, and 0 otherwise

The estimated marginal effect for the gender variable (Column 3, Table 3.7) shows that female-headed households are about 14 per cent more likely to be food insecure than male-headed households. This finding is similar to the vast majority of studies in the literature (Akadiri et al., 2018; Joshi & Joshi, 2017; Kassie et al., 2014; Tibesigwa & Visser, 2016), although, as noted earlier, Mallick and Rafi (2010) found no significant difference in the food security status of male-headed households and female-headed households in Bangladesh using a generalized threshold model. One reason given for this contradictory result is the lack of traditional and social limitations among indigenous groups in the Chittagong Hill Tracts in Bangladesh. This affords women the freedom to partake in the labour market and other income-generating activities. In contrast, our findings are explained by the fact that in the case of Nigeria and most other developing countries, women are still discriminated against in their access to most productive resources.

The estimated marginal effect for farm size, which is the variable representing land access (Column 3, Table 3.7) indicates that a one-acre increase in total land area accessed by households reduces the likelihood of food insecurity by 1.2 per cent. This result is in line with those in other studies from Kenya, Ethiopia and Myanmar (Ghebru & Holden, 2013; Muraoka et al., 2018; Rammohan & Pritchard, 2014), but disagrees with a study in South Africa that finds land grant recipients are more food insecure than non-recipients in land redistribution projects (Valente, 2009).[13] In this case, it may be that the majority of households that are land reform beneficiaries are disadvantaged to start with and are further burdened by relocation and travel costs of participating. In general, with more access to land and the corresponding yields and income, rural households are better equipped to combat food insecurity either by consuming their own produce or by selling their outputs and purchasing food with the proceeds.

The estimated marginal effect of the education variable in Column 3, Table 3.7, indicate that households with the household head having a tertiary education are less likely to be food insecure, as higher education reduces the probability of household food insecurity by about 3.6 per cent in comparison. Pinckney and Kimuyu (1994), Rammohan and Pritchard (2014), Tibesigwa and Visser (2016), and Akadiri et al. (2018) also find a positive relationship between the educational level of the household head and household food security. This suggests that with a higher level of education, the household head may have access to more human capital, information, and skills needed to use the right inputs, therefore increasing their productivity. This may also increase participation in off-farm work and therefore result in more income to purchase food.

In agreement with Gebrehiwot and van der Veen (2014), the estimated coefficient for farm income is negative and statistically significant. Considering that most households in the survey are located in rural areas, this suggests that households with higher farm income have more access to food and are therefore less food insecure. The estimated marginal effect of the fertiliser use variable in Column 3,

[13] Land grant recipients had extra access to land compared with non-recipients.

Table 3.7 indicates that using fertiliser for cultivation reduced the likelihood of a household being food insecure by 7.5 per cent. Fertiliser use has been found to improve agricultural productivity, which in turn increases household income and subsequently their capacity to access a variety of food through the market (Jena et al., 2021). The estimated marginal effect of the soil quality variable in Column 3, Table 3.7 show that households cultivating on farmland with good soil quality are 9.8 per cent less likely to be food insecure. This implies that households cultivating land with good soils may have better yields resulting in increased food availability and income.

Most importantly, the estimated marginal effect of the interaction term between female-headed households and land (Column 3, Table 3.7) is negative and statistically significant at the 10% level. Following Allison (2014), a Wald test ($\chi^2$= 3.37 and p<0.10) and likelihood ratio test ($\chi^2$= 5.31 and p< 0.05) is carried out to compare models with and without the interaction variable.[14] We reject the null hypothesis that the coefficient of the interaction variable is statistically equal to zero at the 0.10 and 0.05 significance levels, respectively. This shows that the coefficient of the interaction variable is statistically different from zero and improves the fit of the model.

**Table 3.8 Average marginal effect of gender on food insecurity at different levels of land access**

| Land access | dy/dx | SE | Z | P>\|z\| | 95% CI | |
|---|---|---|---|---|---|---|
| 1SD<$\bar{x}$ | -0.257 | 0.139 | -1.85 | 0.065 | -0.530 | 0.016 |
| $\bar{x}$ | -0.241 | 0.131 | -1.85 | 0.065 | -0.497 | 0.015 |
| 1SD>$\bar{x}$ | -0.221 | 0.121 | -1.83 | 0.067 | -0.458 | 0.015 |

Note: SE is Standard Error; $\bar{x}$ is mean

We probe the significance of the gender-land interaction variable by computing the average marginal effects of the gender of household head on household food insecurity at three different levels of land access - one standard deviation (SD) below the mean, at the mean and one SD above the mean area

[14] To probe the discrepancy in statistical significance of the interaction term in the Wald and likelihood ratio tests, Table 3.A1 in the appendix compares results of the food insecurity models with and without the gender-land interaction variable. The model with the interaction term has a higher log likelihood and hence is preferred.

of land (Table 3.8). The estimated coefficients in Column 2, Table 3.8, indicates female-headed households are more likely to report food security with additional access to land, not only at the mean land access but also at both one SD below and one SD above the mean land access. Although, the probability is higher for female households with lower levels of land access in comparison with those with higher access to land. These results show that the likelihood of female-headed households being food secure increases depending on the area of land they have access to. Female-headed households with a small area of land access, have a slightly higher probability of being food secure with increased access to land. This reveals that the efficiency by which increased access to land improves food security of households depends on the area of cultivated land they have access to. Improving access to land has more impact in terms of increasing the likelihood of being food secure for those female-headed households that had less access originally. This finding is in line with that of Pindiriri (2021), who finds that the transfer of arable land to female-headed households will only lead to reduced poverty and hunger if it targets the households with fewer than three acres of land or no land at all.

### 3.6.2 Estimating the Non-Linear Interaction Effect

As noted earlier, the coefficient of the gender-land interaction variable in Equation (1) (Table 3.7) does not take into consideration the non-additive effect of the interaction term over the individual effect of both the gender and land variables. To overcome this problem, we estimate the full interaction effect by estimating Equation (2). Table 3.9 reports the full interaction effect and standard errors of the gender-land interaction variable by estimating the cross-partial derivatives of the expected value of food (in)security at different values of covariates. Results show that the mean interaction effect is -0.1615 and varies between -0.304 and 0.015. This implies that for some female-headed households, the interaction variable is negative while, for others, it is positive. The mean interaction effect reveals that with an extra one-acre of arable land, the likelihood of female-headed households self-reporting food insecurity decreases by about 16 per cent compared to male-headed households, *ceteris paribus*. This confirms the hypothesized causal pathway, denoted by Arrow 3 in Figure 3.1, and implies that improving timely access to productive resources like land will help in preventing the vulnerability of female-headed households to food shortages.

**Table 3.9 Mean interaction effect of the gender-land interaction variable**

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Interaction effect | -0.1615 | 0.1268 | -0.3039 | 0.0148 |

Note: Std Dev. is Standard Deviation

This finding may be a result of female household heads being better household resource managers than their counterparts (Levin et al., 1999), even when they are disadvantaged in their access to productive resources (Adesina & Djato, 1997). Also, many studies find that resource decisions made by female household heads improve the welfare of their households more than that of male household heads (Agarwal, 2003; Felker-Kantor & Wood, 2012; Levin et al., 1999; Rao, 2006). Although the results show that the interaction effect could be positive for different values of the covariates, this suggests that for some female-headed households, extra access to land has no effect on their food security. This is possible when households with ample access to land do not have adequate inputs or sufficient labour to make the land productive.

To investigate the significance of our results further, we plot graphs of the gender-land interaction effect against the predicted probability of households being food insecure and the z-statistics of the interaction effect against the predicted probability of being food insecure (see Figures 3.3 and 3.4). These illustrate how the significance and magnitude of the gender-land interaction effect varies.

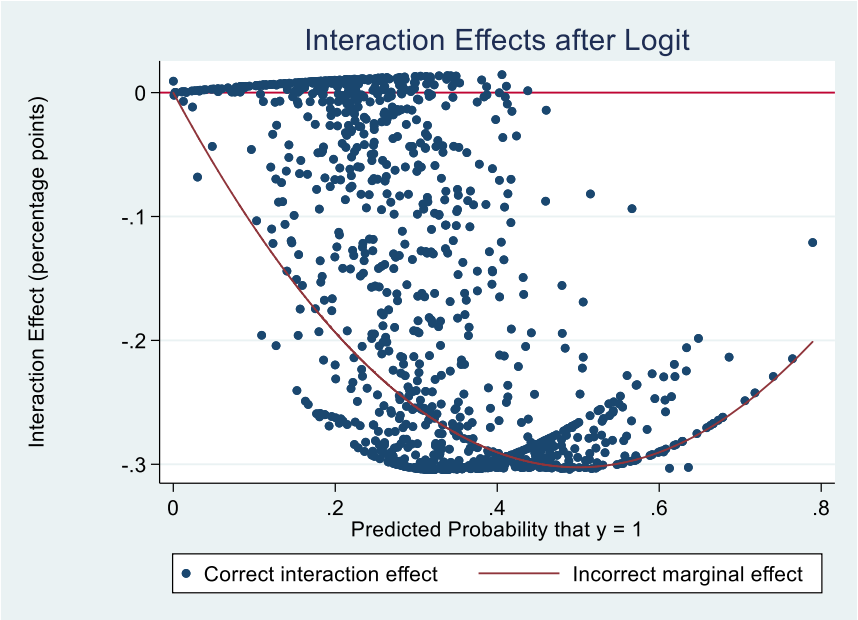


**Figure 3.3 Plot of interaction effects and predicted probability of reporting food insecurity**

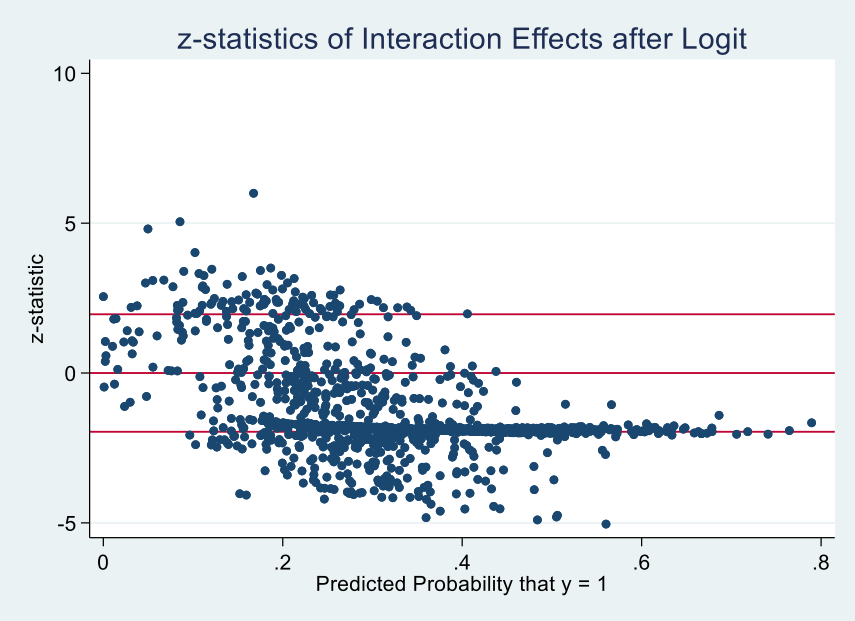


**Figure 3.4 Plot of z-statistics of interaction effects and predicted probability of reporting food insecurity**

For households with a predicted probability of reporting food insecurity between 0 to 0.3 (towards the left side of Figure 3.3), the gender-land interaction effect is positive for some households but negative for the majority. On the right side of Figure 3.3, we can see that for households with predicted probabilities of above 0.5, their interaction effects are mainly negative. This suggests that the more food insecure a female-headed household is, the higher the positive effect of extra land access will be on their food security.

Figure 3.4 indicates that in terms of significance, most of the households with a predicted probability of reporting food insecurity below 0.5 have statistically significant interaction effects. On the other hand, for households with predicted probabilities above 0.5, their interaction effects are mostly insignificant (Figure 3.4). Consequently, even with a significant coefficient for the interaction variable in the logit regression output, the estimation of the interaction effect based on cross-partial derivatives of food insecurity shows that not all gender-land interaction effects are significant. This highlights the importance of capturing the non-linear interaction effect of the gender-land interaction term, which to the best of our knowledge, has not been done in previous studies.

## 3.7 Conclusion

Using Nigerian data from 1096 households, this article has extended the current literature by quantifying the joint effect of the gender of household head and access to land on food insecurity using a binary logit model. Findings show that female-headed households are more food insecure than male-headed households. Also, an increase in land access diminishes the probability of households being food insecure. Analysis of the interaction effect of the gender-land interaction term shows that with a one acre increase in land access, the likelihood of female-headed households being food insecure decreases by about 16%, in comparison with male-headed households. However, our results also show that for some female-headed households, extra access to land has no effect on their food security status. This could be because they do not have the means and resources to cultivate the land and make it productive.

The study does have some limitations. First, it does not capture possible intra-household gender differences. This is a limitation because women in both male- and female-headed households may face different challenges in access to productive resources. Second, the sample is not inherently a representation of the Nigerian population. Also, the lack of observations in some regions means that zonal differences are not accounted for adequately and this may result in zonal misrepresentation.

Notwithstanding these limitations, the results of this study not only add to the literature but also have implications for policy and food security interventions. First, it emphasizes the need for gender equity in accessing land in order to ensure food security. Discrepancies in educational attainment and income between men and women may further increase the food security disparity between male- and female-headed households. Second, the findings can help inform policy implementation around issues of land access and land tenure systems, not only in Nigeria but also in other developing countries, in support of the fifth SDG for gender equality and empowerment of marginalized women. These initiatives have to take into consideration the deep-rooted traditional and cultural beliefs in Nigeria that strengthens the discrimination against women. For example, land redistributive reforms that tackle discrimination

against women in terms of land ownership and timely access to land for economic advancement will invariably improve food security for their households.

## Appendix 3.0

**Table 3.A1 Estimation results of the food insecurity model with and without the gender-land interaction term**

| Explanatory variables | With IT | Without IT |
|---|---|---|
| Farm size | 0.938 (0.028)** | 0.935 (0.029)** |
| Gender | 2.008 (0.659)** | 1.336 (0.354) |
| Gender*land | 0.299 (0.197)* | |
| Age | 1.001 (0.006) | 1.000 (0.006) |
| Age squared | 1.000 (0.000) | 1.000 (0.000) |
| Household size | 0.975 (0.024) | 0.974 (0.024) |
| Location | 1.076 (0.209) | 1.079 (0.209) |
| Electricity | 1.054 (0.161) | 1.064 (0.162) |
| Education | 0.833 (0.066)** | 0.832 (0.066)** |
| Non-farm income | 1.000 (0.000) | 1.000 (0.000) |
| Farm income | 1.000 (0.000)*** | 0.999 (0.000)*** |
| Remittance | 1.900 (0.779) | 1.925 (0.784) |
| Extension officer visits | 0.960 (0.078) | 0.958 (0.075) |
| Land title | 0.948 (0.289) | 0.958 (0.292) |
| Fertiliser use | 0.682 (0.076)*** | 0.686 (0.076)*** |
| Soil quality | 0.611 (0.108)*** | 0.620 (0.109)*** |
| Distance to market | 0.997 (0.002) | 0.997 (0.002) |
| Constant | 1.167 (0.636) | 1.147 (0.623) |
| Sample | 1096 | 1096 |
| P > $chi^2$ | 0.000 | 0.000 |
| *R*-squared | 0.0701 | 0.0662 |
| Log likelihood | -634.096 | -636.752 |

Note: *, **, *** represent significance at 10%, 5%, and 1% levels, respectively; SE in parenthesis; IT denotes interaction term

Dependent variable equals 1 if household is classified as food insecure, and 0 otherwise

# Chapter 4

# Farmer-herder conflicts and food insecurity: Evidence from rural Nigeria

This chapter fulfils objective two and is based on the published journal article below :

Nnaji, A., Ma, W., Ratna, N., & Renwick, A. (2022). Farmer-herder conflicts and food insecurity: Evidence from rural Nigeria. *Agricultural and Resource Economics Review, 51*(2), 391-421. doi:10.1017/age.2022.9 (ABDC ranking: B)

**Chapter 4 – Statement of Authorship**

| | | |
|---|---|---|
| Title of Paper | Farmer-herder conflicts and food insecurity: Evidence from rural Nigeria | |
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**Principal Author**

| | | | |
|---|---|---|---|
| Name of Principal Author (Candidate) | Amaka Precious Nnaji | | |
| Contribution to Paper | Conception and design of the study; data acquisition, analysis and interpretation; drafting of the manuscript; and reviewing the manuscript critically for significant intellectual content. | | |
| Overall percentage (%) | 65% | | |
| Certification: | This paper reports on original research conducted during the period of my Doctoral study and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper. | | |
| Signature |  | Date | 28/10/2022 |

**Co-Author Contribution**

By signing the Statement of Authorship, each author certifies that:

1. the candidate's stated contribution to the publication is accurate (as detailed above);
2. permission is granted for the candidate to include the publication in the thesis; and
3. the sum of all co-author contribution is equal to 100% less the candidate's stated contribution.

| | | | |
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| Name of Co-Author | Assoc. Prof. Nazmun N. Ratna | | |
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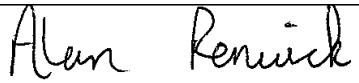
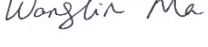
| Signature |  | Date | 16/11/2022 |

| | | | |
|---|---|---|---|
| Name of Co-Author | Prof. Alan Renwick | | |
| Contribution to the Paper | Supervising the development of the study, contributing to drafting the manuscript and revising the manuscript critically for important intellectual content. | | |
| Signature |  | Date | 15/11/2022 |

| | | | |
|---|---|---|---|
| Name of Co-Author | Assoc. Prof. Wanglin Ma | | |
| Contribution to the Paper | Supervising the development of the study, contributing to drafting the manuscript and revising the manuscript critically for important intellectual content. | | |
| Signature |  | Date | 28/10/2022 |

**Abstract**

Food security in many developing countries has been threatened by several factors such as unequal land distribution, ineffective land reform policies, inefficient agricultural value chains, and an increasing number of climate disasters. In Nigeria, these threats are exacerbated by rapid population growth and extreme weather events, which have resulted in farmer-herder conflicts in most agrarian communities. This paper examines the differential impacts of the incidence and severity of farmer-herder resource-use conflicts on food insecurity of rural households in Nigeria. We estimate a two-stage predictor substitution model to using survey data collected from 401 rural households in Nigeria. The empirical results show that both the incidence and the severity of farmer-herder conflicts significantly increase food insecurity, and the severity of these conflicts has a larger impact than their incidence. The estimates of the conditional mixed process models confirm the robustness of our results. Additional analysis reveals that the incidence and severity of farmer-herder conflicts positively and significantly affect food insecurity, measured by the number of days with limited varieties of food eaten. Our findings highlight the importance of policy interventions that address ongoing farmer-herder conflicts in affected countries like Nigeria to enhance food security from a sustainable development perspective.

Keywords: Farmer-herder conflicts; food insecurity; 2SPS model; Nigeria

## 4.1 Introduction

Despite achieving remarkable progress in the first-millennium development goal (MDG) of eradicating extreme poverty globally, food and nutrition security concerns persist in many low-income countries in the post-MDG era. Countries in the Global South are struggling to make substantial progress in sustainable development, especially in countries prone to conflicts, civil wars and political instability. It is estimated that about 381.4 million of the 650.3 million chronically undernourished people in 2019 originate from countries plagued with conflict, usually aggravated by climate-related shocks (FAO et al., 2021). Also, about three-quarters of children aged under five with stunted growth live in war-torn and conflict-ridden countries (FAO et al., 2017, 2021).

Disruptions like political instability, natural disaster, pandemics or conflicts have significant detrimental impacts on social, economic, and human development (George, Adelaja, & Awokuse, 2021; Hamoodi, 2021; Menton et al., 2021; Okunlola & Okafor, 2020; Qayyum, Anjum, & Sabir, 2021; Schillinger et al., 2020; Von Einsiedel et al., 2017). These disruptions also challenge the United Nations' Sustainable Development Goals regarding "No poverty (goal 1)", "Zero hunger (goal 2)", "Good health and well-being (goal 3)", "Responsible consumption and production (goal 12)", and "Peace, justice and strong institutions (goal 16)". For example, George, Adelaja, and Awokuse (2021) revealed that armed conflicts (Fulani ethnic militia) in Nigeria negatively affected farm outputs, areas harvested, and cattle holding. The occurrence of the Covid-19 pandemic in 2020 has exacerbated the ongoing conflicts. A case study by Menton et al. (2021) finds that the Covid-19 pandemic intensifies resource conflicts and indigenous resistance in Brazil.

Resource use conflicts between farmers and herders have been on the increase in most countries in the Sahelian African region due to rapid population growth and the escalating effects of climate change (Day & Caus, 2020a). Farmer-herder (FH) conflicts occur when nomadic herders graze their animals (e.g., cattle) in farmers' cropland, leading to yield and income losses for farmers. Farmers sometimes retaliate by maiming the cattle or forcing herders out of their communities. In response, herders fight back, and FH conflicts occur (Blench, 2010; Dimelu, Danjuma, et al., 2017). Although conflicts between

herders and farmers have been ongoing historically (Mbih, 2020), their frequency and intensity are increasing (George et al., 2022). These conflicts directly influence rural households' food insecurity because of their direct impacts on the ability to cultivate land the herders want to access and/or to access food via markets. There is a dynamic causal relationship between conflicts and food insecurity, as food insecurity can either be an outcome of or a cause of conflicts (Bora et al., 2011; D'Souza & Jolliffe, 2013; George, Adelaja, & Awokuse, 2021; Martin-Shields & Stojetz, 2019; Messer, Cohen, & Marchione, 2001; Teodosijevic, 2003). As most developing countries are already inundated by hunger and poverty (Corral et al., 2020; FAO et al., 2020), the recent increase in resource-use conflicts will invariably have adverse impacts. For example, while the prevalence of extreme poverty has rapidly diminished in many countries since 2000, for countries in conflict-affected areas, poverty rates are stagnant or increasing (Corral et al., 2020). In this study, we focus on farmer-herder (FH) resource use conflicts. This is because of the dearth of literature empirically examining the food and nutritional consequences of FH conflicts on rural livelihoods.

Most of the studies on conflicts and food security have focused on armed and violent conflicts causing deaths (Brück, d'Errico, & Pietrelli, 2019; D'Souza & Jolliffe, 2013; George, Adelaja, & Awokuse, 2021; George, Adelaja, & Weatherspoon, 2020; Jeanty & Hitzhusen, 2006). Only three studies have investigated the relationship between armed conflicts and food consumption (Adelaja & George, 2019; George, Adelaja, & Awokuse, 2021; George et al., 2020). These studies used secondary data on fatalities perpetrated by Boko Haram terrorists and the Fulani ethnic militia (FEM) from Nigeria. To the best of our knowledge, there are no studies that capture how and to what extent ongoing FH conflicts influence rural households' food insecurity.

The objective of this study is to address this gap by focusing on the incidence and severity of FH conflicts and analyze how they affect food insecurity, measured by the household food insecurity access scale (HFIAS) and the coping strategies index (CSI). Specifically, the HFIAS food insecurity indicator captures household anxiety and uncertainty over insecure access to food, as well as their attitude indicating quality and quantity of food (Coates, Swindale, & Bilinsky, 2007; Maxwell, Coates,

& Vaitla, 2013). The CSI food insecurity indicator encapsulates households' behaviour when they do not have access to enough food (Maxwell & Caldwell, 2008). These two measures focus on the food availability and accessibility pillars of food security, and they have been used in previous studies (Benti, Biru, & Tessema, 2022; Dompreh, Asare, & Gasparatos, 2021; Ike, Jacobs, & Kelly, 2017). FH conflicts in our context refer to disagreements, fights, and clashes that occur between farmers and herders. Given the rapid population increases in most Sahelian African countries where nomadic herding is still practised, the impacts of these FH conflicts will continue to increase if the fundamental issues that trigger them are not addressed. Therefore, estimating the impact of FH conflicts on farm households' food security will allow evidence-based policy formulation in Nigeria and many other countries that are also prone to resource-use conflicts. Following Nie, Ma, and Sousa-Poza (2020) and Wan et al. (2015), a two-stage predictor substitution (2SPS) approach is employed to address the endogeneity issues of FH conflict variables and to estimate the data collected from rural farming households in Nigeria. We check the robustness of our empirical results using a conditional mixed process model. To enrich our understanding, we also present and discuss the results estimated for the impacts of FH conflict exposure on food insecurity, as well as the impacts of FH conflicts on food insecurity, measured by the number of months with insufficient food supply and the number of days with limited varieties of food eaten.

We contribute to the literature by developing a conceptual framework to identify causal pathways between the incidence and severity of FH conflicts and food insecurity. We then empirically examine these relationships using farm household data from Nigeria. This issue has been overlooked in the literature, even though FH conflicts have increased in most sub-Saharan African (SSA) countries (ACLED, 2019). Previously, most studies on this topic have been descriptive and exploratory (Audu, 2013; Dary et al., 2017; Dimelu, Salifu, et al., 2017; Dimelu, Salifu, & Igbokwe, 2016; Muhammed, Ismaila, & Bibi, 2015), with very few studies quantifying the magnitude of the impact on the food insecurity of rural households. The study by George, Adelaja, and Awokuse (2021) is an exception, which empirically examines the effect of fatalities resulting from armed conflicts perpetrated by the Boko haram terrorist group on household food security using panel data provided by the Nigerian

General Household Survey. However, our analysis differs from George, Adelaja, and Awokuse (2021) by focusing on primary data collected from rural households in Nigeria and measuring types of FH conflicts differently. Specifically, we consider the incidence and severity of FH conflicts. The incidence of FH conflicts accounts for the number of FH conflicts that occurred in the community in 2018, reported by interviewed farming household heads. The severity of FH conflicts is a weighted index that captures how severe previously occurred FH conflicts were, which is calculated based on survey questions and ranges between 0 and 1. Besides, we consider all FH conflicts, encompassing disagreements and clashes over land resources between farmers and herders, irrespective of whether they result in deaths or not.

Our focus on FH clashes stems from empirical evidence that uncertainties caused by exposure to conflicts prompt farmers to opt for sub-optimal strategies like shifting to lower investment crop portfolios and land use, hiding visible assets, and labour reallocation (Arias et al., 2019; Bozzoli & Brück, 2009; Brück et al., 2019; Gáfaro, Ibáñez, & Justino, 2014). FH clashes negatively influence agricultural production (George et al., 2021b), influencing food availability and accessibility in affected areas. We argue that as rural households are primarily involved in agricultural production, FH clashes will have consequences not just for their livelihoods but also for their production efficiency and, subsequently, their food security. Households that are neither directly involved nor exposed to FH conflicts in their community may also change their production decisions.

Nigeria is an interesting example because, as one of the most affected countries in Africa regarding the occurrence of armed conflicts (Raleigh et al., 2010), the economic consequences of FH conflicts are severe (Dimelu, Salifu, et al., 2017). According to the 2019 Global Terrorism Index, violence between Nigerian farmers and herders accounted for about a third of the increase in deaths, resulting in the nearly 300,000 people displaced in 2018. These FH conflicts have adverse economic effects on farming communities and pastoralists, resulting in enormous financial consequences for all involved (Sulaiman & Ja'afar-Furo, 2010). They limit the activities of herders and farmers, and this constitutes a threat to their livelihoods (Dary et al., 2017). The ongoing FH conflicts also negatively influence agricultural

productivity and output, farmers' cattle holdings, and the harvested land area (George, Adelaja, & Awokuse, 2021).

The rest of this paper is structured as follows. Section 2 provides a background on FH conflicts and food insecurity. We discuss our conceptual framework and estimation strategy in section 3. Section 4 describes the data, variable measurements, and descriptive statistics. Section 5 presents and discusses the empirical results, while Section 6 summarises the results and discusses policy implications.

## 4.2 Farmer-Herder (FH) Conflicts and Food Insecurity

Incidences of FH conflicts have been increasing in most parts of SSA. Several reasons attributing to FH conflicts have been discussed in the literature. These include: changing climatic conditions (Adano et al., 2012; Buhaug et al., 2015; Hendrix & Salehyan, 2012; Theisen, 2012), unfavourable land zoning, and national agricultural policies affecting herders (Benjaminsen & Ba, 2009; Mertz, Rasmussen, & Rasmussen, 2016), population growth (Day & Caus, 2020a), conflicting national and state government policies leading to diverted use of grazing land (Lenshie et al., 2020; Seter, Theisen, & Schilling, 2018), and reallocation of water resources away from grazing land to farming (Clanet & Ogilvie, 2009).

In Nigeria, pastoral activities date back to the inward migration of Fulani clans that have been grazing their cattle for centuries across the Sahelian African region (ICG, 2017), with peaceful coexistence with farming communities (Ahmed & Muhammad, 2021; Seddon & Sumberg, 1997). The rapid increase in FH conflicts in Nigeria can be attributed to the following factors. First, rising temperatures and the resulting droughts and desertification from climate change stressors have led to increased migration of nomadic herders from Nigeria's northern region to the central and southern regions (Benjaminsen et al., 2012; Buhaug et al., 2015). Here, climate and environmental factors prompt herders to graze their animals further south and away from their primary grazing areas in the northern region. This leads to increased competition with farmers in the central and southern regions over scarce land resources, resulting in disagreements and fights between farmers and nomadic herders (Eke, 2020).

Majority of these nomadic Fulani herders being Muslim and sedentary farming communities being Christian also incorporate an ethnoreligious hostility in their interactions (Usman, 2019a). Recently, the situation has been intensified by collective conflicts between sedentary farming communities (mostly mainly Christian and non-Fulani ethnic groups) and non-sedentary herders (mainly Muslim Fulani populace) over land claims, community resource distribution, as well as control of local administrative authorities (George et al., 2022; Vaughan, 2016). The current land tenure system exampled by communal access to land, insecure private property rights, expensive land administration costs and the resulting lack of access to formal land titles further exacerbate the situation (Vanger & Nwosu, 2020). Second, the increasing terrorist insurgency of Boko Haram in the north-eastern region has led to the forced displacement and increased migration of individuals towards the southern region (George, Adelaja, Awokuse, et al., 2021; George et al., 2022). Invariably, this places increased pressure on scarce resources resulting in inadequate land resources. This leads to conflicts between farming communities and nomadic herders in the central and southern regions of the country (Ojo, 2020). Finally, ineffective implementation of existing land policies on open grazing and grazing routes fosters nomadic pastoralists' relegation. In 1965, the grazing reserve law was passed to assign land resources to herders. Yet, some of the land allotted under this law has been commandeered by non-herders for non-grazing activities (Ojo, 2020), often expedited by the failure of the government to enforce the law. Fewer than a quarter of the grazing reserves initially allocated for herders are currently being used for grazing purposes (ICG, 2017).

We argue that the occurrence of FH conflicts could impact the four main pillars of food security, as reported by the (FAO, 2006), including: (1) food availability, (2) food accessibility, (3) food utilization, and (4) food stabilization. For the food availability dimension, the existing literature concludes that conflicts reduce food security through their adverse impacts on agricultural labour supply (Blattman & Miguel, 2010; Serneels & Verpoorten, 2015; Verwimp & Muñoz-Mora, 2018), production decisions (Arias et al., 2019), and outputs (Adelaja & George, 2019; George, Adelaja, & Awokuse, 2021). Conflicts affect the food accessibility dimension of food security through their harmful impacts on physical and economic access to food. For example, conflicts may lead to the destruction of infrastructure like

roads, markets and farms (Kah, 2017). For the food utilization dimension, the adverse impacts of conflicts are usually captured through anthropometric outcomes (Akresh, Lucchetti, & Thirumurthy, 2012; Martin-Shields & Stojetz, 2019; Tranchant, Justino, & Müller, 2014). Finally, for the food stabilization dimension, the adverse effects of conflicts appear to be captured through its impact on variability of food prices and the value of food imports (George et al., 2020).

Since FH conflicts are most likely to affect rural food production and market supply, our food insecurity measurements focus on the food availability and accessibility pillars of food security. In the following section, we discuss how FH conflicts affect food insecurity theoretically before we introduce our data and discuss the empirical results.

## 4.3 Conceptual Framework and Empirical Strategy

### 4.3.1 Conceptual Framework

Following George et al. (2020), we define a household food consumption demand model based on a constrained utility maximization problem to explain how FH conflicts influence rural households' food insecurity. Consider an agricultural household that derives utility from the consumption of its own-produced food ($F_o$) and market-purchased food ($F_m$). Let $F$ be the total consumption demand for food, then the equilibrium demand for food consumption can be presented as follows:

$$F = F_o + F_m \tag{1}$$

To facilitate our analysis, we assume that total food consumption demand (including the level of food insecurity) is affected by household income (*Y*) and production inputs (*X*). We further assume that FH conflicts ($\tau$) have impacts on household income and production inputs, which finally affects household food consumption. Thus, the equilibrium demand for food consumption can be derived as:

$$F = (Y(\tau), X(\tau)) \tag{2}$$

where $Y$ is household income, $X$ indicates inputs used in the production process, and $\tau$ denotes FH

conflicts.

When FH conflicts occur, not all farming households in the community are directly affected. Therefore, we make a case for this by splitting the impact of FH conflicts into two – incidence of FH conflict and severity of FH conflict. Figure 4.1 depicts the key channels through which the two types of conflicts affect food insecurity.

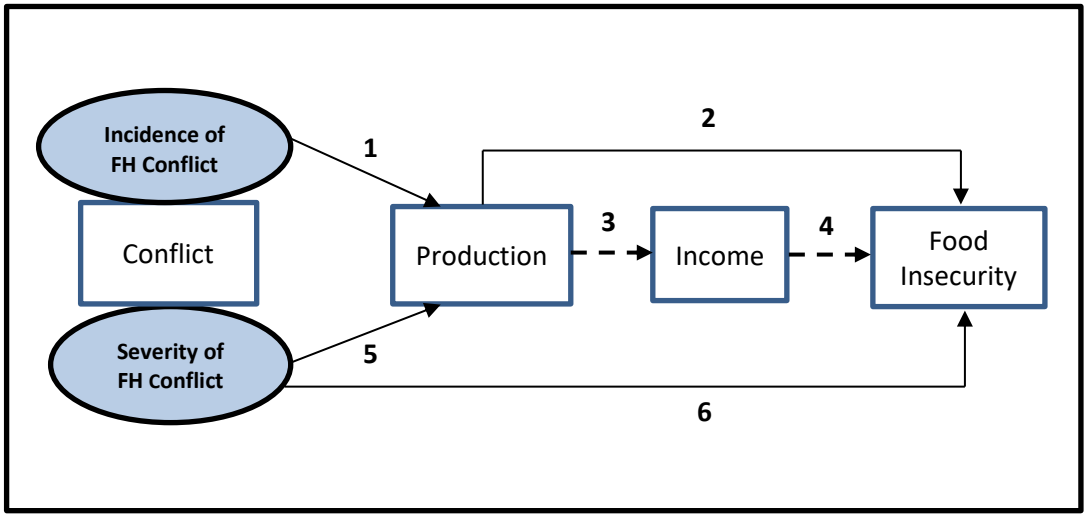



**Figure 4.1 Conceptual framework capturing the impacts of FH conflict on food insecurity**

The incidence of FH conflicts can affect food insecurity by directly influencing farm production (arrows 1 and 2) or by directly influencing farm production and then indirectly affecting household income (arrows 1, 3 and 4). The incidence of FH conflicts causes uncertainty and anxiety. Therefore, farmers influenced by the FH conflicts tend to make less efficient production decisions. For example, in agricultural production, farmers affected by conflicts may shift away from high investment activities like perennial cropping to short-term, lower yield seasonal cropping, as depicted by the arrow (1) in Figure 4.1. This argument is supported by previous studies showing that incidences of terrorist events reduce the availability of hired labour, total outputs and productivity (Adelaja & George, 2019; Arias et al., 2019; George et al., 2020). Reduced production can directly impact food insecurity in terms of food availability for subsistence farmers (arrow 2). It can also negatively impact sales revenue and household income (arrow 3), increasing food insecurity because of decreased food purchasing power

(arrow 4). Brück et al. (2019) also found that violent conflicts reduce households' adaptive capacity via abridged income stability and diversification, which, in turn, increase food insecurity (arrows 3 and 4).

The severity of FH conflicts can also affect food insecurity either directly (arrow 6) or indirectly (arrows 5, 3 and 4). Violent clashes, which lead to the injury and/or death of household members, loss of crop yield, and destruction of farm property, may directly and immediately affect household food insecurity through a reduction in the immediate availability of food (arrow 6). Farmers severely affected by FH conflicts may also shift their production practices from profitable commercial cultivation to subsistence farming to ensure the food demands of their households, resulting in negative consequences for farm productivity (Adelaja & George, 2019; Arias et al., 2019) (arrow 5). Similarly, risk-averse farmers may also change from perennial cultivation to less risky and less profitable seasonal cultivation (Arias et al., 2019). This will have consequences for their food security through a reduced income trajectory and the subsequent inability to access food through the markets (Deininger, 2003; Justino, 2011) (arrows 3 and 4).

Econometrically, the influence of FH conflicts on food insecurity can be derived from the Kuhn-Tucker condition with respect to τ based on Equation (2). Formally, it can be expressed as follows:

$$\frac{\partial F}{\partial \tau} = \left(\frac{\partial F}{\partial Y}.\frac{\partial Y}{\partial \tau}\right) + \left(\frac{\partial F}{\partial X}.\frac{\partial X}{\partial \tau}\right) \quad (3)$$

where τ denotes the conflict measures – incidence or severity of FH conflicts. Equation (3) indicates that FH conflicts affect food consumption through their impacts on total household income and production inputs demanded.

As indicated earlier, we are focusing on the availability and accessibility pillars of food security in this study. Measures of food insecurity capturing the accessibility and availability of food will have an inverse relationship with household food consumption demands. For the purpose of analytical settings, we introduce $\rho_j$, a food insecurity (FI) shock, related to *F* such that $FI_j = \rho_j F$, where $FI_j$ is the food insecurity measure (i.e., either the incidence or severity of FH conflicts) and $\rho_j$ is the coefficient related to the $j$-th food insecurity measure. Given the inverse relationship between $F$ and

$FI_j$, $\rho_j$ is assumed to be negative i.e., $\rho_j < 0$. The effects of FH conflict on household food insecurity can then be denoted as:

$$\frac{\partial FI_j}{\partial \tau} = \rho_j[\left(\frac{\partial F}{\partial Y}.\frac{\partial Y}{\partial \tau}\right) + \left(\frac{\partial F}{\partial X}.\frac{\partial X}{\partial \tau}\right)] \quad (4)$$

where $\frac{\partial FI_j}{\partial \tau}$ captures the impact of FH conflicts on food insecurity. $\frac{\partial F}{\partial Y}.\frac{\partial Y}{\partial \tau}$ and $\frac{\partial F}{\partial X}.\frac{\partial X}{\partial \tau}$ are expected to be negative because, as discussed earlier, FH conflicts have negative impacts on household income and farm production. The intensity of food insecurity will vary as $\rho_j$ varies. Consequently, this will be reflected in the differential impacts of FH conflicts on various food insecurity measures.

Following our conceptual framework above, we define the indirect and direct effects of FH conflicts as the incidence of FH conflicts ($\tau_{in}$) and severity of FH conflicts ($\tau_{se}$) and make the following two hypotheses:

Hypothesis 1: The incidence of FH conflict affects household food insecurity positively ($\frac{\partial FI_j}{\partial \tau_{in}} > 0$).

Hypothesis 2: The severity of FH conflict affects household food insecurity positively ($\frac{\partial FI_j}{\partial \tau_{se}} > 0$).

### 4.3.2 Empirical Strategy

It is challenging to estimate the impacts of FH conflicts on food insecurity using an ordinary least square (OLS) regression model because of potential endogeneity issues related to FH conflicts. FH conflicts do not occur randomly (Eberle, Rohner, & Thoenig, 2020). These conflicts usually break out in agrarian communities with specific institutional and environmental characteristics. When it happens, the severity of an FH conflict is not random either, as households with more assets and access to farmlands may be targeted. Following previous studies (Nie et al., 2020; Wan et al., 2015), we employ a two-stage predictor substitution (2SPS) approach to account for endogeneity issues.

In the first stage, the incidence and severity of FH conflict variables are regressed as functions of a vector of control variables and instrumental variables. Then, the FH conflict variables are predicted. Formally, the first stage equations are estimated as follows:

$$Incidence_i = \alpha_i X_i + \beta_i IV1_i + \varepsilon_i \quad (5a)$$

$$Severity_i = \gamma_i X_i + \delta_i IV2_i + \eta_i \quad (5b)$$

where $Incidence_i$ indicates the incidence of FH conflicts; $Severity_i$ indicates the severity of FH conflicts; $X_i$ represents a vector of the control variables (e.g., age, gender, education, household size, and farm size); $IV1_i$ and $IV2_i$ are the two instrumental variables used for the 2SPS model identification; $\alpha_i$, $\beta_i$, $\gamma_i$ and $\delta_i$ are the parameters to be estimated; $\varepsilon_i$ and $\eta_i$ are two error terms.

$IV1_i$ refers to a variable (IV1) defined as the time taken when travelling from the household to the closest police station, and $IV2_i$ refers to a variable (IV2) capturing the distance from the household to the closest police station.15 The majority of rural households live in their ancestral homes and so do not choose where to live. Under this condition, the further away a household is from a police station with security operatives in attendance, the higher the likelihood of an incidence of FH conflicts. Thus, the distance variables can be justified as valid IVs. Following previous studies (Amadu, McNamara, & Miller, 2020; Di Falco, Veronesi, & Yesuf, 2011; Manda et al., 2019), we employ a falsification test to check the validity and effectiveness of the IVs in this study. The results (Table A1 in the Appendix) show that distance variables are significantly correlated with the FH conflict variables, but they are not significantly associated with the two food insecurity variables. Thus, we can conclude that both IV1 and IV2 can be used as valid IVs in the 2SPS models.

In the second stage, the food insecurity variable is regressed as a function, in which the predicted conflict variable is used to replace the original conflict variable. Formally, we estimate the following two equations:

$$Insecurity_i = \theta_i Incidence_i^P + \zeta_i X_i + \nu_i \quad (6a)$$

[15] We attempted to use the same IV in Equations (5a) and (5b) to simplify our analysis. However, the validity tests of the IV using the falsification tests suggest that we should use different IVs (IV1 and IV2) in the two equations for efficient model estimations.

$$Insecurity_i = \varphi_i Severity_i^P + \phi_i X_i + \omega_i \quad (6b)$$

where $Insecurity_i$ refers to food insecurity indicators. $Incidence_i^P$ refers to the predicted variable representing the incidence of FH conflict; $Severity_i^P$ refers to the predicted variable representing the severity of FH conflict. As shown in previous studies (Mishra & Moss, 2013; Wooldridge, 2015a), the predicted variables control for endogeneity issues and improve the efficiency of model estimations. $X_i$ is defined earlier. $\theta_i$, $\zeta_i$, $\varphi_i$ and $\phi_i$ are parameters to be estimated. $\nu_i$ and $\omega_i$ are error terms capturing the unobserved heterogeneities.

## 4.4 Data, Variable Measurements, and Descriptive Statistics

### 4.4.1 Data

The study uses primary farm household data collected between May and June 2019 in Nigeria. The information collected refers to the 2018 planting season. The sample was selected using a multistage sampling approach. First, we purposively selected the North Central and South-East geopolitical zones in Nigeria because they are the most food secure and least food secure zones (Nnaji, Ratna, & Renwick, 2020). According to the preliminary analysis, the North central zone was found to be the most food-secure zone, while the South-East was food insecure. Other secondary sources also suggest that the North Central zone had the most occurrence of FH conflicts, while the South-East zone had fewer incidences of FH conflicts. The purposive selection of these two regions helps increase the chances of variation in the data collected, making our samples more representative. Second, we purposively selected one state in each zone, then five local government areas (LGAs) in each state, based on the previous occurrences of FH conflicts. Third, two towns from each LGA and then two villages from each town were randomly selected. Finally, approximately ten households in each village were randomly selected to answer the interview questionnaire, contributing to a total of 401 households.

We conducted the survey with the assistance of enumerators who usually help the projects of the International Food Policy Research Institute (IFPRI), Abuja office, Nigeria. The enumerators spoke both

English and local dialects so they could control the survey quality. Before the formal survey, we improved the questionnaire based on the feedback collected from the pre-test samples. We also trained the enumerators to make sure they clearly understood the survey objectives and questions covered in the questionnaire, guaranteeing accuracy and efficiency of data collection. The information derived from the survey related to the 2018 planting season and focused on information, such as household, household head, and farm-level characteristics, asset ownership, and land tenure rights. Questionnaires were administered to household heads on behalf of the household. The households in our sample mainly cultivate crops such as cassava, yam, soybean, and maize and raise livestock such as poultry, sheep, and goats for livelihoods.

### 4.4.2 Variable Measurements

**Food Insecurity**

In this study, we employ both the household food insecurity access scale (HFIAS) and the coping strategies index (CSI) to proxy food insecurity. These two indicators allow us to capture food insecurity in the form of consumption behaviours that clearly indicate the food availability and accessibility pillars of food security. They also capture the elements of sufficiency, quality, and psychological factors (Maxwell, Vaitla, & Coates, 2014). Both HFIAS and CSI have been used in previous studies (Belayneh, Loha, & Lindtjørn, 2021; Oldewage-Theron & Egal, 2021; Pakravan-Charvadeh et al., 2021).

The HFIAS is a behavioural and psychological measure that captures household behaviours that reflect the insufficient quantity and quality of food as well as worry over access to it. It covers a 30-day period and is based on occurrence questions about households' anxiety and uncertainty regarding food supply, inadequate food quality, insufficient food intake, and its consequences. Responses were collected based on the frequency of the condition (rarely, sometimes, or often) and then used to construct an index that captures the prevalence of household food insecurity. The HFIAS ranges from 0 to 27 – households that are entirely food secure to those that are severely food insecure. The HFIAS not only captures the physical aspects of sufficient quantity and quality of food (availability) but also

detects the psychosocial expressions of worry and uncertainty about insecure food access (accessibility) (Castell et al., 2015).

The CSI is an indirect measure of food insecurity that captures the frequency and severity of households' behaviour when they do not have enough food or funds to buy food. It evaluates what people do when they do not have enough food by assessing the severity and frequency of coping behaviours used to manage food shortages. As with the HFIAS, the CSI is based on a 30-day recall of coping strategies that are then weighted (a household that just changes to a less preferred food is less food insecure than one with members that go a whole day without food) and combined into an index. It has a value ranging between 0 to 93. The CSI captures household behaviours and coping approaches in times of food deficit (Maxwell, Caldwell, & Langworthy, 2008).

**FH conflicts**

The CSI is an indirect measure of food insecurity that captures the frequency and severity of households' behaviour when they do not have enough food or funds to buy food. It evaluates what people do when they do not have enough food by assessing the severity and frequency of coping behaviours used to manage food shortages. As with the HFIAS, the CSI is based on a 30-day recall of coping strategies that are then weighted (a household that just changes to a less preferred food is less food insecure than one with members that go a whole day without food) and combined into an index. It has a value ranging between 0 to 93. The CSI captures household behaviours and coping approaches in times of food deficit (Maxwell et al., 2008).

Our measurements of FH conflicts differ from the armed conflicts defined in the Uppsala Conflict Data Program. In particular, the conflicts captured by this program captures armed conflicts with the government as one of the parties and perpetuate the use of armed forces resulting in battle-related deaths (Gleditsch et al., 2002). Their definition of conflicts imposes restrictions on the number of fatalities and the types of actors involved; hence, they are not suited for household-level studies. FH conflicts in the context of this study diverged from the armed FH conflict studied in George, Adelaja, and Awokuse (2021) and captured in the Armed Conflict Location and Event Dataset (ACLED), which

cover only violent FH conflict occurrences that result in fatalities. In our study, we capture both incidences of FH conflicts and the collateral damage from such conflicts. This allows us to specify the severity of conflicts in the number of deaths and injuries, loss of yield, and property. Our comprehensive definitions cover nuances not usually captured by solely a record of the number of battle deaths and these are integral to addressing our research questions.

**Control variables**

Food insecurity is affected by a plethora of factors. Hence, in addition to our key variables of interest – incidence and severity of FH conflict, we include control variables selected based on the literature on the determinants of food security (Baba & Abdulai, 2021; Dasgupta & Robinson, 2022; Delvaux & Paloma, 2018; Gallegos et al., 2022; Goli et al., 2021; Ingutia & Sumelius, 2022; Joshi & Joshi, 2017). Household-level socio-economic characteristics that are most likely to influence household food security are included in our model specification. The household heads' age, gender, and educational attainment are included to capture the influence of the household heads' personal characteristics on household food insecurity.

An asset ownership index is included to measure the effect of household wealth on their food insecurity status. The dependency ratio is specified as the number of household members aged between 15 and 65 years to household size. The road quality variable is measured as a dummy indicating household perception of the road quality from their village to their closest farmland. Farm size is total farmland measured in hectares. The household income variable is measured as total income per household member. The formal land title variable is captured as a dummy indicating whether a household has a formal title deed to their largest farmland. Crop diversification is captured as the number of crops cultivated by households, while the land tenure variables measure the total bundle of rights households have on their largest farmland. The land tenure variable captures households' total bundle of rights to their largest farmland. This measures the exclusive use rights rural households have to their land, which is a proxy for how secure the tenure on their farmland is.

### 4.4.3 Summary Statistics

Table 4.1 provides the summary statistics of the selected variables in the study. The control variables are selected by drawing upon the existing literature on conflicts and food security (Arias et al., 2019; Brück & d'Errico, 2019; Brück et al., 2019; D'Souza & Jolliffe, 2013; George et al., 2020; Martin-Shields & Stojetz, 2019). The food insecurity measures, HFIAS and CSI, are continuous variables. In particular, the value of HFIAS ranges between 0 to 27, and has a mean of 11.27. The value of CSI ranges from 0 to 93, and has a mean of 22.12. The incidence of the FH conflict variable is continuous, with a mean of about 4 (out of 28). This implies that, on average, FH conflicts occurred about four times in the communities surveyed in 2018. The severity of the FH conflict variable is a proportion that has a mean of 0.59 with a standard deviation of 0.39. The closer the value is to one for a household, the more

severe its food insecurity.

In our sample, the average rural household head is aged about 49, which is very close to the age reported in previous studies (Delvaux & Paloma, 2018; Etowa, Nweze, & Arene, 2014; George, Adelaja, & Awokuse, 2021). The average education is just more than eight years of formal education (Table 4.1). Twenty-four per cent of our sampled household heads are female. On average, the households have

**Table 4.1 Variable definitions and descriptive statistics**

| Variables | Definitions | Mean (S.D.) |
|---|---|---|
| *Dependent variables (Food insecurity)* | | |
| HFIAS | Household Food Insecurity Access Scale (0-27) | 11.27 (6.33) |
| CSI | Coping Strategies Index (0-93) | 22.12 (19.77) |
| *Key explanatory variables (Conflict)* | | |
| Incidence of FH Conflict | Number of farmer-herder conflicts in the community in 2018 (0-28) | 3.95 (6.20) |
| Severity of FH Conflict | Index for the severity of farmer-herder conflicts (%) | 0.59 (0.39) |
| *Control variables* | | |
| Age | Age of household head (years) | 49.43 (14.46) |
| Gender | 1 if household head is female, 0 otherwise | 0.24 (0.43) |
| Education | Education of household head (years) | 8.64 (5.18) |
| Asset index | Household asset ownership index | 0.22 (0.21) |
| Dependency ratio | Ratio of the number of members aged below 15 years and above 65 years to household size (%) | 0.40 (0.23) |
| Household size | Number of household members (persons) | 9.44 (6.82) |
| Road quality | 1 if household head perceives the quality of road from village to farmland is good, 0 otherwise | 0.25 (0.43) |
| Farm size | Total area of cultivated farmland (hectares) | 1.59 (1.55) |
| Formal land title | 1 if household has formal title for their land, 0 otherwise | 0.14 (0.35) |
| Household income | Household's total income (₦10,000/capita)[a] | 4.48 (4.47) |
| Crop diversification | The number of crops cultivated by a household (0-17) | 7.52 (3.15) |
| Land tenure | Bundle of property rights on their largest farmland (0-12) | 10.47 (2.45) |
| *Instrumental variables* | | |
| Time taken to police station | Time taken to travel from household to the closest police station (minutes) | 35.97 (34.27) |
| Distance to police station | Distance from household to the closest police station (km) | 7.87 (8.65) |
| Sample size | 401 | |

a ₦ is Nigerian currency (US$1 = ₦ 380), S.D. refers to standard deviation

around nine members and cultivate around seven different crops on about 1.59 hectares of land. In comparison, Ecker and Hatzenbuehler (2021) reported an average farm size of about 2.35 hectares when estimating the Nigerian General Household Survey (GHS) data, and George, Adelaja, and Awokuse (2021) reported an average farm size of 3.77 hectares when estimating the same dataset. The difference is not impossible, given the fact that the GHS captures households in all geopolitical zones in Nigeria, especially zones with higher landmass than the zones captured in this study (North Central and South East). A quarter of household heads perceive that the quality of the road from their residing village to farmland is good. Only 14% of households have formal land titles. The average household income is 44,800 naira/capita/year (US$1=380 naira), which is higher than the income reported by Etowa et al. (2014), which is 29,504.06 naira/capita/year. The difference could be attributed to inflation over time.

## 4.5 Results and Discussion

### 4.5.1 Impacts of the Incidence of FH Conflicts on Food Insecurity

Table 2 reports the impacts of the incidence of FH conflicts on food insecurity, which are estimated by Equations (5a) and (6a) using the 2SPS model. As discussed earlier, we used the predicted variable representing the incidence of FH conflicts in the two food insecurity equations to address the endogeneity issues.

The results of the first-stage estimations (column 2 of Table 4.2) show that the age and gender of the household head and the perceived road quality to farmland are the main factors that negatively affect the incidence of FH conflicts. For example, the age variable appears to affect the incidence of FH conflicts negatively and significantly, suggesting that households with older heads experience fewer FH conflicts. This indicates that younger farmers may draw more FH conflicts due to a higher probability of them confronting herders and a lack of experience in peaceful coexistence and resolution of grievances. This finding aligns with that of Usman (2019b), who pointed out that younger farmers are more vicious in handling issues with herders, leading to more occurrence of FH conflicts in the Northern Senatorial District, Kaduna State, Nigeria. On the other hand, household size, crop

diversification, land tenure, and the time taken to the closest police station are the main factors that positively influence the incidence of FH conflicts. For example, the variable representing land tenure has a positive and statistically significant coefficient. This finding suggests that the more rights households have to their farmland, the more FH conflicts. This may be explained by the fact that with secure tenure, farming households are less likely to tolerate encroachment onto their land by herders who may be reluctant to obey formal land rights held by farming households leading to more incidences of FH conflicts. This implies that with a higher bundle of rights to their farmland, rural households are more protective of their farm assets which result in more lashes with herders. Our finding is in line with Rugadya (2020), who found land tenure to be a cause of tension and a driver of conflict among mining communities in Karamoja, Uganda.

**Table 4.2 Impacts of the incidence of FH conflict on food insecurity: 2SPS model estimation**

| | First stage | Second stage | |
|---|---|---|---|
| Variables | Incidence of FH conflict (Coefficients) | HFIAS (Coefficients) | CSI (Coefficients) |
| Incidence of FH conflict (predicted) | | 0.074 (0.338)** | 1.967 (1.076)* |
| Age | -0.067 (0.028)** | 0.021 (0.036) | 0.110 (0.109) |
| Gender | -1.824 (0.459)*** | 1.230 (1.077) | 4.289 (3.307) |
| Education | -0.065 (0.064) | 0.087 (0.077) | -0.073 (0.242) |
| Asset index | -1.531 (1.712) | -6.538 (1.698)*** | -3.330 (5.166) |
| Farm size | -0.158 (0.144) | 0.046 (0.211) | 0.649 (0.575) |
| Formal land title | -0.205 (1.023) | 3.275 (0.898)*** | 17.888 (3.140)*** |
| Household income | -0.004 (0.059) | 0.001 (0.069) | -0.188 (0.188) |
| Dependency ratio | -0.011 (0.012) | 0.003 (0.014) | 0.013 (0.042) |
| Household size | 0.036 (0.069)** | -0.157 (0.063)** | -0.512 (0.182)*** |
| Crop diversification | 0.207 (0.110)* | -0.257 (0.141)* | -1.125 (0.447)** |
| Road quality | -1.490 (0.523)*** | -0.775 (0.921) | 0.173 (2.986) |
| Land tenure | 0.199 (0.011)** | -0.503 (0.148)*** | -2.081 (0.492) ** |
| Time taken to police station | 0.026 (0.011)** | | |
| Constant | 3.861 (2.259)* | 16.071 (3.134)*** | 41.128 (9.044)*** |
| Sample size | 401 | 401 | 401 |
| *R*-squared | 0.183 | 0.152 | 0.151 |

Note: Robust standard errors in parentheses. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively.

We used the variance inflation factor (VIF) to test the multicollinearity between independent variables, and did not find the existence of such an issue.

The results of the second-stage estimations (last two columns) show that the predicted variable representing the incidence of FH conflicts has positive and statistically significant coefficients. The findings suggest that a single increase in the incidence of FH conflicts increases food insecurity by 0.07 HFIAS units and 1.97 CSI units. The findings of the positive impacts of the incidence of FH conflicts on

food insecurity support Hypothesis 1. Incidences of FH conflicts may increase households' food insecurity through reduced income resulting from losses of crop yields or the destruction of farm property (as depicted in Figure 4.1). The finding is similar to that of George et al. (2020), who examined the effect of terrorism and armed conflicts on food insecurity and found that the frequency of terrorist attacks reduced household food consumption scores.

Among other control variables, the asset index variable is negative and statistically significant in column 3 of Table 4.2. This finding implies that a unit increase in a household's asset index reduces their food insecurity by 6.54 HFIAS units. The asset index is used as a proxy for wealth. The wealthier households are, the less food insecure they are. This finding agrees with previous studies (Chamberlin & Ricker-Gilbert, 2016; Mulwa & Visser, 2020; Mutisya et al., 2016; Neelakantan et al., 2020). The estimated coefficients for the variable representing formal land titles are positive and statistically significant. These findings suggest that having a formal title deed to farmland increases food insecurity. This implies that with formal rights to their farmland, rural households are more likely to protect their farmlands from encroaching herders. This will invariably lead to more occurrences of FH conflicts if herders do not respect the formal land rights of rural households and the subsequent increase in household food insecurity. Additionally, the high costs of obtaining land titles would limit title registration to lands situated in most urban and peri-urban areas, increasing household food insecurity. Our finding is supported mainly by Kehinde et al. (2021) for Nigeria. The household size variable's negative and statistically significant coefficients suggest that households with more members are negatively associated with food insecurity. A larger household size indicates more labour endowments to some extent; thus, they can benefit more from the farm and off-farm work and increase their food security.

### 4.5.2 Impacts of the Severity of FH Conflicts on Food Insecurity

Table 4.3 presents the results for the impacts of the severity of FH conflicts on food insecurity. The results are estimated by the 2SPS model using Equations (5b) and (6b). The first stage estimation results (column 2) reveal that farm size and household size have statistically significant and negative

impacts on the severity of FH conflicts. In contrast, crop diversification, road quality, and the distance from the household to the closest police station have statistically significant and positive impacts on the severity of FH conflicts. For example, the significant and negative coefficient of the household size variable suggests that households with more members are less severely affected by FH conflicts compared to households with fewer members. A possible explanation for this is that a larger household size offers more fighting power and hence, experience less severe FH conflicts. This finding agrees with that of Chamo et al. (2020). The significant and negative coefficient of the farm size variable indicates that households cultivating larger areas of farmland are less severely affected by FH conflicts. A reason for this may be that households with larger farmlands under cultivation may have other means of protecting themselves in the event of a FH conflict. They may also have means of protecting their farmlands and enforcing their property rights than those cultivating smaller pieces of farmland. The significant and positive coefficient of the crop diversification variable illustrates that households cultivating diverse crops are more severely affected by FH conflicts. Farmlands with diversified crops cultivated may attract grazing animals. The farmers lose more income and fight herders in retaliation, resulting in more severe FH conflicts because of competition. On the other hand, with increased diversified crops, herders may be less able to dissuade their animals from grazing on the farmland, which ultimately results in increased severity of FH conflict. This finding is in agreement with that of D'Errico, Bori, and Campos (2021), who found crop diversification to increase the likelihood of conflict in Mali.

**Table 4.3 Impacts of the severity of FH conflict on food insecurity: 2SPS model estimation**

| | First stage | Second stage | |
|---|---|---|---|
| | Severity of FH conflict | HFIAS | CSI |
| Variables | (Marginal effect) | (Coefficients) | (Coefficients) |
| Severity of FH conflict (predicted) | | 2.044 (0.610)*** | 5.407 (1.981)*** |
| Age | 0.001(0.001) | -0.023 (0.024) | -0.015 (0.075) |
| Gender | 0.058 (0.041) | -0.217 (0.810) | 0.250 (2.517) |
| Education | 0.000 (0.004) | 0.032 (0.071) | 0.230 (0.220) |
| Asset index | 0.077 (0.089) | -7.720 (1.478)*** | -6.729 (4.668) |
| Farm size | -0.021 (0.012)* | 0.107 (0.216) | 0.794 (0.562) |
| Formal land title | 0.042 (0.005) | 2.844 (0.864)*** | 16.718 (2.979)*** |
| Household income | 0.004 (0.005) | -0.030 (0.070) | -0.272 (0.187) |
| Dependency ratio | -0.000 (0.001) | -0.003 (0.013) | -0.005 (0.042) |
| Household size | -0.007 (0.003)** | -0.032 (0.044) | -0.167 (0.129) |
| Crop diversification | 0.027 (0.005)*** | -0.280 (0.126)** | -1.159 (0.386)*** |
| Road quality | 0.045 (0.042)** | -1.337 (0.744)* | -1.478 (2.437) |
| Land tenure | 0.009 (0.008) | -0.411 (0.130)*** | -1.815 (0.434)*** |
| Distance to police station | 0.021 (0.003)*** | | |
| Constant | | 20.064 (2.468)*** | 52.246 (7.350)*** |
| Sample size | 401 | 401 | 401 |
| *R*-squared | 0.132 | 0.169 | 0.163 |

Note: Robust standard errors in parentheses. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively.

We used the variance inflation factor (VIF) to test the multicollinearity between independent variables, and did not find the existence of such an issue.

The second-stage results (columns 3-4 of Table 4.3) show that the estimated coefficients of the predicted variable indicate that the severity of FH conflicts has statistically significant and positive impacts on food insecurity for both the HFIAS and CSI models at the 1% level. These results imply that a unit increase in the severity of FH conflicts increases household food insecurity by 2.04 HFIAS and 5.41 CSI units. Hence, Hypothesis 2, 'the severity of FH conflicts positively impacts food insecurity', is supported. The severity of FH conflicts increases households' food insecurity through its negative impacts on the scarcity of food and income losses, crop yields, injury to livestock as well as the destruction of farm property (as depicted in Figure 4.1). Our findings are in line with the results of extant studies showing that violent conflicts reduce agricultural production and food security (Adelaja & George, 2019; Arias et al., 2019; Brück et al., 2019; George, Adelaja, & Awokuse, 2021; George et al., 2020).

Among other factors affecting food insecurity, the estimated coefficients for crop diversification are statistically significant and negative at the 1% level, indicating that increased diversification in crop cultivation reduces food insecurity. The finding is supported by the result of Goshu, Kassa, and Ketema (2012), who found a positive association between crop diversification and food security in rural Ethiopia. The finding of the negative relationship between crop diversification and food insecurity may be because areas, where a variety of crops are cultivated may imply fertile soils with an abundance of crops and foliage for grazing cattle. Hence, those areas are most likely to have increased availability of diverse types of food crops despite facing a higher probability of the incidence and severity of FH conflicts. The significant and negative coefficient of the road quality variable in column 3 shows that good quality roads from villages to farmland decreases food insecurity. Farmers can conveniently transport inputs from the markets to the farmland when the road is of good quality, which helps improve production efficiency and land productivity, contributing to food security. Land tenure affects HFIAS and CSI negatively and significantly, suggesting that land tenure security reduces food insecurity. Higher land tenure security motivates farmers to invest more in their farms, enhancing farm productivity and food security (Ghebru & Holden, 2013; Rockson, Bennett, & Groenendijk, 2013).

### 4.5.3 Robustness Check

We estimated the impact of FH conflicts on food insecurity using conditional mixed process (CMP) models for robustness check purposes. The CMP model can help address the endogeneity issues of the FH conflict variables (Baum, 2016; Zhu, Ma, & Leng, 2020). The results estimated for the impact of the incidence of FH conflicts on food insecurity are presented in Table 4.A2 in the Appendix. Table 4.A3 in the Appendix shows the results for the impact of the severity of FH conflicts on food insecurity. Overall, the estimates in the two tables show that the coefficients of the variables representing the incidence and severity of FH conflicts are positive and statistically significant. The findings suggest that FH conflicts increase food insecurity, which echoes our results from the 2SPS models and confirms the robustness of our estimates.

### 4.5.4 Additional Analyses

To enrich our understanding of the relationship between FH conflicts and food insecurity, we conducted three additional analyses using the 2SPS models. First, we estimated the impacts of FH conflict exposure on food insecurity. Here FH conflict exposure is measured as a binary variable, which is given the value of one if households have been exposed to FH conflicts and zero otherwise. This variable captures households in communities that have had at least one FH conflict incidence in the preceding year. Exposure to FH conflicts may not directly affect household production and food availability, but it may instil fear in rural people, making them modify their typical production investments and limit their economic activities (Arias et al., 2019). The results are presented in Table 4.A4 in the Appendix. We show that FH conflict exposure has a positive and statistically significant impact on HFIAS and CSI. The findings imply that FH conflict exposure also leads to food insecurity.

Second, we use two other outcome variables to capture food insecurity: the number of months with insufficient food supply and the number of days with limited varieties of food eaten. The results for the impact of the incidence of FH conflicts on the two outcome variables are presented in columns 2-3 of Table A5 in the Appendix, and the results for the impact of the severity of FH conflicts on them are shown in the last three columns of the table. Our estimates show that the incidence of FH conflicts positively impacts the number of days with limited varieties of food eaten. The severity of FH conflicts significantly increases food insecurity, as measured by the number of months with insufficient food supply and the number of days with limited varieties of food eaten. In general, the results presented in Tables 4.A4, and 4.A5 in the Appendix are largely consistent with our main findings in Tables 4.2 and 4.3.

Third, we have re-estimated our food security models by including the interactions between female-headed households and the main conflict variables. This exploration is interesting. Because women cannot inherit land in some tribes in Nigeria, the prevalence of women having access to land and land titles is low. Legally though, women can own land. The results presented in Table 4.A6 in the Appendix show that the coefficients of the interaction terms are insignificant, even at the 10% significance level.

The findings suggest that the gendered differentials do not necessarily influence the impact of FH conflict on food insecurity.

## 4.6 Conclusion and Policy Insights

Although any kind of conflict is detrimental to food security in general, studies on the impact of FH conflicts, the predominant type of conflict in SSA, is scarce in the literature. To fill in the research gap, this study estimated the impacts of the incidence and severity of FH conflicts on rural households' food insecurity, using data of 401 farm households collected from Nigeria. Food insecurity was captured using the HFIAS and CSI food insecurity measures. The 2SPS model was utilized to address the endogeneity issues of the conflict variables.

Empirical results revealed that both the incidence and severity of FH conflict significantly increase rural households' food insecurity. The severity of FH conflict has a larger impact on food insecurity than the incidence of FH conflict does. The positive relationship between FH conflicts and food insecurity is further confirmed by our estimates using the CMP model. We found food insecurity is negatively affected by asset index, household size, crop diversification, road quality, and land tenure, but it is positively influenced by formal title to farmland. The additional analysis showed that FH conflict exposure affects food insecurity positively and significantly. We also found that the incidence and severity of FH conflicts increase the number of days with limited varieties of food eaten, while the severity of FH conflicts also increases the number of months with insufficient food supply.

Our findings of the positive relationship between FH conflicts and rural households' food insecurity highlight the need for policy interventions to help households adversely impacted by ongoing FH conflicts. The results may expedite policy interventions to support households adversely impacted by ongoing FH conflicts. Such policies, for example, can include the provision of immediate safety nets, like food aid, to affected families, and planning post-conflict rehabilitation for both farmers and herders in regions severely affected by FH conflicts. Furthermore, while the above suggestions respond

to the conflict symptoms, there is a need to address the root causes. In particular, there is a need to consider policies that encourage more sustainable herding and farming practices. Early warning and alert systems that inform large farms and security forces about impending conflict will assist in preventing the onset of FH conflicts, which, in turn, will reduce their detrimental effect on rural livelihoods.

Additionally, since herders are mostly attracted to small farms in Nigeria establishing a community-wide solution where large farms cooperate with smaller farms would help prevent these conflicts. The need to curb the likelihood of FH conflicts in the future is paramount as the adverse effects of a changing climate are placing increased pressure on the land resources in Nigeria. This could be an interesting area for future research. The finding of the positive relationship between ownership of formal titles to farmland and food insecurity highlights the importance of establishing mechanisms or improving existing mechanisms that enforce formal land rights, aimed at reducing occurrences of these FH conflicts and subsequent food insecurity. This study focuses on the impacts of FH conflicts on the food insecurity of farmers. Future studies may look at how FH conflicts affect herders' herding behaviours and their food security.

## Appendix 4.0

**Table 4.A1 Falsification tests of instrumental variables**

| Variables | Instrumental variables | | | |
|---|---|---|---|---|
| | Time to police station | | Distance to police station | |
| | *F*-value | *p*-value | *F*-value | *p*-value |
| HFIAS | 2.15 | 0.143 | 1.52 | 0.218 |
| CSI | 1.69 | 0.194 | 1.69 | 0.195 |
| Incidence of FH conflict | 8.10*** | 0.005 | | |
| Severity of FH conflict | | | $\chi^2$=56.08***; *p*=0.000 | |

Note: *** denote significance level at 1%

**Table 4.A2 CMP parameter estimates for the impacts of incidence of FH conflict on food insecurity: Robustness check**

| | HFIAS | | CSI | |
|---|---|---|---|---|
| Variables | First stage (Coefficient) | Second stage (Coefficient) | First stage (Coefficient) | Second stage (Coefficient) |
| Incidence of FH conflict | | 0.704 (0.369)* | | 1.968 (2.367)* |
| Age | -0.067 (0.028)** | 0.021 (0.040) | -0.067 (0.028)** | 0.110 (0.119) |
| Gender | -1.824 (0.466)*** | 1.230 (1.161) | -1.824 (0.452)*** | 4.289 (3.481) |
| Education | -0.065 (0.063) | 0.087 (0.082) | -0.065 (0.063) | -0.073 (0.252) |
| Asset index | -1.531 (1.684) | -6.538 (1.937)*** | -1.531 (1.684) | -3.330 (6.042) |
| Farm size | -0.158 (0.142) | 0.046 (0.273) | -0.158 (0.142) | 0.649 (0.625) |
| Formal land title | -0.205 (1.006) | 3.275 (0.904)*** | -0.205 (1.006) | 17.888 (3.155)*** |
| Household income | -0.004 (0.058) | 0.001 (0.075) | -0.004 (0.058) | -0.188 (0.206) |
| Dependency ratio | -0.011 (0.012) | 0.003 (0.015) | -0.011 (0.012) | 0.013 (0.047) |
| Household size | 0.136 (0.058) | -0.157 (0.075)** | 0.136 (0.068)** | -0.512 (0.211)** |
| Crop diversification | 0.207 (0.108)* | -0.257 (0.149)* | 0.207 (0.108)* | -1.125 (0.461)** |
| Road quality | -1.490 (0.515)*** | -0.775 (0.969) | -1.490 (0.515)*** | 0.174 (2.980) |
| Land tenure | 0.199 (0.089)** | -0.503 (0.166)*** | 0.199 (0.089)** | -2.081 (0.531)*** |
| Time taken to police station | 0.026 (0.011)** | | 0.026 (0.011)** | |
| Constant | 3.861 (2.222)* | 16.071 (3.342)*** | 3.389 (2.037)*** | 41.128 (9.558)*** |
| $\ln(\sigma_1)$ | 1.869 (0.157)*** | | 2.987 (0.139)*** | |
| $\ln(\sigma_2)$ | 1.722 (0.062)*** | | 1.721 (0.062)*** | |
| $\text{ath}(\rho_{\varepsilon v})$ | -0.500 (0.332) | | -0.447 (0.322) | |
| Sample | 401 | 401 | 401 | 401 |

Note: Robust standard errors in parentheses. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively.

**Table 4.A3 CMP parameter estimates for the impacts of the severity of FH conflict on food insecurity**

| | HFIAS | | CSI | |
|---|---|---|---|---|
| Variables | First stage (Coefficient) | Second stage (Coefficient) | First stage (Coefficient) | Second stage (Coefficient) |
| Severity of FH conflict | | 0.048 (0.008)*** | | 0.111 (0.024)*** |
| Age | -0.002 (0.004) | -0.028 (0.022) | -0.002 (0.004) | -0.032 (0.070) |
| Gender | 0.112 (0.127) | -0.267 (0.795) | 0.112 (0.127) | 0.149 (2.492) |
| Education | 0.007 (0.012) | 0.031 (0.068) | 0.007 (0.012) | -0.233 (0.213) |
| Asset index | 0.217 (0.270) | -7.997 (1.387)*** | 0.217 (0.270) | -7.581 (4.547)* |
| Farm size | -0.081 (0.035)** | 0.076 (0.192) | -0.081 (0.035)** | 0.670 (0.630) |
| Formal land title | 0.128 (0.158) | 2.940 (0.795)*** | 0.127 (0.158) | 17.013 (2.838)*** |
| Household income | 0.013 (0.013) | -0.024 (0.067) | 0.013 (0.013) | -0.250 (0.186) |
| Dependency ratio | -0.001 (0.002) | -0.003 (0.013) | -0.001 (0.002) | -0.005 (0.041) |
| Household size | -0.016 (0.009)* | -0.032 (0.040) | -0.016 (0.009)* | -0.174 (0.121) |
| Crop diversification | 0.073 (0.017)*** | -0.239 (0.104)** | 0.073 (0.017)*** | -0.993 (0.327)*** |
| Road quality | -0.222 (0.123)* | -1.420 (0.716)** | -0.222 (0.123)* | -1.848 (2.354) |
| Land tenure | 0.020 (0.023) | -0.396 (0.124)*** | 0.020 (0.023) | -1.761 (0.421)*** |
| Distance to police station | 0.012 (0.001)*** | | 0.012 (0.001)*** | |
| Constant | -0.820 (0.415) | 17.732 (2.403)*** | -0.819 (0.415) | 46.759 (7.169)*** |
| $\ln(\sigma_1)$ | 1.720 (0.034)*** | | 2.880 (0.040)*** | |
| $\text{ath}(\rho_{\eta\omega})$ | -0.013 (0.032) | | -0.011 (0.033) | |
| Sample | 401 | 401 | 401 | 401 |

Note: Robust standard errors in parentheses. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively.

**Table 4.A4 2SPS Parameter estimates for the impacts of FH conflict exposure on food insecurity**

| Variables | First stage | Second stage | |
|---|---|---|---|
| | FH conflict exposure (marginal effect) | HFIAS | CSI |
| | | (Coefficients) | (Coefficients) |
| FH conflict exposure (predicted) | | 0.882 (0.424) ** | 2.466 (0.349) * |
| Age | -0.002 (0.002) | -0.018 (0.025) | 0.001 (0.077) |
| Gender | 0.140 (0.061) | -0.231 (0.821) | 0.205 (0.220) |
| Education | 0.005 (0.005) | 0.019 (0.071) | -0.265 (0.220) |
| Asset index | -0.027 (0.127) | -7.497 (1.532)*** | -6.011 (4.759) |
| Farm size | -0.025 (0.016) | 0.043 (0.211) | 0.640 (0.573) |
| Formal land title | -0.001 (0.068) | 3.134 (0.888)*** | 17.493 (3.073) *** |
| Household income | 0.005 (0.006) | -0.025 (0.069) | -0.261 (0.190) |
| Dependency ratio | -0.002 (0.001)* | 0.003 (0.014) | 0.012 (0.042) |
| Household size | -0.001 (0.004) | -0.056 (0.043) | -0.229 (0.125)* |
| Crop diversification | 0.015 (0.008)** | -0.179 (0.120) | -0.909 (0.373)** |
| Road quality | -0.163 (0.052)*** | -1.103 (0.837) | -0.743 (2.720) |
| Land tenure | 0.007 (0.010) | -0.394 (0.135)*** | -1.776 (0.442)*** |
| Time taken to police station | 0.004 (0.001) *** | | |
| Constant | | 18.946 (2.563)*** | 49.165 (7.429)*** |
| Sample | 401 | 401 | 401 |
| *R*-squared | | 0.152 | 0.151 |

Note: Robust standard errors in parentheses. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively.

**Table 4.A5 2SPS parameter estimates for the impacts of incidence and severity of FH conflict on alternative food insecurity indicators**

| Variables | Incidence of FH conflict | | | Severity of FH conflict | | |
|---|---|---|---|---|---|---|
| | First stage | Second stage | | First stage | Second stage | |
| | | number of months with insufficient food supply | number of days with limited varieties of food eaten | | number of months with insufficient food supply | number of days with limited varieties of food eastern |
| Incidence of FH conflict (predicted) | | 0.246 (0.156) | 0.092 (0.051)* | | | |
| Severity of FH conflict (predicted) | | | | | 0.378 (0.229)* | 0.272 (0.088)*** |
| Age | -0.067 (0.028)** | 0.018 (0.015) | 0.005 (0.006) | 0.001 (0.001) | 0.001 (0.009) | -0.001 (0.004) |
| Gender | -1.824 (0.459)*** | 0.642 (0.407) | 0.067 (0.170) | 0.058 (0.041) | 0.144 (0.302) | -0.121 (0.123) |
| Education | -0.065 (0.064) | 0.037 (0.028) | 0.021 (0.012)* | 0.000 (0.004) | 0.017 (0.024) | 0.014 (0.011) |
| Asset index | -1.531 (1.712) | -1.915 (0.624)*** | -1.561 (0.251)*** | 0.077 (0.089) | -2.432 (0.545)*** | -1.712 (0.212)*** |
| Farm size | -0.158 (0.144)(0.144) | 0.006 (0.072) | 0.028 (0.037) | -0.021 (0.012)* | 0.001 (0.070) | 0.036 (0.038) |
| Formal land title | -0.205 (1.023) | 0.148 (0.282) | 0.312 (0.123) | 0.042 (0.005) | 0.034 (0.284) | 0.256 (0.122)** |
| Household income | -0.004 (0.059) | -0.055 (0.023)** | 0.009 (0.011) | 0.004 (0.005) | -0.062 (0.024)*** | 0.005 (0.011) |
| Dependency ratio | -0.011 (0.012) | 0.004 (0.005) | 0.002 (0.002) | -0.000 (0.001) | 0.001 (0.005) | 0.001 (0.002) |
| Household size | 0.036 (0.069)** | -0.075 (0.026)*** | -0.011 (0.009) | -0.007 (0.003)** | -0.036 (0.016)** | 0.005 (0.006) |
| Crop diversification | 0.207 (0.110)* | 0.042 (0.068) | 0.011 (0.021) | 0.027 (0.005)*** | -0.015 (0.057) | -0.014 (0.019) |
| Road quality | -1.490 (0.523)*** | -0.296 (0.344) | -0.078 (0.137)** | 0.045 (0.042)** | -0.580 (0.251)** | 0.149 (0.111) |
| Land tenure | 0.199 (0.011)** | -0.111 (0.053)** | -0.061 (0.021)*** | 0.009 (0.008) | -0.069 (0.044) | -0.049 (0.019)*** |
| Time taken to police station | 0.026 (0.011)** | | | | | |
| Distance to police station | | | | 0.021 (0.003)*** | | |
| Constant | 3.861 (2.259)* | 3.080 (1.122)*** | 2.848 (0.489)*** | | 4.428 (0.837)*** | 3.369 (0.366)*** |
| Sample | 401 | 401 | 401 | 401 | 401 | 401 |
| *R*-squared | 0.183 | 0.115 | 0.176 | | 0.114 | 0.190 |

Note: Robust standard errors in parentheses. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively.

**Table 4.A6 2SPS parameter estimates for the impacts of incidence and severity of FH conflicts on food insecurity including gender-conflict interaction**

| | Incidence of FH conflict | | | Severity of FH conflict | | |
|---|---|---|---|---|---|---|
| | First stage | Second stage | | First stage | Second stage | |
| Variables | | HFIAS | CSI | | HFIAS | CSI |
| Incidence of FH conflict (predicted) | | 0.696 (0.338)** | 1.946 (1.080)* | | | |
| Severity of FH conflicts (predicted) | | | | | 1.944 (0.611)*** | 5.298 (1.957)*** |
| Incidence of FH conflict (predicted) – Gender interaction | | -0.612 (0.451) | -1.752 (1.367) | | | |
| Severity of FH conflict (predicted) – Gender interaction | | | | | 1.284 (1.536) | 1.415 (5.621) |
| Age | -0.067 (0.028)** | 0.014 (0.35) | 0.089 (0.110) | 0.001 (0.001) | -0.025 (0.024) | -0.018 (0.075) |
| Gender | -1.824 (0.459)*** | 2.227 (1.196)* | 7.143 (4.054)* | 0.058 (0.041) | -0.448 (0.861) | -0.005 (2.797) |
| Education | -0.065 (0.064) | 0.078 (0.076) | -0.099 (0.241) | 0.000 (0.004) | 0.029 (0.071) | -0.233 (0.220) |
| Asset index | -1.531 (1.712) | -6.557 (1.696)*** | -3.383 (5.170) | 0.077 (0.089) | -7.714 (1.478)*** | -6.722 (4.676) |
| Farm size | -0.158 (0.144) | 0.008 (0.209) | 0.541 (0.576) | -0.021 (0.012)* | 0.120 (0.222) | 0.809 (0.565) |
| Formal land title | -0.205 (1.023) | 3.147 (0.897)*** | 17.521 (3.139)*** | 0.042 (0.005) | 2.925 (0.869)*** | 16.808 (2.998)*** |
| Household income | -0.004 (0.059) | -0.001 (0.069) | -0.195 (0.187) | 0.004 (0.005) | -0.034 (0.069) | -0.276 (0.186) |
| Dependency ratio | -0.011 (0.012) | 0.002 (0.014) | 0.010 (0.043) | -0.000 (0.001) | -0.003 (0.013) | -0.005 (0.042) |
| Household size | 0.036 (0.069)** | -0.152 (0.063)** | -0.498 (0.182)*** | -0.007 (0.003)** | -0.031 (0.043) | -0.166 (0.130) |
| Crop diversification | 0.207 (0.110)* | -0.220 (0.147) | -1.019 (0.457)** | 0.027 (0.005)*** | -0.298 (0.130)** | -1.178 (0.397)*** |
| Road quality | -1.490 (0.523)*** | -0.997 (0.924) | -0.463 (3.032) | 0.045 (0.042)** | -1.224 (0.733)* | -1.353 (2.438) |
| Land tenure | 0.199 (0.011)** | -0.471 (0.150)*** | -1.988 (0.502)*** | 0.009 (0.008) | -0.411 (0.131)*** | -1.815 (0.434)*** |
| Time taken to police station | 0.026 (0.011)** | | | | | |
| Distance to police station | | | | 0.021 (0.003)*** | | |
| Constant | 3.861 (2.259)* | 16.016 (3.118)*** | 40.971 (9.057)*** | | 20.347 (2.488)*** | 52.559 (5.621)*** |
| Sample | 401 | 401 | 401 | 401 | 401 | 401 |
| *R*-squared | 0.183 | 0.157 | 0.155 | | 0.171 | 0.163 |

Note: Robust standard errors in parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

**Chapters 5 & 6 removed - Embargoed until 4 June 2024**

# Chapter 7

# General Conclusion and Policy Implications

## 7.1 Introduction

The unequal access to productive resources like land in most developing countries, as well as the recent increase in the frequency of occurrence of farmer-herder (FH) conflicts, motivated the need to examine the effect of gendered land access on the food security status of the household, and the direct and indirect effects of FH conflicts on rural household livelihoods. This thesis contributes to the extant literature by investigating the joint influence of access to land and gender on household food security and the multifaceted effect of FH conflicts on rural households' production decisions and food security in Nigeria. First, the joint influence of gender and land access on household food security status is determined. Second, the differential impact of the incidence and severity of FH conflicts on rural households' food insecurity is investigated. Third, a theoretical model of farmer-herder resource use conflict is developed, and the hypotheses derived tested, which posits that the risk perception of FH conflict will influence rural households' productive input use, participation in the land rental market, and their time allocation for farm work. Finally, the social-economic and cultural determinants of rural households' risk perception of FH conflict is examined.

## 7.2 Summary of Results

The results in Chapter 3 reveal that in Nigeria, increased access to arable land reduces the likelihood of households being food insecure. In addition, male-headed households are more likely to be food secure than female-headed households. The findings of the non-linear interaction between gender of household head and area of land accessed show that a one-acre increase in arable land reduced the probability of female-headed households being food insecure by about 16% on average when compared to male-headed households. However, the results also show that increased access to arable land does not improve the food security prospects for some female-headed households in Nigeria.

In Chapter 4, a positive and statistically significant impact of the incidence and severity of FH conflict on rural household food insecurity is found in rural Nigeria. An additional incidence of FH conflict increased rural household food insecurity by 0.07 HFIAS units and 1.97 CSI units. Similarly, it is found that a unit increase in the severity of FH conflicts increases rural households' food insecurity by 2.04 HFIAS units and 5.41 CSI units. The occurrence and severity of FH conflicts may raise household food insecurity through reduced food availability or diminished income resulting from the destruction of farm property, crop failure, and consequent crop yield loss. The results suggest that although both the incidence and severity of FH conflict have a statistically significant positive impact on rural households' food insecurity, the latter's impact is higher. Furthermore, household size, crop diversification, road quality to farmland, household asset index, and land tenure have significant negative impacts on food insecurity, while having a formal title to farmland positively influences food insecurity.

Chapter 5 finds that the risk perception of FH conflict has a negative and statistically significant effect on rural households' decision to use fertilisers. Similarly, rural households' risk perception of FH conflicts has a significant negative effect on their investment in fertilisers. This negative impact on productive input use, in this case, fertiliser, may invariably have adverse consequences for productivity and subsequent income. The results also reveal a statistically significant positive effect of the risk perception of FH conflict on rural households' time allocation for farm work. This suggests that rural households commit more time to farm work because of the perceived negative consequences of FH conflicts. Furthermore, the results show no significant impact of the risk perception of FH conflict on the area of cropland rural households' rent-in for cultivation. However, by splitting households into groups based on their perception of FH conflicts, our results show that risk-averse households rent in less cropland than risk-loving households.

Several social, economic, and demographic factors that influence rural households' risk perception of FH conflicts are discussed in Chapter 6. Specifically, the age of household head, farm size, migration status, and having formal title to cropland have a significant negative influence on the risk perception of FH conflicts. On the other hand, the farming experience of household head, household crop and

livestock diversity, number of languages spoken, distance from household to closest neighbour, households being in the north-central region, and the occurrence of a FH conflict in the community in the last five years, have a significant positive influence on the risk perception of FH conflicts. Furthermore, splitting the FH conflict risk perception index into two sub-indices relating to food production and supply and physical insecurity, reveals that age of household head, household language diversity, and exposure to FH conflict, are significant predictors of FH conflict risk perception regarding food production and supply. In contrast, household size, income, education of household head, farm size, and distance from household to the closest city are significant factors influencing FH conflict risk perception regarding physical insecurity and wellbeing.

## 7.3 Policy and Governance

For an ethnic and culturally diverse country like Nigeria, the successful implementation of policies presents major challenges. There have been numerous agricultural policies focused on advancing food security, including those focused on land and gender issues. However, while the implementation of some of these policies was partly successful, some were abandoned, and others simply failed. Before discussing the policy implications of this study, it is important to place the work within the context of the wider policy situation in Nigeria. Therefore, in this section, some of the core policies to address food security, land access and gender equality are discussed and the possible barriers to implementation are reviewed.

One of the major policies to improve the nutritional status of every Nigerian especially children, women and the elderly, were identified under the National Plan of Action on Food and Nutrition which was established in 2004. Its specific goal was to establish an operable system for coordinating the food and nutrition activities of all sectors and stakeholders as well as promoting habits that diminish malnutrition levels in the country. Evaluation of this policy between 2013 and 2016, exposed its non-performance and failure to achieve the set goals for food and nutrition security.

Currently, Nigeria is executing a National Multisectoral Plan of Action for Food and Nutrition (NMPFAN) between 2021 and 2025 aimed at attaining optimal nutrition for every Nigerian especially the most vulnerable including children, women and internally displaced people. The NMPFAN policy seeks to scale up cost-effective and high-impact nutrition interventions like enhancing infant and young child feeding, in order to improve the deteriorating nutrition situation in the country as well as meet post-SDG targets. All tiers of government in Nigeria are to finance the cost of implementing the NMPFAN policy within their budgets. The policy is also being supported by development partners and the private sector by building partnerships and scaling up nutrition interventions. Although the policy is only part way through, a barrier to its successful implementation may include a lack of coordination and synergy among key stakeholders and implementers.

In the agricultural sector, the Agricultural Transformation Agenda (ATA) policy was implemented over the period between 2011 and 2015. The ATA policy had multiple objectives, including promotion of agribusiness; reduction of post-harvest losses; improving efficiency across the agricultural value chain; development of rural infrastructure and; enhanced access to financial services and markets by smallholder farmers. If successful, the ATA would have also greatly improved food security. Unfortunately, the ATA had significant shortcomings, and as a result, the Agriculture Promotion Policy (APP) was developed and implemented between 2016 – 2020 to drive the growth and development of Nigeria's agriculture sector over the period. The overarching objectives of the APP are food security, economic diversification and job creation, as well as input substitution. The APP sought to address some of the shortcomings in the ATA like insufficient input supply and smallholder credit access, post-harvest losses etc. Although the APP made progress in some objectives like reducing unemployment in the agricultural sector, improving smallholder access to certified seeds, training more women, and increasing the volume of agricultural exports, there were still gaps in reaching the set objectives. Some of the gaps identified are the empowerment of women and youths in the agricultural sector, postharvest losses, import substitution and foreign exchange earnings amongst others. Recently, the federal ministry of agriculture launched the National Agricultural Technology, and Innovation Policy (NATIP) which is being implemented between 2022 and 2027.

For land administration policies, the cultural biases within the framework in which these decisions are made also determine how successful they are. For example, in the case of farmer-herder conflicts over land resources, the Nigerian government has made prior policy attempts to resolve the issue. The Nigeria Land use act of 1978 abolished the existing land tenure systems in both Northern and Southern Nigeria and replaced them with a uniform land administration system whereby land is under the control of the Governor for use and for the benefit of natives of the region. With the increased occurrence of FH conflicts, some state governments banned open grazing in order to curtail the onset of conflicts. This policy decision failed to resolve the issue of FH conflicts and may have increased tension between farmers and herders.[30]

The Federal government then proposed the enactment of Rural Grazing Areas (RUGA) settlements to be piloted in 12 states in the country. This policy process was suspended because of the fear of ethnic domination among key stakeholders and firm opposition by some state governments in the Southern region in their bid to protect the land for their natives. The RUGA policy, formulated amid overwhelming ethnic prejudice, failed because of a failure to have an inclusive policy process that enables collective efforts to address the devastating consequences of FH conflict. Following the failure of the RUGA settlements, the federal government initiated a National Livestock Transformation Plan (NLTP) which proposes the establishment of ranches across interested states. This is with the goal of reducing open grazing and subsequently decreasing the incidences of FH conflicts. As of mid-2021, only a fifth of the 20 states that agreed to the NLTP were ready for its implementation. This lack of trust and coordination among different governmental stakeholders further worsens the likelihood of resolving the burden of FH conflicts sustainably. Another contributory factor to the government's failure in addressing FH conflicts is the ethnic and religious biases of both farmers and herders. Most herders are Muslim and from the Fulani tribe, while most farmers are Christian and of diverse ethnicities. This imposes another layer of distrust among all concerned parties and may further buttress wariness and cynicism in enacting adequate policies to resolve these types of conflicts.

[30] See Yikwabs et al (2020)

Although examining the ethnic and religious bias involved in FH conflicts was beyond the scope of the research questions, it is important to note its influence on the implementation of the above-mentioned policies.[31]

Within this wider policy context, this thesis has provided evidence of the devastating effects of FH conflicts and the impact of gendered access to land on food security. The complex-policy making failures described above bring to light the difficulty that may be experienced by the Nigerian government in its bid to enact the right policies. These impediments include the federal government's inability to implement any land policies without the express permission of state governors. State governors, on the other hand, may be averse to certain land policies, for example, RUGA, because of differing ethnic and political interests. Also, mistrust of the government and failed institutional processes due to vested interests by key public and private stakeholders may disrupt the execution and performance of suggested policies. All of these may prevent the implementation of suggested policy processes that potentially prevent and alleviate the burden of FH conflicts.

One of the major policies to address gender equality is the Nigerian National Gender Policy (NGP) in Agriculture aiming to promote the adoption of gender-sensitive and gender-responsive strategies in the agricultural sector that ensure women and men have equal access to productive resources for improved agricultural productivity.[32] The NGP recognizes barriers to the advancement of the Nigerian agricultural sector due to the exclusion of female smallholder farmers in terms of accessing productive resources and strategic participation in key decision-making processes. For example, court land arbitrations are expensive and time-consuming with negotiations usually in favour of men over women due to deeply entrenched systemic cultural biases. Also, the NGP acknowledges that the rate of implementation of already existing policies to bridge the gender gap is poor. Hence, this policy provides

[31] See Ogu (2022) and Yamusa (2022) for a discussion on ethnic and religious bias influencing to FH conflicts.
[32] Gender-responsive policies refer to policies that incorporate gender and inclusion to improve targeted interventions while gender-transformative policies do not just incorporate gender and inclusion interventions, but also inform structural changes in norms and power relations that ultimately result in sustained improvements leading to gender equality.

a logical plan for the implementation of plans and programmes that will ensure the unbiased and equitable contribution of all farmers to the food and agricultural system.

The NGP proposes to address gender bias in the agricultural sector through mainstreaming gender equity in agricultural extension and coaching agricultural workers to pinpoint and address gender issues in the agricultural sector. The policy also seeks to empower female smallholder farmers by building their financial management skills and setting up a monitoring and evaluation framework to assess differential impacts of ongoing projects and interventions on men and women. Impediments to the successful implementation of the national gender policy are the inadequate documenting of policy processes, lack of programmes or initiatives that directly address the structural power relations, social norms, gender biases and inequalities in ownership and access to resources.[33]

## 7.4 Policy Implications

The previous section has outlined the broader policy environment in which this thesis is situated. Against this background, this section discusses the policy implications for each research objective. These policy implications are assessed within a nexus approach. In this case, the nexus of climate change, water and food security, energy and social justice embodied in the sustainable development goals (SDGs), are useful in understanding connections, linkages and trade-offs between governmental and non-governmental sectors.[34] This approach recognises that sustainably improving food security is hinged on complex trade-offs between food, water, energy and the environment. It goes beyond just increasing food production in isolation of other processes which may result from it. Interventions must be carried out within a framework that captures the intricacies of the effect of policies, strong institutions, health services, market infrastructures and resilience capacity.

The findings in Chapter 3 of this thesis show that although male-headed households are more food secure than female-headed households, with a one-acre increase in access to arable land, female-

[33] See Amadi (2017).
[34] See Grafton et al. (2016) and Lui et al (2018) for discussions on nexus approaches to global challenges of sustainable development.

headed households are less likely to be food insecure. This has implications for policies that seek to improve the food security of rural dwellers. First, it emphasizes the importance of gender equity in access to arable land to ensure food security. Also, the finding provides evidence that can help inform policy initiatives around issues of gendered access to land in support of the fifth SDG for gender equality and the empowerment of marginalized women. For instance, findings from this chapter can influence the review of the 2019 NGP being conducted by Nigeria's Federal Ministry of Agriculture and Rural Development (FMARD).

As noted in the previous section the NGP in agriculture aims to foster the implementation of gender-responsive and gender-transformative plans and programmes in the agricultural sector towards ensuring the equal control of, and access to, productive resources for men and women. Findings from this thesis emphasize the need for gender-transformative approaches to bridge gender gaps as well as in distributing productive resources to reduce food insecurity among Nigerian households. For multi-national organisations such as the Food and Agricultural Organisation (FAO) or World Food Programme (WFP), the research findings will help streamline already existing programmes and facilitate new ones that not only bridge the gap of gendered access to productive resources but encourage equity in access to these resources in order to enhance household food security at all levels.

An immediate response could be for the government to enact specific policies to facilitate and provide direct cash transfers or food crop subsidies to female-headed households to alleviate their food insecurity, especially during the lean season or episodes of drought. Nevertheless, direct cash transfers and crop subsidies will only alleviate the immediate needs of women and not address the root cause of the problem. In addition, the government can facilitate an inclusive framework, bringing together all key stakeholders to develop more gender-transformative policies that go beyond identifying the gender gaps to addressing the structural power relations, social norms and inequalities that foster these gaps. Also, agricultural project development at all levels should involve all stakeholders, including rural men and women. This is to ensure the relevance of interventions as well as enhance the probability of its success.

In Chapter 4, the result of the positive impact of incidence and severity of FH conflict on rural household food insecurity highlights the detrimental effects of the ongoing FH conflicts. This finding emphasizes the importance of policy initiatives to support rural households adversely affected by FH conflicts. For instance, policies that facilitate urgent safety nets like food aid to affected households or conflict resolution and rehabilitation for both herders and farmers in affected communities. Additionally, there is a need to establish policies that may prevent the onset of FH conflicts by addressing the root causes of these conflicts. For example, facilitating initiatives that encourage more sustainable herding practices like ranching and intensive crop farming. This is most likely to help in curbing the probability of FH conflicts in the future. This is important because the adverse effects of climate change are continually placing increased pressure on available arable land resources.

Results in Chapter 5 of the negative effect of the risk perception of FH conflict on the decision to use fertilisers, subsequent investment in fertilisers, and the area of cropland rented-in for cultivation suggests that FH conflict risk perception may have adverse consequences for agricultural productivity. Given that use of productive inputs use has been found to improve farm productivity and yield, the negative effect of FH conflict on fertiliser use may invariably have a detrimental impact on rural households' production and output. Thus, this finding provides empirical evidence of the damaging psychological effect of FH conflicts. The finding supports the argument that strategies targeted at improving rural farmers' productivity and efficiency, especially in conflict regions, should include improving their perception of security and safety. This can be done by enhancing the rule of law by increasing both the presence of security personnel and their effectiveness in FH conflict-affected communities and developing rural infrastructure like access roads. In addition, although challenging, the facilitation of an efficient conflict-resolution mechanism between farmers and herders that may include police personnel, the community heads and the neighbourhood watch may not only reduce the likelihood of FH conflict occurrence but also build trust and increase the perceived security of farming communities. These will facilitate the reduction of the perceived risks associated with FH conflicts. Currently, Nigeria is unable to meet domestic food demand for its growing population; thus, there is an urgent need for policies that will help boost food production.

The social, economic, and demographic factors that influence how rural households perceive the risk of FH conflicts have significant implications. Findings in Chapter 6 suggest that the facilitation of strategies that improve the procurement of formal titles to farmland may reduce how rural households perceive the risk of FH conflicts. For example, improving the security of land tenure through the facilitation of formal titles to cropland will help reduce how rural households perceive the risk of FH conflicts. Given that findings in Chapter 5 show that rural households' risk perception of FH conflicts significantly influences their production input use decisions, initiatives that reduce how adversely FH conflicts are perceived should be established. This result has implications for governmental and development agents keen on influencing the risk attitude of rural farmers and understanding how they respond to policy changes regarding FH conflicts.

Findings of the determinants of the risk perception of FH conflicts will also facilitate understanding of what factors influence how rural dwellers behave, especially with the threat of FH conflicts. Subsequently, this will inform the development of strategies that seek to influence rural households' risk attitudes to FH conflicts and improve risk management strategies. Also, findings in chapter 6 will help develop future studies where we can have more nuanced investigations with an interdisciplinary lens to help influence how farmers perceive the risk of FH conflicts. Engagement and coordination among key stakeholders and different tiers of government to identify potential trade-offs of different policy options will further increase the chances of arriving at a feasible solution to the vicious cycle of FH conflicts.

## 7.5 Limitations and Future Research

This thesis is not without limitations. A major limitation of the thesis is the lack of nationally representative data for analysis. Data from the third wave of the Nigerian general household survey was used in Chapter 3, but the number of observations was reduced to 1096 households after selecting key variables. Also, the analysis in Chapter 3 does not capture intra-household gender differences. This

is a shortcoming because women in male- and female-headed households may encounter different challenges in accessing land resources.

A second limitation is that the study does not capture herders in the survey data. Apart from the study's primary data research design being solely focused on rural farming households, the possibility of reaching out to nomadic herders was extremely limited. Inclusion of herders was not possible not only because of funding and time restraints, but also because of the risk factors. Hence, the research questions focused on rural farming households.

Another limitation of the thesis arises from the use of cross-sectional data due to a lack of micro-level longitudinal data on FH conflicts. Examining the seasonality effects of the risk perception of FH conflicts will be beneficial for future research. Longitudinal data will be more effective in capturing unobserved heterogeneities that also affect FH conflicts, for example, time-varying seasonality effects and climate conditions. This will give more insight into the long-term effects of FH conflict. Further studies investigating how past FH conflict shocks affect current risk perceptions will be important to improve understanding of the dynamics of FH conflicts.

Despite the inevitable limitations, the analytical chapters in this thesis make novel contributions by providing new insights into the influence of gendered access to land on food security; examining the direct and indirect effect of FH conflicts on rural households' livelihoods and food security; and exploring the social, economic, and demographic determinants of the risk perception of FH conflicts.

# References


Abdulai, A., & Goetz, R. (2014). Time-related characteristics of tenancy contracts and investment in soil conservation practices. *Environmental and Resource Economics, 59*(1), 87-109. doi:https://doi.org/10.1007/s10640-013-9719-y

Abdulai, A., Owusu, V., & Goetz, R. (2011). Land tenure differences and investment in land improvement measures: Theoretical and empirical analyses. *Journal of Development Economics, 96*(1), 66-78. doi:https://doi.org/10.1016/j.jdeveco.2010.08.002

Abonazel, M. R., & Ibrahim, M. G. (2018). On estimation methods for binary logistic regression model with missing values. *International Journal of Mathematics and Computational Science, 4*(3), 79-85.

ACLED. (2019). *Armed Conflict Location & Event Data Project (ACLED) codebook*. Retrieved from https://acleddata.com/acleddatanew/wp-content/uploads/dlm_uploads/2019/01/ACLED_Codebook_2019FINAL.docx.pdf

Adano, W. R., Dietz, T., Witsenburg, K., & Zaal, F. (2012). Climate change, violent conflict and local institutions in Kenya's drylands. *Journal of Peace Research, 49*(1), 65-80. doi:https://doi.org/10.1177/0022343311427344

Adekola, A. G., Adereti, F. O., Koledoye, G. F., & Owombo, P. T. (2013). Gender discrimination in Agricultural land access: Implications for food security in Ondo State, Nigeria. *Journal of Development and Agricultural Economics, 5*(2), 49-56. doi:https://doi.org/10.5897/JDAE12.048

Adelaja, A., & George, J. (2019). Effects of conflict on agriculture: Evidence from the Boko Haram insurgency. *World Development, 117*, 184-195.

Adelman, S., & Peterman, A. (2014). Resettlement and gender dimensions of land rights in post-conflict northern Uganda. *World Development, 64*, 583-596. doi:https://doi.org/10.1016/j.worlddev.2014.06.031

Adeniran, A. I. (2020). *Climatic factors in Nigeria's farmer-herder conflict*. Retrieved from https://media.africaportal.org/documents/Adeniran_-_Final_1.pdf

Adeosun, O. T., & Owolabi, K. E. (2021). Gender inequality: determinants and outcomes in Nigeria. *Journal of Business and Socio-economic Development, 1*(2), 165-181.

Adereti, F. (2005). Rural women's access to and control over productive resources: Implications for poverty alleviation among Osun State rural women, Nigeria. *Journal of Human Ecology, 18*(3), 225-230. doi:https://doi.org/10.1080/09709274.2005.11905835

Adesina, A. A., & Djato, K. K. (1997). Relative efficiency of women as farm managers: Profit function analysis in Côte d'Ivoire. *Journal of the International Association of Agricultural Economists, 16*, 47-53.

Adeyemi, R. A., Mayaki, J., Zewotir, T. T., & Ramroop, S. (2021). Demography and Crime: A Spatial analysis of geographical patterns and risk factors of Crimes in Nigeria. *Spatial Statistics, 41*, 100485.

Aditto, S. (2011). *Risk analysis of smallholder farmers in central and northeast Thailand.* (Doctoral Thesis), Lincoln University, New Zealand, Retrieved from http://dspace.lincoln.ac.nz/handle/10182/3924

AfDB. (2021). *African Economic Outlook 2021*. Retrieved from https://www.afdb.org/en/knowledge/publications/african-economic-outlook

Agarwal, B. (1994). *A field of one's own: Gender and land rights in South Asia* (Vol. 58). United Kingdom: Cambridge University Press.

Agarwal, B. (2003). Gender and land rights revisited: Exploring new prospects via the state, family and market. *Journal of Agrarian Change, 3*(1-2), 184-224.

Ahmed, A., & Kuusaana, E. D. (2021). Cattle ranching and farmer-herder conflicts in sub-Saharan Africa: Exploring the conditions for successes and failures in Northern Ghana. *African Security*, 1-24. doi:https://doi.org/10.1080/19392206.2021.1955496

Ahmed, A. A., & Muhammad, R. A. (2021). Participant observation of a farmers-herders community in Anguwar Jaba Keffi Nigeria. *International Journal of Scientific and Research Publications, 11*(7), 84-87.

Ahsan, D. A. (2011). Farmers' motivations, risk perceptions and risk management strategies in a developing economy: Bangladesh experience. *Journal of Risk Research, 14*(3), 325-349. doi:https://doi.org/10.1080/13669877.2010.541558

Ai, C., & Norton, E. C. (2003). Interaction terms in logit and probit models. *Economics letters, 80*(1), 123-129.

Ajefu, J. B., & Abiona, O. (2020). The mitigating impact of land tenure security on drought-induced food insecurity: Evidence from rural Malawi. *Journal of Development Studies, 56*(12), 2169-2193. doi:https://doi.org/10.1080/00220388.2020.1762862

Akadiri, S. S., Nwaka, k. D., & Jenkins, G. P. (2018). *Are female-headed households less food secure? Evidence from Nigeria and Ethiopia*. Paper presented at the 2018 Allied Social Science Association Annual Conference, Philadelphia.

Akov, E. T. (2017). The resource-conflict debate revisited: Untangling the case of farmer–herdsman clashes in the North Central region of Nigeria. *African Security Review, 26*(3), 288-307.

Akresh, R., Lucchetti, L., & Thirumurthy, H. (2012). Wars and child health: Evidence from the Eritrean–Ethiopian conflict. *Journal of Development Economics, 99*(2), 330-340. doi:https://doi.org/10.1016/j.jdeveco.2012.04.001

Ali, A., Abdulai, A., & Goetz, R. (2012). Impacts of tenancy arrangements on investment and efficiency: Evidence from Pakistan. *Agricultural Economics, 43*, 85-97. doi:https://doi.org/10.1111/j.1574-0862.2012.00622.x

Aliyu, U., Bashar, A. U., & Usman, U. (2021). Predictors for Risk Factors of Diabetes: Binary Logistic Regression Model Approach. *International Journal of Statistical Distributions and Applications, 7*(4), 89-94.

Allison, P. D. (2014). *Measures of fit for logistic regression.* Paper presented at the Proceedings of the SAS global forum 2014 conference.

Amadi, E. I. (2017). Implementation of Nigeria's national gender policy, revisiting the affirmative action. *International Journal of Political Science and Development*, *5*(5), 145-160.

Amadu, F. O., McNamara, P. E., & Miller, D. C. (2020). Understanding the adoption of climate-smart agriculture: A farm-level typology with empirical evidence from southern Malawi. *World Development, 126*, 104692. doi:https://doi.org/10.1016/j.worlddev.2019.104692

Amaza, P., Umeh, J. C., Helsen, J., & Adejobi, A. (2006). *Determinants and measurements of food insecurity in Nigeria: Some empirical policy guide*. Paper presented at the International Association of Agricultural Economists (IAAE) 2006 Annual Meeting August 12-18, Queensland, Australia. https://ageconsearch.umn.edu/record/25357/

Ankrah, D. A., Freeman, C. Y., & Afful, A. (2020). Gendered access to productive resources: Evidence from small holder farmers in Awutu Senya West District of Ghana. *Scientific African, 10*, e00604. doi:https://doi.org/10.1016/j.sciaf.2020.e00604

Aragie, T., & Genanu, S. (2017). Level and determinants of food security in North Wollo Zone (Amhara Region—Ethiopia). *Journal of Food Security, 5*(6), 232-247.

Aregheore, E. M. (2009). *Country pasture/forage resource profiles*. Retrieved from https://docplayer.net/65169942-Country-pasture-forage-resource-profiles-nigeria-by-eroarome-martin-aregheore.html

Arene, C., & Anyaeji, R. (2010). Determinants of food security among households in Nsukka Metropolis of Enugu State, Nigeria. *Pakistan Journal of Social Sciences, 30*(1), 9-16.

Arias, M. A., Ibáñez, A. M., & Zambrano, A. (2019). Agricultural production amid conflict: Separating the effects of conflict into shocks and uncertainty. *World Development, 119*, 165-184. doi:https://doi.org/10.1016/j.worlddev.2017.11.011

Audu, S. D. (2013). Conflicts among farmers and pastoralists in northern Nigeria induced by freshwater scarcity. *Developing Country Studies, 3*(12), 25-32.

Ayinde, O. E., & Obalola, T. O. (2017). Effect of socioeconomic characteristics and income status on onion farmers risk attitude in Sokoto state, Nigeria. *Agricultura Tropica Et Subtropica, 50*(3), 141-146.

Baba, A. R., & Abdulai, A.-M. (2021). Determinants of crop diversification and its effects on household food security in Northern Ghana. *Arthaniti: Journal of Economic Theory and Practice, 20*(2), 227-245.

Bar-Shira, Z., Just, R. E., & Zilberman, D. (1997). Estimation of farmers' risk attitude: An econometric approach. *Agricultural Economics, 17*(2-3), 211-222. doi:https://doi.org/10.1111/j.1574-0862.1997.tb00475.x

Baum, C. (2016). Conditional mixed-process models. *Lecture notes in Applied Econometrics, Boston College*.

Belayneh, M., Loha, E., & Lindtjørn, B. (2021). Seasonal variation of household food insecurity and household dietary diversity on wasting and stunting among young children in A drought prone area in South Ethiopia: A cohort study. *Ecology of food and nutrition, 60*(1), 44-69. doi:https://doi.org/10.1080/03670244.2020.1789865

Bello, L. O., Baiyegunhi, L. J., & Danso-Abbeam, G. (2021). Productivity impact of improved rice varieties' adoption: Case of smallholder rice farmers in Nigeria. *Economics of Innovation and New Technology, 30*(7), 750-766. doi:https://doi.org/10.1080/10438599.2020.1776488

Benjaminsen, T. A., Alinon, K., Buhaug, H., & Buseth, J. T. (2012). Does climate change drive land-use conflicts in the Sahel? *Journal of Peace Research, 49*(1), 97-111. doi:https://doi.org/10.1177/0022343311427343

Benjaminsen, T. A., & Ba, B. (2009). Farmer–herder conflicts, pastoral marginalisation and corruption: A case study from the inland Niger delta of Mali. *Geographical Journal, 175*(1), 71-81. doi:https://doi.org/10.1111/j.1475-4959.2008.00312.x

Benjaminsen, T. A., & Ba, B. (2019). Why do pastoralists in Mali join jihadist groups? A political ecological explanation. *The Journal of Peasant Studies, 46*(1), 1-20. doi:https://doi.org/10.1080/03066150.2018.1474457

Benti, D. W., Biru, W. T., & Tessema, W. K. (2022). The effects of commercial orientation on (Agro) pastoralists' household food security: Evidence from (Agro) pastoral communities of Afar, Northeastern Ethiopia. *Sustainability, 14*(2), 731.

Betts, J. R., & Fairlie, R. W. (2001). Explaining ethnic, racial, and immigrant differences in private school attendance. *Journal of Urban Economics, 50*(1), 26-51.

Blattman, C., & Miguel, E. (2010). Civil war. *Journal of Economic literature, 48*(1), 3-57. doi:10.1257/jel.48.1.3

Blench, R. (2010). *Conflict between pastoralists and cultivators in Nigeria*. Retrieved from http://www.rogerblench.info/Development/Nigeria/Pastoralism/Fadama%20II%20paper.pdf

Bogale, A. (2012). Vulnerability of smallholder rural households to food insecurity in Eastern Ethiopia. *Food Security, 4*(4), 581-591. doi:https://doi.org/10.1007/s12571-012-0208-x

Bora, S., Ceccacci, I., Delgado, C., & Townsend, R. (2011). *Food security and conflict*. Retrieved from World Bank, Washington, D. C. https://openknowledge.worldbank.org/handle/10986/9107

Bozzoli, C., & Brück, T. (2009). Agriculture, poverty, and postwar reconstruction: Micro-level evidence from Northern Mozambique. *Journal of Peace Research, 46*(3), 377-397. doi:https://doi.org/10.1177/0022343309102658

Bozzoli, C., & Brück, T. (2010) Child morbidity and camp decongestion in post-war Uganda. In, *MICROCON Research Working Paper 24*. MICROCON, Brighton.

Brander, M., Bernauer, T., & Huss, M. (2021). Improved on-farm storage reduces seasonal food insecurity of smallholder farmer households–Evidence from a randomized control trial in Tanzania. *Food Policy, 98*, 101891. doi:https://doi.org/10.1016/j.foodpol.2020.101891

Brottem, L. (2021). *The growing complexity of farmer-herder conflict in West and Central Africa*. Retrieved from https://www.jstor.org/stable/resrep32891

Brown, R., Montalva, V., Thomas, D., & Velásquez, A. (2019). Impact of violent crime on risk aversion: Evidence from the Mexican drug war. *Review of Economics and Statistics, 101*(5), 892-904.

Brück, T., & d'Errico, M. (2019). Food security and violent conflict: Introduction to the special issue. *World Development, 117*, 167-171. doi:https://doi.org/10.1016/j.worlddev.2019.01.007

Brück, T., d'Errico, M., & Pietrelli, R. (2019). The effects of violent conflict on household resilience and food security: Evidence from the 2014 Gaza conflict. *World Development, 119*, 203-223. doi:https://doi.org/10.1016/j.worlddev.2018.05.008

Brück, T., & Schindler, K. (2009). Smallholder land access in post-war northern Mozambique. *World Development, 37*(8), 1379-1389. doi:https://doi.org/10.1016/j.worlddev.2008.08.016

Buhaug, H., Benjaminsen, T. A., Sjaastad, E., & Theisen, O. M. (2015). Climate variability, food production shocks, and violent conflict in Sub-Saharan Africa. *Environmental Research Letters, 10*(12), 125015. doi:https://doi.org/10.1088/1748-9326/10/12/125015

Burke, W. J., & Jayne, T. (2021). Disparate access to quality land and fertilisers explain Malawi's gender yield gap. *Food Policy, 100*, 102002. doi:https://doi.org/10.1016/j.foodpol.2020.102002

Castell, G. S., Rodrigo, C. P., de la Cruz, J. N., & Bartrina, J. A. (2015). Household food insecurity access scale (HFIAS). *Nutricion hospitalaria, 31*(3), 272-278.

CDD. (2021). Farmer-herder conflict in Northern Nigeria: Trends, dynamics and gender perspectives. https://media.africaportal.org/documents/Farmer-Herder-Conflict-in-Northern-Nigeria-Trends-Dynamics-and-Gender-Perspectives-2.pdf

Chamberlin, J., Jayne, T., & Headey, D. (2014). Scarcity amidst abundance? Reassessing the potential for cropland expansion in Africa. *Food Policy, 48*, 51-65. doi:https://doi.org/10.1016/j.foodpol.2014.05.002

Chamberlin, J., & Ricker-Gilbert, J. (2016). Participation in rural land rental markets in Sub-Saharan Africa: Who benefits and by how much? Evidence from Malawi and Zambia. *American Journal of Agricultural Economics*, 1507-1528. doi:https://doi.org/10.1093/ajae/aaw021

Chamo, A., Abdullahi, A., Tafida, I., Karaye, A., Mamman, B., Kundiri, M., . . . Ja'afar, U. (2020). Effect of demographic characteristics on conflicts management in Jigawa State, Nigeria. *Journal of Agricultural Extension, 25*(1), 62-74. doi:10.4314/jae.v25i1.5S

Chege, C. G., Andersson, C. I., & Qaim, M. (2015). Impacts of supermarkets on farm household nutrition in Kenya. *World Development, 72*, 394-407. doi:https://doi.org/10.1016/j.worlddev.2015.03.016

Chikaire, J. U., Orusha, J. O., Tim-Ashama, A., Nwarieji, F. E., & Amanze, P. C. (2016). Perceived effects of insecure land rights on rural women's roles in household food security in Okigwe Agricultural Zone of Imo State, Nigeria. *Basic Research Journal of Soil and Environmental Science, 4*(1), 06-14.

Choithani, C. (2020). Gendered livelihoods: Migrating men, left-behind women and household food security in India. *Gender, Place & Culture, 27*(10), 1373-1394. doi:https://doi.org/10.1080/0966369X.2019.1681366

Chukwuma, K. H. (2020). Constructing the herder–farmer conflict as (in) security in Nigeria. *African Security, 13*(1), 54-76.

Clanet, J.-C., & Ogilvie, A. (2009). Farmer–herder conflicts and water governance in a semi-arid region of Africa. *Water International, 34*(1), 30-46. doi:https://doi.org/10.1080/02508060802677853

Coates, J., Swindale, A., & Bilinsky, P. (2007). Household Food Insecurity Access Scale (HFIAS) for measurement of food access: Indicator guide. *Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development*.

Cohn, L. D., Macfarlane, S., Yanez, C., & Imai, W. K. (1995). Risk-perception: Differences between adolescents and adults. *Health Psychology, 14*(3), 217-222. doi:https://doi.org/10.1037/0278-6133.14.3.217

Corral, P., Irwin, A., Krishnan, N., & Mahler, D. G. (2020). *Fragility and conflict: On the front lines of the fight against poverty*. Washington, DC: World Bank.

D'Errico, M., Bori, A., & Campos, A. P. d. l. O. (2021). Resilience and conflict: Evidence from mali. *Sustainability, 13*(18), 10444.

D'Souza, A., & Jolliffe, D. (2013). Conflict, food price shocks, and food insecurity: The experience of Afghan households. *Food Policy, 42*, 32-47. doi:https://doi.org/10.1016/j.foodpol.2013.06.007

Dary, S. K., James, H. S., & Mohammed, A. S. (2017). Triggers of farmer-herder conflicts in Ghana: A non-parametric analysis of stakeholders' perspectives. *Sustainable Agriculture Research, 6*(2), 141-151. doi:https://doi.org/10.5539/sar.v6n2p141

Dasgupta, S., & Robinson, E. J. (2022). Impact of COVID-19 on food insecurity using multiple waves of high frequency household surveys. *Scientific Reports, 12*(1), 1-15.

Day, A., & Caus, J. (2020a). *Conflict prevention in the era of climate change: Adapting the UN to climate-security risks* (9280865145). Retrieved from http://collections.unu.edu/view/UNU:7632#viewAttachments

Day, A., & Caus, J. (2020b). *Conflict prevention in the Sahel: Emerging practice across the UN* (9280865110). Retrieved from http://collections.unu.edu/view/UNU:7536#viewAttachments

de Brauw, A., & Herskowitz, S. (2021). Income variability, evolving diets, and elasticity estimation of demand for processed foods in Nigeria. *American Journal of Agricultural Economics, 103*(4), 1294-1313.

Deininger, K. (2003). Causes and consequences of civil strife: Micro-level evidence from Uganda. *Oxford Economic Papers, 55*(4), 579-606. doi:https://doi.org/10.1093/oep/55.4.579

Deininger, K., & Jin, S. (2006). Tenure security and land-related investment: Evidence from Ethiopia. *European Economic Review, 50*(5), 1245-1277. doi:https://doi.org/10.1016/j.euroecorev.2005.02.001

Delvaux, P. A. G., & Paloma, S. G. (2018). Access to common resources and food security: Evidence from national surveys in Nigeria. *Food Security, 10*(1), 121-140. doi:https://doi.org/10.1007/s12571-017-0757-0

Demeke, M. K., Valerie A; Jayne, Thomas S; Said, Ali; Vallee, Le; Chen, Hao. (1998). *Agricultural market performance and determinants of fertiliser use in Ethiopia*. Retrieved from https://ageconsearch.umn.edu/record/55599/

Dessai, S., & Sims, C. (2010). Public perception of drought and climate change in southeast England. *Environmental hazards, 9*(4), 340-357. doi:https://doi.org/10.3763/ehaz.2010.0037

Dhraief, M., Bedhiaf-Romdhania, S., Dhehibib, B., Oueslati-Zlaouia, M., Jebali, O., & Ben-Youssef, S. (2018). Factors affecting the adoption of innovative technologies by livestock farmers in arid areas of Tunisia. *FARA Res. Rep, 3*(5), 22.

Di Falco, S., Veronesi, M., & Yesuf, M. (2011). Does adaptation to climate change provide food security? A micro-perspective from Ethiopia. *American Journal of Agricultural Economics, 93*(3), 829-846. doi:https://doi.org/10.1093/ajae/aar006

Dimelu, M., Salifu, D., Enwelu, A., & Igbokwe, E. (2017). Challenges of herdsmen-farmers conflict in livestock production in Nigeria: Experience of pastoralists in Kogi State, Nigeria. *African Journal of Agricultural Research, 12*(8), 642-650. doi:https://doi.org/10.5897/AJAR2016.11740

Dimelu, M. U., Danjuma, S. E., Mbolle, C. J., Achonam, E. I., & Mbadiwe, I. E. (2017). Livelihood issues in herdsmen-farmers conflict among farming communities in Kogi State, Nigeria. *African Journal of Agricultural Research, 12*(24), 2105-2115. doi:https://doi.org/10.5897/AJAR2017.12319

Dimelu, M. U., Salifu, E. D., & Igbokwe, E. M. (2016). Resource use conflict in agrarian communities, management and challenges: A case of farmer-herdsmen conflict in Kogi State, Nigeria. *Journal of Rural Studies, 46*, 147-154. doi:https://doi.org/10.1016/j.jrurstud.2016.06.011

Dokken, T. (2015). Allocation of Land Tenure Rights in Tigray: How Large Is the Gender Bias? *Land Economics, 91*(1), 106-125. doi:10.3368/le.91.1.106

Dompreh, E. B., Asare, R., & Gasparatos, A. (2021). Sustainable but hungry? Food security outcomes of certification for cocoa and oil palm smallholders in Ghana. *Environmental Research Letters, 16*(5), 055001.

Doss, C., McPeak, J., & Barrett, C. B. (2008). Interpersonal, intertemporal and spatial variation in risk perceptions: Evidence from East Africa. *World Development, 36*(8), 1453-1468. doi:https://doi.org/10.1016/j.worlddev.2007.06.023

Doss, C., Meinzen-Dick, R., Quisumbing, A., & Theis, S. (2018). Women in agriculture: Four myths. *Global Food Security, 16*, 69-74. doi:https://doi.org/10.1016/j.gfs.2017.10.001

Doss, C., Summerfield, G., & Tsikata, D. (2014). Land, gender, and food security. *Feminist Economics, 20*(1), 1-23. doi:https://doi.org/10.1080/13545701.2014.895021

Doss, C. R. (1997). *The effects of women's bargaining power on household health and education outcomes in Ghana*. Paper presented at the Annual Meeting of the Population Association of America (PAA), March 27-29, 1997, Washington, DC.

Doss, C. R., & Morris, M. L. (2000). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agricultural Economics, 25*(1), 27-39. doi:https://doi.org/10.1111/j.1574-0862.2001.tb00233.x

Duflo, E., & Udry, C. (2004). *Intrahousehold resource allocation in Cote d'Ivoire: Social norms, separate accounts and consumption choices*. Retrieved from https://www.nber.org/papers/w10498

Duong, T. T., Brewer, T., Luck, J., & Zander, K. (2019). A global review of farmers' perceptions of agricultural risks and risk management strategies. *Agriculture, 9*(1), 10. doi:https://doi.org/10.3390/agriculture9010010

Dzialek, J. (2013). Perception of Natural Hazards and Disasters. In P. T. Bobrowsky (Ed.), *Encyclopedia of Natural Hazards* (pp. 756-759). Dordrecht: Springer Netherlands.

Eberle, U. J., Rohner, D., & Thoenig, M. (2020). Heat and Hate: Climate Security and Farmer-Herder Conflicts in Africa. *CEPR Discussion Paper No. 15542*. https://ssrn.com/abstract=3753942

Ecker, O., & Hatzenbuehler, P. L. (2021). Food consumption–production response to agricultural policy and macroeconomic change in Nigeria. *Applied Economic Perspectives and Policy*. doi:https://doi.org/10.1002/aepp.13161

Ecker, O., Hatzenbuehler, P. L., & Mahrt, K. (2018). Transforming agriculture for improving food and nutrition security among Nigerian farm households. *NSSP Working Paper 56*. http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/132881

Ecker, O., & Kennedy, A. (2019). *Transforming Agriculture to Improve Food and Nutrition Security in Nigeria*. Retrieved from https://www.ifpri.org/publication/transforming-agriculture-improve-food-and-nutrition-security-nigeria

Eke, S. (2020). 'Nomad savage'and herder–farmer conflicts in Nigeria: The (un) making of an ancient myth. *Third World Quarterly, 41*(5), 745-763. doi:https://doi.org/10.1080/01436597.2019.1702459

Ekong, P. S., Ducheyne, E., Carpenter, T. E., Owolodun, O. A., Oladokun, A. T., Lombin, L. H., & Berkvens, D. (2012). Spatio-temporal epidemiology of highly pathogenic avian influenza (H5N1) outbreaks in Nigeria, 2006–2008. *Preventive veterinary medicine, 103*(2-3), 170-177. doi:https://doi.org/10.1016/j.prevetmed.2011.10.001

Emenyonu, C. A., Eze, C. C., & Ejike, O. U. (2020). Factors Influencing Cassava Farmers' Climate Change Risk Perception in Anambra State, Nigeria. *American Journal of Climate Change, 9*(3), 217-227.

Endale, K. (2011). Fertiliser consumption and agricultural productivity in Ethiopia. *Working Papers 003, Ethiopian Development Research Institute*. https://ideas.repec.org/p/etd/wpaper/003.html

Ereeş, S., EREES, S., & DEMİREL, N. (2012). Omitted variable bias and detection with reset test in regression analysis. *Anadolu University Journal of Science and Technology B-Theoretical Sciences, 2*(1), 1-19.

ESRI. (2018). Africa Countries. Retrieved from https://www.arcgis.com/home/item.html?id=64aff05d66ff443caf9711fd988e21dd

Etowa, E. B., Nweze, N. J., & Arene, C. J. (2014). Effects of Migrant Remittances on Farm Household Welfare in Nigeria. *Review of Agricultural and Applied Economics, 18*, 3-10. doi:10.22004/ag.econ.254134

FAO. (1996). *The Rome declaration on world food security*. Retrieved from Rome: http://www.fao.org/docrep/003/w3548e/w3548e00.htm

FAO. (2006). *Food Security*. Retrieved from https://www.fao.org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf

FAO. (2011a). *Global food losses and food waste–Extent, causes and prevention*. Retrieved from https://www.fao.org/3/mb060e/mb060e00.htm

FAO. (2011b). *Women: Key to food security*. Retrieved from https://www.fao.org/3/am719e/am719e00.pdf

FAO. (2020). *World food and agriculture - Statistical yearbook 2020*. Retrieved from https://doi.org/10.4060/cb1329en

FAO. (2021). FAOSTAT statistical database. Available from http://www.fao.org/faostat/en/#home Retrieved May 2021

FAO, IFAD, UNICEF, WFP, & WHO. (2017). *The state of food security and nutrition in the world 2017: Building resilience for peace and food security*. Retrieved from http://www.fao.org/3/a-I7695e.pdf

FAO, IFAD, UNICEF, WFP, & WHO. (2020). *The state of food security and nutrition in the world 2020: Transforming food systems for affordable healthy diets.* Retrieved from https://www.fao.org/3/ca9692en/ca9692en.pdf

FAO, IFAD, UNICEF, WFP, & WHO. (2021). *The State of Food Security and Nutrition in the World: Transforming food systems for food security, improved nutrition and affordable healthy diets for all*. Retrieved from Rome, Italy: https://doi.org/10.4060/cb4474en

Faridi, R., & Wadood, S. N. (2010). An econometric assessment of household food security in Bangladesh. *Bangladesh Development Studies, 33*(3), 97-111.

Federal Ministry of Environment (2018). National drought plan. Retrieved from https://www.unccd.int/sites/default/files/country_profile_documents/1%2520FINAL_NDP_Nigeria.pdf

Felker-Kantor, E., & Wood, C. H. (2012). Female-headed households and food insecurity in Brazil. *Food Security, 4*(4), 607-617. doi:https://doi.org/10.1007/s12571-012-0215-y

Fjelde, H., & von Uexkull, N. (2012). Climate triggers: Rainfall anomalies, vulnerability and communal conflict in sub-Saharan Africa. *Political Geography, 31*(7), 444-453.

Fladmoe, A., & Steen-Johnsen, K. (2018). Is ethnic diversity bad for any dimension of social capital? Trust, networks and voluntarism in Norwegian Communities. *Scandinavian Political Studies, 41*(3), 336-366. doi:https://doi.org/10.1111/1467-9477.12127

Fonjong, L. N., & Gyapong, A. Y. (2021). Plantations, women, and food security in Africa: Interrogating the investment pathway towards zero hunger in Cameroon and Ghana. *World Development, 138*, 105293. doi:https://doi.org/10.1016/j.worlddev.2020.105293

Freeman, H. A., & Omiti, J. M. (2003). Fertiliser use in semi-arid areas of Kenya: Analysis of smallholder farmers' adoption behavior under liberalized markets. *Nutrient cycling in Agroecosystems, 66*(1), 23-31. doi:https://doi.org/10.1023/A:1023355011400

Fufa, B., & Hassan, R. M. (2006). Determinants of fertiliser use on maize in Eastern Ethiopia: A weighted endogenous sampling analysis of the extent and intensity of adoption. *Agrekon, 45*(1), 38-49. doi:https://doi.org/10.1080/03031853.2006.9523732

Gáfaro, M., Ibáñez, A. M., & Justino, P. (2014) Local institutions and armed group presence in Colombia. In. *HiCN Working Paper 178*. Bogotá, Colombia: Faculty of Economics, University of the Andes. doi:10.35648/20.500.12413/11781/ii162

Gallegos, D., McKechnie, R., McAndrew, R., Russell-Bennett, R., & Smith, G. (2022). How gender, education and nutrition knowledge contribute to food insecurity among adults in Australia. *Health & social care in the community*.

Gazoni, J. L., & Brasileiro, I. L. G. (2021). Public visitation and deforestation in protected areas of the Brazilian Amazon: an application of the Linear Probability Model. *Journal of Ecotourism*, 1-18.

Gebre, G. G., Isoda, H., Amekawa, Y., Rahut, D. B., Nomura, H., & Watanabe, T. (2021). What explains gender gaps in household food security? Evidence from maize farm households in Southern Ethiopia. *Social Indicators Research, 155*(1), 281-314. doi:https://doi.org/10.1007/s11205-020-02600-8

Gebrehiwot, T., & van der Veen, A. (2014). Coping with food insecurity on a micro-scale: Evidence from Ethiopian rural households. *Ecology of Food and Nutrition, 53*(2), 214-240. doi:https://doi.org/10.1080/03670244.2013.811387

Gebru, T. A., Brhane, G. K., & Gebremedhin, Y. G. (2021). Contributions of water harvesting technologies intervention in arid and semi-arid regions of Ethiopia, in ensuring households' food security, Tigray in focus. *Journal of Arid Environments, 185*, 104373. doi:https://doi.org/10.1016/j.jaridenv.2020.104373

George, J., Adelaja, A., Awokuse, T., & Vaughan, O. (2021). Terrorist attacks, land resource competition and violent farmer-herder conflicts. *Land Use Policy, 102*, 105241. doi:https://doi.org/10.1016/j.landusepol.2020.105241

George, J., Adelaja, A., & Awokuse, T. O. (2021). The agricultural impacts of armed conflicts: The case of Fulani militia. *European Review of Agricultural Economics, 48*(3), 538-572. doi:https://doi.org/10.1093/erae/jbaa022

George, J., Adelaja, A., Vaughan, O., & Awokuse, T. (2022). Explaining transhumance-related violence: Fulani Ethnic Militia in rural Nigeria. *Journal of Rural Studies, 89*, 275-286.

George, J., Adelaja, A., & Weatherspoon, D. (2020). Armed conflicts and food insecurity: Evidence from Boko Haram's attacks. *American Journal of Agricultural Economics, 102*(1), 114-131. doi:https://doi.org/10.1093/ajae/aaz039

Ghebru, H., & Holden, S. T. (2013) Links between tenure security and food security: Evidence from Ethiopia. In. *CLTS Working paper 2013:2*. Norwegian University of Life Sciences (NMBU). Retrieved from http://hdl.handle.net/11250/2478729

Gibson, J., & Alimi, O. (2020). Measuring poverty with noisy and corrected estimates of annual consumption: Evidence from Nigeria. *African Development Review, 32*(1), 96-107.

Gill, D. S. (1988). *Effectiveness of agricultural extension services in reaching rural women: A synthesis of studies from five African countries*. Paper presented at the workshop on improving the effectiveness of agricultural extension services in reaching rural women in Africa. Harare, Zimbabwe.

Gleditsch, N. P., Wallensteen, P., Eriksson, M., Sollenberg, M., & Strand, H. (2002). Armed conflict 1946-2001: A new dataset. *Journal of Peace Research, 39*(5), 615-637. doi:https://doi.org/10.1177/0022343302039005007

Goli, S., Rammohan, A., & Reddy, S. P. (2021). The interaction of household agricultural landholding and Caste on food security in rural Uttar Pradesh, India. *Food Security, 13*(1), 219-237. doi:https://doi.org/10.1007/s12571-020-01109-9

Goshu, D., Kassa, B., & Ketema, M. (2012). Does crop diversification enhance household food security? Evidence from rural Ethiopia. *Advances in Agriculture, Sciences and Engineering Research, 2*(11), 503-515.

Gould, W., Pitblado, J., & Sribney, W. (2006). *Maximum likelihood estimation with Stata*: Stata press.

Grafton, R. Q., McLindin, M., Hussey, K., Wyrwoll, P., Wichelns, D., Ringler, C., ... & Williams, J. (2016). Responding to global challenges in food, energy, environment and water: Risks and options assessment for decision‐making. *Asia & the Pacific Policy Studies*, *3*(2), 275-299.

Grun, R. E. (2008). Household investment under violence: The Colombian case. *World Bank Policy Research Working Paper No. 4713*. https://openknowledge.worldbank.org/handle/10986/6986

Hamoodi, M. N. (2021). Investigating the effects of armed and political conflicts on the land use/cover change and surface urban heat islands: A case study of Baghdad, Iraq. *Journal of the Indian Society of Remote Sensing*, 1-14. doi:https://doi.org/10.1007/s12524-021-01330-9

Handa, S. (1996). Expenditure behavior and children's welfare: An analysis of female headed households in Jamaica. *Journal of Development Economics, 50*(1), 165-187. doi:https://doi.org/10.1016/0304-3878(96)00008-9

Hardaker, J. B., Huirne, R. B. M., & Anderson, J. R. (1997). *Coping with Risk in Agriculture* (Vol. 29). New York: CAB International.

Harrison, G. W., Lau, M. I., & Rutström, E. E. (2007). Estimating risk attitudes in Denmark: A field experiment. *scandinavian Journal of Economics, 109*(2), 341-368. doi:https://doi.org/10.1111/j.1467-9442.2007.00496.x

Hartog, J., Ferrer-i-Carbonell, A., & Jonker, N. (2002). Linking measured risk aversion to individual characteristics. *Kyklos, 55*(1), 3-26. doi:https://doi.org/10.1111/1467-6435.00175

Hendrix, C. S., & Salehyan, I. (2012). Climate change, rainfall, and social conflict in Africa. *Journal of Peace Research, 49*(1), 35-50. doi:https://doi.org/10.1177/0022343311426165

HDX. (2017). Nigeria - Subnational administrative boundaries. Retrieved from https://data.humdata.org/dataset/nga-administrative-boundaries

Higazi, A. (2011). *The Jos Crisis: A recurrent Nigerian Tragedy*. Retrieved from Abuja, Nigeria: https://library.fes.de/pdf-files/bueros/nigeria/07812.pdf

Higgins, D., Balint, T., Liversage, H., & Winters, P. (2018). Investigating the impacts of increased rural land tenure security: A systematic review of the evidence. *Journal of Rural Studies, 61*, 34-62. doi:https://doi.org/10.1016/j.jrurstud.2018.05.001

Höhler, J., & Müller, J. (2021). Simultaneous production decisions in agricultural contexts: An experimental investigation of pesticide use, animal welfare and wheat production. *British Food Journal, 123*(13), 19-36. doi:https://doi.org/10.1108/BFJ-08-2020-0708

Holden, S., & Ghebru, H. (2016). Land tenure reforms, tenure security and food security in poor agrarian economies: Causal linkages and research gaps. *Global Food Security, 10*, 21-28. doi:https://doi.org/10.1016/j.gfs.2016.07.002

Hooper, D. (2012). Exploratory factor analysis. In H. Chen (Ed.), *Approaches to Quantitative Research:Theory and its Practical Application: A Guide to Dissertation Students*. Cork, Ireland: Oak Tree Press.

Huffman, W. E. (1991). Agricultural household models: Survey and critique. *Staff General Research Papers Archive 11008, Department of Economics, Iowa State University.* https://ideas.repec.org/p/isu/genres/11008.html

Huss, M., Brander, M., Kassie, M., Ehlert, U., & Bernauer, T. (2021). Improved storage mitigates vulnerability to food-supply shocks in smallholder agriculture during the COVID-19 pandemic. *Global Food Security, 28*, 100468. doi:https://doi.org/10.1016/j.gfs.2020.100468

Hussein, K., Sumberg, J., & Seddon, D. (1999). Increasing violent conflict between herders and farmers in Africa: Claims and evidence. *Development Policy Review, 17*(4), 397-418.

Huy, H. T., Lyne, M., Ratna, N., & Nuthall, P. (2016). Drivers of transaction costs affecting participation in the rental market for cropland in Vietnam. *Australian Journal of Agricultural and Resource Economics, 60*(3), 476-492. doi:https://doi.org/10.1111/1467-8489.12149

ICG. (2017). *Herders against Farmers: Nigeria's Expanding Deadly Conflict.* Retrieved from https://www.crisisgroup.org/africa/west-africa/nigeria/252-herders-against-farmers-nigerias-expanding-deadly-conflict

ICG. (2018). *Stopping Nigeria's Spiralling Farmer-Herder Violence*. Retrieved from https://www.crisisgroup.org/africa/west-africa/nigeria/262-stopping-nigerias-spiralling-farmer-herder-violence

ICG. (2021). *Ending Nigeria's Herder-Farmer Crisis: The Livestock Reform Plan*. Retrieved from https://www.crisisgroup.org/africa/west-africa/nigeria/302-ending-nigerias-herder-farmer-crisis-livestock-reform-plan

IEP. (2016). *Global Terrorism Index*. Retrieved from http://economicsandpeace.org/wp-content/uploads/2016/11/Global-Terrorism-Index-2016.2.pdf

Ike, C. U., Jacobs, P. T., & Kelly, C. (2017). A multidimensional approach to measuring household food security in Taraba State, Nigeria: Comparing key indicators. *Development in Practice, 27*(2), 234-246. doi:https://doi.org/10.1080/09614524.2017.1281225

Il Islam, D., Rahman, A., Sarker, N. I., Sarker, S. R., & Jianchao, L. (2021). Factors influencing rice farmers' risk attitudes and perceptions in Bangladesh amid environmental and climatic issues. *Polish Journal of Environmental Studies, 30*(1), 177–187. doi:https://doi.org/10.15244/pjoes/120365

ILO. (2019). ILOSTAT database. from International Labour Organization https://ilostat.ilo.org/data/

Ingutia, R., & Sumelius, J. (2022). Determinants of food security status with reference to women farmers in rural Kenya. *Scientific African*, e01114.

Iruonagbe, T. C. (2011). Gender equity and food security: Lessons from Ozalla community, Edo State, Nigeria. *Gender and Behaviour, 9*(1), 3543-3565.

Iwuchukwu, J., & Igbokwe, E. (2012). Lessons from agricultural policies and programmes in Nigeria. *Journal of Law, Policy and Globalization, 5*, 11.

Jaiyeola, A. O., & Choga, I. (2021). Assessment of poverty incidence in Northern Nigeria. *Journal of Poverty, 25*(2), 155-172.

Jakiela, P., & Ozier, O. (2019). The impact of violence on individual risk preferences: Evidence from a natural experiment. *Review of Economics and Statistics, 101*(3), 547-559.

Jayne, T. S., Chamberlin, J., & Headey, D. D. (2014). Land pressures, the evolution of farming systems, and development strategies in Africa: A synthesis. *Food Policy, 48*, 1-17. doi:https://doi.org/10.1016/j.foodpol.2014.05.014

Jayne, T. S., Yamano, T., Weber, M. T., Tschirley, D., Benfica, R., Chapoto, A., & Zulu, B. (2003). Smallholder income and land distribution in Africa: Implications for poverty reduction strategies. *Food Policy, 28*(3), 253-275. doi:https://doi.org/10.1016/S0306-9192(03)00046-0

Jeanty, P. W., & Hitzhusen, F. (2006). *Analyzing the effects of conflicts on food security in developing countries: An instrumental variable panel data approach*. Paper presented at the American Agricultural Economics Association 2006 Annual Meeting , July 23-26, Long Beach, CA.

Jellason, N. P., Robinson, E. J., Chapman, A. S., Neina, D., Devenish, A. J., Po, J. Y., & Adolph, B. (2021). A systematic review of drivers and constraints on agricultural expansion in Sub-Saharan Africa. *Land, 10*(3), 332. doi:https://doi.org/10.3390/land10030332

Jellason, N. P., Robinson, E. J., & Ogbaga, C. C. (2021). Agriculture 4.0: Is Sub-Saharan Africa Ready? *Applied Sciences, 11*(12), 5750. doi:https://doi.org/10.3390/app11125750

Jena, P. R., De Groote, H., Nayak, B. P., & Hittmeyer, A. (2021). Evolution of fertiliser use and its impact on maize productivity in Kenya: Evidence from multiple surveys. *Food Security, 13*(1), 95-111. doi:https://doi.org/10.1007/s12571-020-01105-z

Jones-Casey, K., & Knox, A. (2011). *Farmer-herder conflicts in Mali*. Retrieved from www.focusonland.com/download/51dda6a62a68d/

Joshi, G. R., & Joshi, B. (2017). Household food security: Trends and determinants in mountainous districts of Nepal. *Future of Food: Journal on Food, Agriculture and Society, 5*(2), 42-55.

Justino, P. (2011). Poverty and violent conflict: A micro-level perspective on the causes and duration of warfare. *IDS Working Papers, 2011*(385), 1-25. doi:https://doi.org/10.1111/j.2040-0209.2011.00385_2.x

Kah, H. K. (2017). 'Boko Haram is losing, but so is food production: Conflict and food insecurity in Nigeria and Cameroon. *Africa Development, 42*(3), 177-196.

Kahneman, D., & Tversky, A. (1982). Subjective probability: A judgement of representativeness. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 32-47). New York: Cambridge University Press.

Karl, M. (2009). *Inseparable: The crucial role of women in food security revisited*. Retrieved from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.470.4940&rep=rep1&type=pdf

Kassie, M., Ndiritu, S., & Shiferaw, B. (2015). *Determinants of food security in Kenya, a gender perspective*. Retrieved from https://su-plus.strathmore.edu/handle/11071/3785

Kassie, M., Ndiritu, S. W., & Stage, J. (2014). What determines gender inequality in household food security in Kenya? Application of exogenous switching treatment regression. *World Development, 56*, 153-171. doi:https://doi.org/10.1016/j.worlddev.2013.10.025

Kehinde, M., Shittu, A., Adewuyi, S., Osunsina, I., & Adeyonu, A. (2021). Land tenure and property rights, and household food security among rice farmers in Northern Nigeria. *Heliyon, 7*(2), e06110. doi:https://doi.org/10.1016/j.heliyon.2021.e06110

Kennedy, E., & Peters, P. (1992). Household food security and child nutrition: The interaction of income and gender of household head. *World Development, 20*(8), 1077-1085. doi:https://doi.org/10.1016/0305-750X(92)90001-C

Keovilignavong, O., & Suhardiman, D. (2020). Linking land tenure security with food security: Unpacking farm households' perceptions and strategies in the rural uplands of Laos. *Land Use Policy, 90*, 104260.

Khalid, A., Nyborg, I., & Khattak, B. N. (2015). Whose property whose authority? Gendering the legal and customary practices in ownership and access to land: A case of Swat, Pakistan. *Journal of Rural Studies, 41*, 47-58. doi:https://doi.org/10.1016/j.jrurstud.2015.07.004

Khalid, M., Al-Badri, B., & Dhehibi, B. (2017). Economic Analysis of the factors affecting the adoption of sub-surface irrigation technology in Iraq. *International Journal of Science and Research, 6*(9), 1777-1783.

Kharisma, V., & Abe, N. (2020). Food insecurity and associated socioeconomic factors: Application of rasch and binary logistic models with household survey data in three megacities in Indonesia. *Social Indicators Research, 148*(2), 655-679.

Knuth, D., Kehl, D., Hulse, L., & Schmidt, S. (2014). Risk perception, experience, and objective risk: A cross-national study with European emergency survivors. *Risk analysis, 34*(7), 1286-1298. doi:https://doi.org/10.1111/risa.12157

Kobe, I. H., Olamide, O. E., Bamidele, F. S., Benedict, A. T., Yemisi, B. K., & Kamal, D. A. (2018). Economic assessment of agricultural land market in rural Nigeria: Pattern and drivers. *Journal of Land and Rural Studies, 6*(1), 50-66. doi:10.1177/2321024917732889

Kondylis, F. (2010). Conflict displacement and labor market outcomes in post-war Bosnia and Herzegovina. *Journal of Development Economics, 93*(2), 235-248. doi:https://doi.org/10.1016/j.jdeveco.2009.10.004

Kousar, R., & Abdulai, A. (2016). Off-farm work, land tenancy contracts and investment in soil conservation measures in rural Pakistan. *Australian Journal of Agricultural and Resource Economics, 60*(2), 307-325. doi:https://doi.org/10.1111/1467-8489.12125

Krätli, S., & Toulmin, C. (2020). *Farmer-herder conflict in sub-Saharan Africa?* Retrieved from http://www.indiaenvironmentportal.org.in/files/file/Farmer%20herder%20conflict%20in%20sub%20Saharan%20Africa.pdf

Lambrecht, I. B. (2016). "As a husband I will love, lead, and provide." Gendered access to land in Ghana. *World Development, 88*, 188-200. doi:https://doi.org/10.1016/j.worlddev.2016.07.018

Larson, J. B., Castellanos, P., & Jensen, L. (2019). Gender, household food security, and dietary diversity in western Honduras. *Global Food Security, 20*, 170-179. doi:https://doi.org/10.1016/j.gfs.2019.01.005

Legesse, B., & Drake, L. (2005). Determinants of smallholder farmers' perceptions of risk in the Eastern Highlands of Ethiopia. *Journal of Risk Research, 8*(5), 383-416. doi:https://doi.org/10.1080/1366987042000192426

Lenshie, N. E., Okengwu, K., Ogbonna, C. N., & Ezeibe, C. (2020). Desertification, migration, and herder-farmer conflicts in Nigeria: Rethinking the ungoverned spaces thesis. *Small Wars & Insurgencies*, 1-31. doi:https://doi.org/10.1080/09592318.2020.1811602

Lenshie, N. E., Okengwu, K., Ogbonna, C. N., & Ezeibe, C. (2021). Desertification, migration, and herder-farmer conflicts in Nigeria: Rethinking the ungoverned spaces thesis. *Small Wars & Insurgencies, 32*(8), 1221-1251.

Levin, C. E., Ruel, M. T., Morris, S. S., Maxwell, D. G., Armar-Klemesu, M., & Ahiadeke, C. (1999). Working women in an urban setting: Traders, vendors and food security in Accra. *World Development, 27*(11), 1977-1991. doi:https://doi.org/10.1016/S0305-750X(99)00096-0

Li, Y., & Yu, W. (2010). Households food security in poverty-stricken regions: Evidence from western rural China. *Agriculture and Agricultural Science Procedia, 1*, 386-395.

Lobos, G., Schnettler, B., Mena, C., Ormazábal, Y., Cantillana, J. C., & Retamales, J. B. (2018). Perception of risk sources by Chilean blueberry producers. *Revista Brasileira de Fruticultura, 40*(6), 1-11. doi:https://doi.org/10.1590/0100-29452018248

Lucas, M. P., & Pabuayon, I. M. (2011). Risk perceptions, attitudes, and influential factors of rainfed lowland rice farmers in Ilocos Norte, Philippines. *Asian Journal of Agriculture and Development, 8*, 61-77.

Liu, J., Hull, V., Godfray, H. C. J., Tilman, D., Gleick, P., Hoff, H., ... & Li, S. (2018). Nexus approaches to global sustainable development. *Nature Sustainability*, *1*(9), 466-476.

Lundqvist, J., de Fraiture, C., & Molden, D. (2008). *Saving water from field to fork: Curbing losses and wastage in the food chain*: Stockholm International Water Institute Stockholm.

Lutomia, C. K., Obare, G. A., Kariuki, I. M., & Muricho, G. S. (2019). Determinants of gender differences in household food security perceptions in the Western and Eastern regions of Kenya. *Cogent Food & Agriculture, 5*(1), 1694755. doi:https://doi.org/10.1080/23311932.2019.1694755

Ma, C., Ho, S. K., Singh, S., & Choi, M. Y. (2021). Gender disparities in food security, dietary intake, and nutritional health in the United States. *American Journal of Gastroenterology, 116*(3), 584-592. doi:10.14309/ajg.0000000000001118

Ma, W. (2016). *The impact of agricultural cooperatives on the adoption of technologies and farm performance of apple farmers in China.* (Doctoral dissertation), Faculty of Agricultural and Nutritional Science, Christian-Albrecht Univeristy of Kiel.

Madu, I. A., & Nwankwo, C. F. (2020). Spatial pattern of climate change and farmer–herder conflict vulnerabilities in Nigeria. *GeoJournal*. doi:https://doi.org/10.1007/s10708-020-10223-2

Maharjan, K. L., & Joshi, N. P. (2011). Determinants of household food security in Nepal: A binary logistic regression analysis. *Journal of Mountain Science, 8*(3), 403-413. doi:10.1007/s11629-011-2001-2

Makate, C., Wang, R., Makate, M., & Mango, N. (2016). Crop diversification and livelihoods of smallholder farmers in Zimbabwe: Adaptive management for environmental change. *SpringerPlus, 5*(1), 1135. doi:https://doi.org/10.1186/s40064-016-2802-4

Mallick, D., & Rafi, M. (2010). Are female-headed households more food insecure? Evidence from Bangladesh. *World Development, 38*(4), 593-605. doi:https://doi.org/10.1016/j.worlddev.2009.11.004

Manda, J., Alene, A. D., Tufa, A. H., Abdoulaye, T., Wossen, T., Chikoye, D., & Manyong, V. (2019). The poverty impacts of improved cowpea varieties in Nigeria: A counterfactual analysis. *World Development, 122*, 261-271. doi:https://doi.org/10.1016/j.worlddev.2019.05.027

Mapila, M. A. T. J., Njuki, J., Delve, R. J., Zingore, S., & Matibini, J. (2012). Determinants of fertiliser use by smallholder maize farmers in the Chinyanja Triangle in Malawi, Mozambique and Zambia. *Agrekon, 51*(1), 21-41. doi:https://doi.org/10.1080/03031853.2012.649534

Martin-Shields, C. P., & Stojetz, W. (2019). Food security and conflict: Empirical challenges and future opportunities for research and policy making on food security and conflict. *World Development, 119*, 150-164. doi:https://doi.org/10.1016/j.worlddev.2018.07.011

Matuschke, I., & Qaim, M. (2009). The impact of social networks on hybrid seed adoption in India. *Agricultural Economics, 40*(5), 493-505. doi:https://doi.org/10.1111/j.1574-0862.2009.00393.x

Maxwell, D., & Caldwell, R. (2008). The coping strategies index: Field methods manual. *Cooperative for Assistance and Relief Everywhere Inc. USA*.

Maxwell, D., Caldwell, R., & Langworthy, M. (2008). Measuring food insecurity: Can an indicator based on localized coping behaviors be used to compare across contexts? *Food Policy, 33*(6), 533-540. doi:https://doi.org/10.1016/j.foodpol.2008.02.004

Maxwell, D., Coates, J., & Vaitla, B. (2013). How do different indicators of household food security compare? Empirical evidence from Tigray. *Medford, USA: Feinstein International Center, Tufts University. http://fic.tufts.edu/assets/Different-Indicators-of-HFS. pdf*.

Maxwell, D., Vaitla, B., & Coates, J. J. F. P. (2014). How do indicators of household food insecurity measure up? An empirical comparison from Ethiopia. *47*, 107-116. doi:https://doi.org/10.1016/j.foodpol.2014.04.003

Mbih, R. A. (2020). The politics of farmer–herder conflicts and alternative conflict management in Northwest Cameroon. *African Geographical Review, 39*(4), 324-344. doi:https://doi.org/10.1080/19376812.2020.1720755

Mengistu, D. D., Degaga, D. T., & Tsehay, A. S. (2021). Analyzing the contribution of crop diversification in improving household food security among wheat dominated rural households in Sinana District, Bale Zone, Ethiopia. *Agriculture & Food Security, 10*(1), 1-15. doi:https://doi.org/10.1186/s40066-020-00280-8

Menton, M., Milanez, F., de Andrade Souza, J. M., & Cruz, F. S. M. (2021). The COVID-19 pandemic intensified resource conflicts and indigenous resistance in Brazil. *World Development, 138*, 105222. doi:https://doi.org/10.1016/j.worlddev.2020.105222

Meraner, M., & Finger, R. (2019). Risk perceptions, preferences and management strategies: Evidence from a case study using German livestock farmers. *Journal of Risk Research, 22*(1), 110-135.

Mertz, O., Rasmussen, K., & Rasmussen, L. V. (2016). Weather and resource information as tools for dealing with farmer-pastoralist conflicts in the Sahel. *Earth System Dynamics, 7*(4), 969.

Messer, E., Cohen, M. J., & Marchione, T. (2001). *Conflict: A cause and effect of hunger*. Retrieved from https://pdf.usaid.gov/pdf_docs/pnadf986.pdf#page=7

Michels, M., Fecke, W., Feil, J.-H., Musshoff, O., Pigisch, J., & Krone, S. (2020). Smartphone adoption and use in agriculture: Empirical evidence from Germany. *Precision Agriculture, 21*(2), 403-425. doi:https://doi.org/10.1007/s11119-019-09675-5

Milazzo, A., & Van de Walle, D. (2015). Women left behind? Poverty and headship in Africa. *Policy Research Working Paper*. https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-7331

Mishra, A. K., & Moss, C. B. (2013). Modeling the effect of off-farm income on farmland values: A quantile regression approach. *Economic Modelling, 32*, 361-368. doi:https://doi.org/10.1016/j.econmod.2013.02.022

Moya, A. (2018). Violence, psychological trauma, and risk attitudes: Evidence from victims of violence in Colombia. *Journal of Development Economics, 131*, 15-27.

Moyo, K. J. (2017). *Women's access to land in Tanzania: The case of the Makete District.* (Doctoral thesis), Royal Institute of Technology (KTH), Retrieved from https://www.diva-portal.org/smash/get/diva2:1081194/FULLTEXT01.pdf

Muhammed, I., Ismaila, A. B., & Bibi, U. M. (2015). An assessment of farmer-pastoralist conflict in Nigeria using GIS. *International Journal of Engineering Science Invention, 4*(7), 23-33.

Mulwa, C. K., & Visser, M. (2020). Farm diversification as an adaptation strategy to climatic shocks and implications for food security in northern Namibia. *World Development, 129*, 104906. doi:https://doi.org/10.1016/j.worlddev.2020.104906

Muraoka, R., Jin, S., & Jayne, T. (2018). Land access, land rental and food security: Evidence from Kenya. *Land Use Policy, 70*, 611-622. doi:https://doi.org/10.1016/j.landusepol.2017.10.045

Murugani, V. G., Thamaga-Chitja, J. M., Kolanisi, U., & Shimelis, H. (2014). The role of property rights on rural women's land use security and household food security for improved livelihood in Limpopo Province. *Journal of Human Ecology, 46*(2), 205-221. doi:https://doi.org/10.1080/09709274.2014.11906721

Mutisya, M., Ngware, M. W., Kabiru, C. W., & Kandala, N.B. (2016). The effect of education on household food security in two informal urban settlements in Kenya: A longitudinal analysis. *Food Security, 8*(4), 743-756. doi:https://doi.org/10.1007/s12571-016-0589-3

Nam, C. W. (2020). *World economic outlook for 2020 and 2021.* Paper presented at the CESifo Forum, ifo Institut - Leibniz-Institut für Wirtschaftsforschung an der Universität München, München.

NBS. (2016a). *Basic Information Document: Nigeria General Household Survey–Panel 2015/16*. Retrieved from http://microdata.worldbank.org/index.php/catalog/2734/download/46028

NBS. (2016b). *General Household Survey-Panel Wave 3 (Post Harvest) 2015-2016, Third round*. Retrieved from: https://www.nigerianstat.gov.ng/nada/index.php/catalog/52

NBS. (2019). *LSMS Integrated Surveys on Agriculture Nigeria General Household SurveyPanel, Wave 4*. Retrieved from https://www.proshareng.com/admin/upload/report/12973-LSMSIntegratedPanelSurveyReport-proshare.pdf

NBS. (2020a). *Nigeria Living Standards Survey 2018/2019*. Retrieved from https://nigerianstat.gov.ng/elibrary

NBS. (2020b). *Nigerian Gross Domestic Product Report*. Retrieved from https://www.nigerianstat.gov.ng/pdfuploads/GDP_Report_Q2_2020.pdf

NBS. (2021a). *2020 Statistical Report on Women and Men in Nigeria*. Retrieved from https://nigerianstat.gov.ng/elibrary

NBS. (2021b). *Nigerian Gross Domestic Product Report*. Retrieved from https://nigerianstat.gov.ng/elibrary

Ndaeyo, N. U., Umoh, G. S., & Ekpe, E. O. (2001). Farming systems in southeastern Nigeria: Implications for sustainable agricultural production. *Journal of Sustainable Agriculture, 17*(4), 75-89. doi:10.1300/J064v17n04_07

Ndamani, F., & Watanabe, T. (2017). Determinants of farmers' climate risk perceptions in agriculture: A rural Ghana perspective. *Water, 9*(3), 210. doi:https://doi.org/10.3390/w9030210

Neelakantan, A., DeFries, R., Sterling, E., & Naeem, S. (2020). Contributions of financial, social and natural capital to food security around Kanha National Park in central India. *Regional Environmental Change, 20*(1), 1-14. doi:https://doi.org/10.1007/s10113-020-01589-7

Nie, P., Ma, W., & Sousa-Poza, A. (2020). The relationship between smartphone use and subjective well-being in rural China. *Electronic Commerce Research*, 1-27. doi:https://doi.org/10.1007/s10660-020-09397-1

Njiru, B. N. (2012). Climate change, resource competition, and conflict amongst pastoral communities in Kenya. In J. Scheffran, M. Brzoska, H. G. Brauch, P. M. Link, & J. Schilling (Eds.), *Climate change, human security and violent conflict: Challenges for societal stability* (pp. 513-527). Berlin, Heidelberg: Springer Berlin Heidelberg.

Nnaji, A., Ratna, N., & Renwick, A. (2020). Gendered access to land and household food insecurity: Evidence from Nigeria. *Available at SSRN 3802064*. doi:http://dx.doi.org/10.2139/ssrn.3802064

Nnaji, A., Ratna, N., Renwick, A., & Ma, W. (2020a). *Do conflicts reduce household food security? Farmer-Herdsmen conflicts in Nigeria.* Paper presented at the Australasian Agricultural and

Resource Economics Society Conference held 10-14 February 2020., Perth, Western Australia.

Nnaji, A., Ratna, N., Renwick, A., & Ma, W. (2020b). *Influence of risk perception of conflict on farmer's production decisions: Evidence from rural Nigeria.* Paper presented at the New Zealand Agricultural Resource Economics Society Conference 26-28 August 2020, Online.

Norton, E. C., Wang, H., & Ai, C. (2004). Computing interaction effects and standard errors in logit and probit models. *Stata Journal, 4*, 154-167. doi:https://doi.org/10.1177/1536867X0400400206

Ntakirutimana, L., Li, F., Huang, X., Wang, S., & Yin, C. (2019). Green manure planting incentive measures of local authorities and farmers' perceptions of the utilization of rotation fallow for sustainable agriculture in Guangxi, China. *Sustainability, 11*(10), 2723. doi:https://doi.org/10.3390/su11102723

Nygaard, M. R., Austad, A., Kleiven, T., & Mæland, E. (2020). Religious healing experiences and earned security. *Pastoral Psychology, 69*(5), 487-507. doi:10.1007/s11089-020-00922-5

O'Loughlin, J., Witmer, F. D., Linke, A. M., Laing, A., Gettelman, A., & Dudhia, J. (2012). Climate variability and conflict risk in East Africa, 1990–2009. *Proceedings of the National Academy of Sciences, 109*(45), 18344-18349.

Obot, A., Osuafor, O., Nwigwe, C., & Ositanwosu, C. (2021). Analysis of agricultural policy on Catfish value chain in Akwa Ibom State, Nigeria. *Issues in Agriculture, 1*(1), 96-101.

Odeny, M. (2013). *Improving access to land and strengthening women's land rights in Africa'.* Paper presented at the Annual World Bank conference on land and poverty', The World Bank, Washington, DC.

OECD/FAO. (2016). Agriculture in Sub-Saharan Africa: Prospects and challenges for the next decade. In *OECD-FAO Agricultural Outlook 2016-2025*. Paris: OECD.

Oginni, A., Ahonsi, B., & Ukwuije, F. (2013). Are female-headed households typically poorer than male-headed households in Nigeria? *The Journal of Socio-Economics, 45*, 132-137. doi:https://doi.org/10.1016/j.socec.2013.04.010

Ogola, J. B., Ayieko, M. W., Orawo, A. O., & Kimani, F. W. (2011). Analysis of fertiliser use in potato production in Nakuru district, Kenya. *African Journal of Agricultural Research, 6*(16), 3672-3677.

Ogu, M.I. (2022). Ethnicity, Farmer–Herder Conflicts, and Nation-Building in Nigeria. In: Oloruntoba, S.O. (eds) The Political Economy of Colonialism and Nation-Building in Nigeria. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-73875-4_14

Ojo, J. S. (2020). Governing "ungoverned spaces" in the foliage of conspiracy: Toward (re) ordering terrorism, from Boko Haram insurgency, Fulani militancy to banditry in Northern Nigeria. *African Security, 13*(1), 77-110. doi:https://doi.org/10.1080/19392206.2020.1731109

Okali, D., Okpara, E., & Olawoye, J. (2001). *Profile of South-Eastern Nigeria and Description of the Study Area*. Retrieved from http://www.jstor.org/stable/resrep01762.5

Okonya, J. S., & Kroschel, J. (2014). Gender differences in access and use of selected productive resources among sweet potato farmers in Uganda. *Agriculture & Food Security, 3*(1), 1-10. doi:https://doi.org/10.1186/2048-7010-3-1

Okoro, J. P. (2018). Herdsmen-farmers conflict and its effects on socio-economic development in Nigeria. *Journal of Peace, Security, and Development, 4*(1), 143-158.

Okunlola, O. C., & Okafor, I. G. (2020). Conflict–poverty relationship in Africa: A disaggregated approach. *Journal of Interdisciplinary Economics*. doi:https://doi.org/10.1177/0260107920935726

Olale, E. K. (2005). *Adoption of soil fertility management technologies in the semi-arid areas of Kenya: The case of Machakos, Makueni and Kitui Districts.* University of Nairobi, Kenya,

Olarinde, L. O., Manyong, V. M., & Akintola, J. O. (2010). Factors influencing risk aversion among maize farmers in the Northern Guinea Savanna of Nigeria: Implications for sustainable crop development programmes. *Journal of Food, Agriculture and Environment, 8*(1), 128-134.

Oldewage-Theron, W., & Egal, A. A. (2021). Is food insecurity a problem among the elderly in Sharpeville, South Africa? *Food security, 13*(1), 71-81. doi:https://doi.org/10.1007/s12571-020-01125-9

Olowe, V. (2021). Africa 2100: How to feed Nigeria in 2100 with 800 million inhabitants. *Organic Agriculture, 11*, 199-208. doi:https://doi.org/10.1007/s13165-020-00307-1

Oseni, G., & Winters, P. (2009). Rural nonfarm activities and agricultural crop production in Nigeria. *Agricultural Economics, 40*(2), 189-201. doi:https://doi.org/10.1111/j.1574-0862.2009.00369.x

Otani, H., Leonard, S. D., Ashford, V. L., Bushroe, M., & Reeder, G. (1992). Age differences in perception of risk. *Perceptual and Motor Skills, 74*(2), 587-594. doi:https://doi.org/10.2466/pms.1992.74.2.587

Otsuka, K. (2013). Food insecurity, income inequality, and the changing comparative advantage in world agriculture. *Agricultural Economics, 44*(s1), 7-18. doi:https://doi.org/10.1111/agec.12046

Pakravan-Charvadeh, M. R., Mohammadi-Nasrabadi, F., Gholamrezai, S., Vatanparast, H., Flora, C., & Nabavi-Pelesaraei, A. (2021). The short-term effects of COVID-19 outbreak on dietary diversity and food security status of Iranian households: A case study in Tehran province. *Journal of cleaner production, 281*, 124537. doi:https://doi.org/10.1016/j.jclepro.2020.124537

Pawlak, K., & Kołodziejczak, M. (2020). The role of agriculture in ensuring food security in developing countries: Considerations in the context of the problem of sustainable food production. *Sustainability, 12*(13), 5488. doi:https://doi.org/10.3390/su12135488

Peacock, W. G., Brody, S. D., & Highfield, W. (2005). Hurricane risk perceptions among Florida's single-family homeowners. *Landscape and Urban Planning, 73*(2-3), 120-135. doi:https://doi.org/10.1016/j.landurbplan.2004.11.004

Pinckney, T. C., & Kimuyu, P. K. (1994). Land tenure reform in East Africa: Good, bad or unimportant? *Journal of African Economies, 3*(1), 1-28. doi:https://doi.org/10.1093/oxfordjournals.jae.a036794

Pindiriri, C. (2021). *Land inequality, gender land disparity and poverty in rural Zimbabwe*. Retrieved from https://media.africaportal.org/documents/PB1-Carren-Pindiriri.pdf

Pregibon, D. J. (1980). *Data analytic methods for generalized linear models.* (Doctoral Thesis), University of Toronto, Canada.

Qasim, S., Qasim, M., Shrestha, R. P., & Khan, A. N. (2018). Socio-economic determinants of landslide risk perception in Murree hills of Pakistan. *AIMS Environ Sci, 5*(5), 305-314.

Qayyum, U., Anjum, S., & Sabir, S. (2021). Armed conflict, militarization and ecological footprint: Empirical evidence from South Asia. *Journal of cleaner production, 281*, 125299. doi:https://doi.org/10.1016/j.jclepro.2020.125299

Quisumbing, A. R., Haddad, L., Meinzen-Dick, R., & Brown, L. R. (1998). Gender issues for food security in developing countries: Implications for project design and implementation. *Canadian Journal of Development Studies, 19*(4), 185-208. doi:https://doi.org/10.1080/02255189.1998.9669784

Raleigh, C. (2010). Political marginalization, climate change, and conflict in African sahel states. *International Studies Review, 12*(1), 69-86.

Raleigh, C., Linke, A., Hegre, H., & Karlsen, J. (2010). Introducing ACLED: An armed conflict location and event dataset: special data feature. *Journal of Peace Research, 47*(5), 651-660. doi:https://doi.org/10.1177/0022343310378914

Ramirez, A. (2013). The influence of social networks on agricultural technology adoption. *Procedia-Social and Behavioral Sciences, 79*(6), 101-116. doi:https://doi.org/10.1016/j.sbspro.2013.05.059

Rammohan, A., & Pritchard, B. (2014). The role of landholding as a determinant of food and nutrition insecurity in rural Myanmar. *World Development, 64*, 597-608. doi:https://doi.org/10.1016/j.worlddev.2014.06.029

Rao, N. (2006). Land rights, gender equality and household food security: Exploring the conceptual links in the case of India. *Food Policy, 31*(2), 180-193. doi:https://doi.org/10.1016/j.foodpol.2005.10.006

Reiley, D. H. (2006). Field experiments on the effects of reserve prices in auctions: More magic on the internet. *The RAND Journal of Economics, 37*(1), 195-211.

Reilly, W. (2017). Diversity and Security: The effect of in-state tribal and racial diversity on homicide rate, civil conflict, and chances of international war-fighting. *International Journal of Contemporary Applied Sciences, 4*(4), 77-93.

Rizwan, M., Ping, Q., Saboor, A., Ahmed, U. I., Zhang, D., Deyi, Z., & Teng, L. (2020). Measuring rice farmers' risk perceptions and attitude: Evidence from Pakistan. *Human and Ecological Risk Assessment: An International Journal, 26*(7), 1832-1847. doi:https://doi.org/10.1080/10807039.2019.1602753

Rockmore, M. (2012). *Living within conflicts: Risk of violence and livelihood portfolios*. *HiCN Working Papers 121*. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.636.4889

Rockmore, M. (2015). *Conflict and agricultural portfolios: Evidence from Northern Uganda*. Retrieved from http://cega.berkeley.edu/assets/miscellaneous_files/45-ABCA_-Conflict_and_Agricultural_Portfolios.pdf

Rockmore, M. (2020). Conflict risk and agricultural portfolios: Evidence from Northern Uganda. *The Journal of Development Studies, 56*(10), 1856-1876. doi:https://doi.org/10.1080/00220388.2019.1703953

Rockson, G., Bennett, R., & Groenendijk, L. (2013). Land administration for food security: A research synthesis. *Land Use Policy, 32*, 337-342. doi:https://doi.org/10.1016/j.landusepol.2012.11.005

Rogers, B. L. J. W. D. (1996). The implications of female household headship for food consumption and nutritional status in the Dominican Republic. *24*(1), 113-128. doi:https://doi.org/10.1016/0305-750X(95)00122-S

Roodman, D. (2011). Fitting fully observed recursive mixed-process models with CMP. *Stata Journal, 11*(2), 159-206. doi:https://doi.org/10.1177/1536867X1101100202

Rugadya, M. A. (2020). Land tenure as a cause of tensions and driver of conflict among mining communities in Karamoja, Uganda: Is secure property rights a solution? *Land Use Policy, 94*, 104495. doi:https://doi.org/10.1016/j.landusepol.2020.104495

Ruwanpura, K., & Humphries, J. (2003). Female-headship in Eastern Sri Lanka: A comparative study of ethnic communities in the context of conflict. *IFP/CRISIS Working Paper*. https://ideas.repec.org/p/ilo/ilowps/993609123402676.html

Sahadevan, P. (2002). Ethnic conflicts and militarism in South Asia. *International Studies, 39*(2), 103-138. doi:10.1177/002088170203900201

Sasson, A. (2012). Food security for Africa: An urgent global challenge. *Agriculture & Food Security, 1*, 2. doi:https://doi.org/10.1186/2048-7010-1-2

Savage, I. (1993). Demographic influences on risk perceptions. *Risk analysis, 13*(4), 413-420. doi:https://doi.org/10.1111/j.1539-6924.1993.tb00741.x

Savikhin, A. C., & Sheremeta, R. M. (2013). Simultaneous decision‐making in competitive and cooperative environments. *Economic Inquiry, 51*(2), 1311-1323. doi:https://doi.org/10.1111/j.1465-7295.2012.00474.x

Schillinger, J., Özerol, G., Güven‐Griemert, Ş., & Heldeweg, M. (2020). Water in war: Understanding the impacts of armed conflict on water resources and their management. *Wiley Interdisciplinary Reviews: Water, 7*(6), e1480. doi:https://doi.org/10.1002/wat2.1480

Seddon, D., & Sumberg, J. (1997). *Conflict between farmers and herders in Africa: An analysis*. Retrieved from https://assets.publishing.service.gov.uk/media/57a08d5140f0b649740017b8/R6618a.pdf

Serneels, P., & Verpoorten, M. (2015). The impact of armed conflict on economic performance: Evidence from Rwanda. *Journal of Conflict Resolution, 59*(4), 555-592. doi:https://doi.org/10.1177/0022002713515409

Seter, H., Theisen, O. M., & Schilling, J. (2018). All about water and land? Resource-related conflicts in East and West Africa revisited. *GeoJournal, 83*(1), 169-187. doi:https://doi.org/10.1007/s10708-016-9762-7

Shettima, A. G., & Tar, U. A. (2008). Farmer-pastoralist conflict in West Africa: Exploring the causes and consequences. *Information, Society and Justice Journal, 1*(2), 163-184.

Shin, Y.G. (2020). *How the gender of the household's head influences household food security in developing countries.* (Master's Dissertation), Seoul National University.

Shuaibu, M., & Nchake, M. (2021). Impact of credit market conditions on agriculture productivity in Sub-Saharan Africa. *Agricultural Finance Review, 81*(4).

Singh, I., Squire, L., & Strauss, J. (1986). A survey of agricultural household models: Recent findings and policy implications. *The World Bank Economic Review, 1*(1), 149-179. doi:https://doi.org/10.1093/wber/1.1.149

Slovic, P. (1987). Perception of risk. *science, 236*(4799), 280-285. doi:https://doi.org/10.1126/science.3563507

Slovic, P. (2000). *The perception of risk*. London: Earthscan publications.

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1982). Why study risk perception? *Risk analysis, 2*(2), 83-93.

Slovic, P., & Peters, E. (2006). Risk perception and affect. *Current Directions in Psychological Science, 15*(6), 322-325. doi:https://doi.org/10.1111/j.1467-8721.2006.00461.x

Smith, K., Barrett, C. B., & Box, P. W. (2000). Participatory risk mapping for targeting research and assistance: With an example from East African pastoralists. *World Development, 28*(11), 1945-1959. doi:https://doi.org/10.1016/S0305-750X(00)00053-X

Srivastava, V. K., & Giles, D. E. (2020). *Seemingly unrelated regression equations models: Estimation and inference* (Vol. 80). New York: CRC press.

Strasberg, P. J., Jayne, T. S., Yamano, T., Nyoro, J. K., Karanja, D. D., & Strauss, J. (1999). *Effects of agricultural commercialization on food crop input use and productivity in Kenya*. Retrieved from https://ageconsearch.umn.edu/record/54675/

Suchá, L., Schlossarek, M., Dušková, L., Malan, N., & Šarapatka, B. (2020). Land tenure security and its implications for investments to urban agriculture in Soweto, South Africa. *Land Use Policy, 97*, 104739.

Sulaiman, A., & Ja'afar-Furo, M. (2010). Economic effects of farmer-grazier conflicts in nigeria: A case study of Bauchi State. *Trends in Agricultural Economics, 3*(3), 147-157. doi:10.3923/tae.2010.147.157

Sulewski, P., & Kłoczko-Gajewska, A. (2014). Farmers' risk perception, risk aversion and strategies to cope with production risk: An empirical study from Poland. *Studies in Agricultural Economics, 116*(3), 140-147. doi:http://dx.doi.org/10.7896/j.1414

Sund, B., Svensson, M., & Andersson, H. (2017). Demographic determinants of incident experience and risk perception: Do high-risk groups accurately perceive themselves as high-risk? *Journal of Risk Research, 20*(1), 99-117. doi:https://doi.org/10.1080/13669877.2015.1042499

Taylor, J. E., & Adelman, I. (2003). Agricultural household models: Genesis, evolution, and extensions. *Review of Economics of the Household, 1*(1-2), 33-58. doi:https://doi.org/10.1023/A:1021847430758

Tefera, T., & Tefera, F. (2014). Determinants of households food security and coping strategies for food shortfall in Mareko District, Guraghe Zone Southern Ethiopia. *Journal of Food Security, 2*(3), 92-99.

Tekwa, N. (2020). *Gender, land reform and welfare outcomes: A case study of Chiredzi District, Zimbabwe.* (Doctoral thesis), University of South Africa, Retrieved from http://hdl.handle.net/10500/27126

Teodosijevic, S. B. (2003). *Armed conflicts and food security*. Retrieved from http://www.fao.org/3/a-ae044t.pdf

Theisen, O. M. (2012). Climate clashes? Weather variability, land pressure, and organised violence in Kenya, 1989–2004. *Journal of Peace Research, 49*(1), 81-96. doi:https://doi.org/10.1177/0022343311425842

Tibesigwa, B., & Visser, M. (2016). Assessing gender inequality in food security among small-holder farm households in urban and rural South Africa. *World Development, 88*, 33-49. doi:https://doi.org/10.1016/j.worlddev.2016.07.008

Tran, T. N., Cam, H., Le Thanh Sang, N. T. P., Cham, N. T. P. L., & Long, V. T. (2013). *Women's Access to Land in Contemporary Việt Nam*. Retrieved from

https://www.vn.undp.org/content/vietnam/en/home/library/democratic_governance/women_access_to_land_in_viet_nam.html

Tranchant, J.P., Justino, P., & Müller, C. (2014). *Political violence, drought and child malnutrition: Empirical evidence from Andhra Pradesh, India*. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.434.9789&rep=rep1&type=pdf

Tripta, T., & Mehta, S. (2009). Productive resources and women empowerment. *Asian Journal of Home Science, 4*(1), 193-196.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive psychology, 5*(2), 207-232.

Twum, K. O., Asiama, K., Ayer, J., & Asante, C. Y. (2020). Gender, land and food access in Ghana's suburban cities: A Case of the Adenta Municipality. *Land, 9*(11), 427. doi:https://doi.org/10.3390/land9110427

Uaiene, R. N. (2011). *Determinants of agricultural technology adoption in Mozambique.* Paper presented at the 10th African Crop Science Conference Proceedings, Maputo, Mozambique, 10-13 October 2011.

Uler, N. (2021). The impact of exposure to armed conflict on risk and ambiguity attitiudes. *SSRN*. http://dx.doi.org/10.2139/ssrn.3838073

Umar, B. F. (2002). *The pastoral-agricultural conflicts in Zamfara State, Nigeria*. Presentation for the International Farming Systems Association, Florida, USA. University of Florida, Institute of Food and Agricultural Sciences.

Urama, N. E., & Yuni, D. N. (2018). *Evaluating food crop sector performance in Nigeria (1999-2016)*. Retrieved from https://media.africaportal.org/documents/Working_Paper_2018-002.pdf

Usman, A. (2019a). Ethno-religious and political dimensions of farmers-herdsmen conflict in Nigeria. *Dutse International Journal of Social and Economics Research, 2*(2), 1-21.

Usman, I. S., Bakari, U., & Abdullahi, A. (2017). Crop farmers and herders conflicts in Girei local government area, Adamawa State, Nigeria: Causes, repercussions and resolutions. *Scientific Papers Series-Management, Economic Engineering in Agriculture and Rural Development, 17*(1), 467-472.

Usman, S. G. (2019b). Socio-ecological indices of farmer-herder conflicts: Implications for conflicts prevention in northern senatorial district of kaduna state, Nigeria. http://hubrural.org/IMG/pdf/_final_usman_research.pdf

Valente, C. (2009). The food (in) security impact of land redistribution in South Africa: Microeconometric evidence from national data. *World Development, 37*(9), 1540-1553. doi:https://doi.org/10.1016/j.worlddev.2009.01.005

Van der Linden, S. (2015). The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology, 41*, 112-124. doi:https://doi.org/10.1016/j.jenvp.2014.11.012

Van Raaij, W. F. (1981). Economic psychology. *Journal of Economic psychology, 1*(1), 1-24. doi:https://doi.org/10.1016/0167-4870(81)90002-7

van Winsen, F., de Mey, Y., Lauwers, L., Van Passel, S., Vancauteren, M., & Wauters, E. (2016). Determinants of risk behaviour: Effects of perceived risks and risk attitude on farmer's adoption of risk management strategies. *Journal of Risk Research, 19*(1), 56-78. doi:https://doi.org/10.1080/13669877.2014.940597

Vanger, E. T., & Nwosu, B. U. (2020). Institutional parameters that condition farmer–herder conflicts in Tivland of Benue State, Nigeria. *African Security Review, 29*(1), 20-40.

Vaughan, O. (2016). *Religion and the Making of Nigeria*. Durham, NC: Duke University Press.

Verpoorten, M. (2009). Household coping in war-and peacetime: Cattle sales in Rwanda, 1991–2001. *Journal of Development Economics, 88*(1), 67-86. doi:https://doi.org/10.1016/j.jdeveco.2008.01.003

Verwimp, P., & Muñoz-Mora, J. C. (2018). Returning home after civil war: Food security and nutrition among Burundian households. *The Journal of Development Studies, 54*(6), 1019-1040. doi:https://doi.org/10.1080/00220388.2017.1311407

Villanueva‐Moya, L., & Expósito, F. (2021). Gender differences in decision‐making: The effects of gender stereotype threat moderated by sensitivity to punishment and fear of negative evaluation. *Journal of Behavioral Decision Making*. doi:https://doi.org/10.1002/bdm.2239

Von Einsiedel, S., Bosetti, L., Cockayne, J., Salih, C., & Wan, W. (2017). Civil war trends and the changing nature of armed conflict. *Occasional paper 10*. https://www.urban-response.org/system/files/content/resource/files/main/Civil_war_trends_UPDATED.pdf

Wan, F., Small, D., Bekelman, J. E., & Mitra, N. (2015). Bias in estimating the causal hazard ratio when using two‐stage instrumental variable methods. *Statistics in medicine, 34*(14), 2235-2265. doi:https://doi.org/10.1002/sim.6470

Wang, M., Ye, T., & Shi, P. (2016). Factors affecting farmers' crop insurance participation in China. *Canadian Journal of Agricultural Economics, 64*(3), 479-492. doi:10.1111/cjag.12088

Watkins, M. W. (2018). Exploratory factor analysis: A guide to best practice. *Journal of Black Psychology, 44*(3), 219-246.

Weber, E. U., & Hsee, C. (1998). Cross-cultural differences in risk perception, but cross-cultural similarities in attitudes towards perceived risk. *Management Science, 44*(9), 1205-1217.

WFP, & FAO. (2021). *Hunger hotspots, FAO-WFP early warnings on acute food insecurity: August to November 2021 outlook*. Retrieved from https://docs.wfp.org/api/documents/WFP-0000130653/download/?_ga=2.266848137.648069093.1634605001-927745476.1634605001

Whitmarsh, L. (2008). Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *Journal of Risk Research, 11*(3), 351-374. doi:https://doi.org/10.1080/13669870701552235

Whitmarsh, L. (2009). Behavioural responses to climate change: Asymmetry of intentions and impacts. *Journal of Environmental Psychology, 29*(1), 13-23. doi:https://doi.org/10.1016/j.jenvp.2008.05.003

Wineman, A., & Liverpool-Tasie, L. S. O. (2017). Land markets and land access among female-headed households in Northwestern Tanzania. *World Development, 100*, 108-122. doi:https://doi.org/10.1016/j.worlddev.2017.07.027

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (Second ed.). Cambridge, MA: MIT press.

Wooldridge, J. M. (2015a). Control function methods in applied econometrics. *Journal of Human Resources, 50*(2), 420-445. doi:10.3368/jhr.50.2.420

Wooldridge, J. M. (2015b). *Introductory econometrics: A modern approach*. Boston, MA Cengage learning.

World Bank. (2021). *World Bank macro poverty outlook - Nigeria*. Retrieved from https://pubdocs.worldbank.org/en/848651492188167743/mpo-nga.pdf

Xie, H., Wen, Y., Choi, Y., & Zhang, X. (2021). Global trends on food security research: A bibliometric analysis. *Land, 10*(2), 119. doi:https://doi.org/10.3390/land10020119

Yamusa, P. M. (2022). *The Root Causes of the Upsurge in Farmer-Herder Conflict Case Study on Middle-Belt Nigeria* (Master's thesis). Near East University.

Yikwabs, P. Y., Kayode, B. M., Gambo, N. S., & Tsonji, F. (2020). Farmers-Herders Conflict and the Consequences of the Open Grazing Prohibition and Ranches Establishment Law in Benue State Nigeria. *Fuwukari International Journal of Sociology and Development*, *2*(1), 1-19.

Yikwabs, P. Y., & Tade, O. (2021). How farming communities cope with displacement arising from farmer-herder conflict in North Central Nigeria. *Journal of Asian and African Studies*, 1-11. doi:https://doi.org/10.1177%2F00219096211034882

Yong, A. G., & Pearce, S. (2013). A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutorials in quantitative methods for psychology, 9*(2), 79-94.

Zellner, A. (1962). An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. *Journal of the American statistical Association, 57*(298), 348-368.

Zhang, J., Manske, G., Zhou, P. Q., Tischbein, B., Becker, M., & Li, Z. H. (2017). Factors influencing farmers' decisions on nitrogen fertiliser application in the Liangzihu Lake basin, Central China. *Environment, Development and Sustainability, 19*(3), 791-805. doi:https://doi.org/10.1007/s10668-016-9765-z

Zhang, J., Mishra, A. K., & Zhu, P. (2021). Land rental markets and labor productivity: Evidence from rural China. *Canadian Journal of Agricultural Economics, 69*(1), 93-115. doi:https://doi.org/10.1111/cjag.12247

Zhou, Y., Yang, H., Mosler, H.-J., & Abbaspour, K. C. (2010). Factors affecting farmers' decisions on fertiliser use: A case study for the Chaobai watershed in Northern China. *Consilience*(4), 80-102.

Zhu, Z., Ma, W., & Leng, C. (2020). ICT adoption, individual income and psychological health of rural farmers in China. *Applied Research in Quality of Life*, 1-21. doi:https://doi.org/10.1007/s11482-020-09879-2

Zondo, B. S. (2020). Determinants of adoption and use intensity of organic fertiliser. *SA-TIED Working Paper No 135*. https://sa-tied.wider.unu.edu/sites/default/files/pdf/SA-TIED-WP-135.pdf

# Appendix A

# Data Collection Questionnaire

## Primary Data Questionnaire

**Access to Land, Gender, and Conflict: Implications for Food Security of Rural Households in Nigeria**

**Questionnaire**

**Instructions**

- Please interview the household head. If it is not possible, then interview the most important member of the household.
- First introduce yourself and explain thoroughly the purpose of the survey.
- Please stick to the units in which figures and values are asked.
- Please use codes where provided.
- Please fill out all the details as correctly as possible.
- Please note that the information will be kept secret and will not be disclosed to anyone.
- Please have household head read and sign the consent form. Where this is not possible, please explain to them that participation is absolutely voluntary and their consent can be withdrawn any time before 5th August 2019 by calling the lead researcher, Amaka Nnaji on +2347038146361 or +64225384550. Also, the results of this project will be used for publications in journals and conferences with the understanding that their anonymity will be guaranteed.
- Tick the box if verbal consent has been received ☐

Time interview commenced: _____ GPS coordinates: _____

Household No.: _____Date: _____

LGA/State: _____Town: _____

Village: _____ Name of Respondent: _____

Distance from village to the nearest city: _____ (km) Phone no:_____

### A/ General information on the household head

Please write down the basic information about the Household head.

**[A1]** Age? (years) _____

**[A2]** Gender? (1=Male, 0=Female) _____

**[A3]** Educational level of household head? (1=no formal education, 2=primary education, 3=secondary education, 4=vocational education, 5=university degree)

**[A31]** Number of years you spent schooling? (years) _____

**[A4]** Marital status? (1= Unmarried, 2= Married, 3= Widow/Widower, 4=Divorced, 5=Separated) _____

**[A5]** Religion? (1=None, 2=Muslim, 3=Christian, 4=Traditionalist,

**[A51]**=others specify (_____)

**[A6]** Main occupation? (1= Crop farming, 2= livestock farming, 3= Trading,

4 = Civil service, 5= Artisan, **[A61]** =others specify (_____))

**[A7]** Secondary occupation? ((1= Crop farming, 2= livestock farming, 3= Trading,

4 = Civil service, 5= Artisan, **[A61]** =others specify (_____))

**[A8]** Did you participate in off-farm work in 2018? (1=Yes, 0=No) _____

**[A81]**Time taken between household and place of off-farm work by usual transport?(minutes)

Did any of the following participate in off farm work in 2018? (1=Yes, 0=No). If yes, how many?

| **[A82]** Your neighbour | | **[A83]** Your close friends | | **[A84]** Your relatives | |
|---|---|---|---|---|---|
| (1=Yes, 0=No) | How many? | (1=Yes, 0=No) | How many? | (1=Yes, 0=No) | How many? |
| | | | | | |

**[A85]** Do you think it is easy to find off-farm work locally? (1=Yes, 0=No) _____

**[A9]** Did your household migrate to the community? (1=Yes, 0=No) _____

**[A10]** Farming experience of household head? (years) _____

**[A11]** Are you a member of any Farmer's association/cooperative? (1=Yes, 0=No) _____

Are any of the following members of a Farmer's association/cooperative? (1=Yes, 0=No)

| **[A111]** Your neighbour | **[A112]** Your closest friend | **[A113]** Your relative |
|---|---|---|
| | | |

**[A12]** What ethnic group do you belong to? _____ (0=if you prefer not to say)

**[A13]** What languages are spoken in your household? _____

**B/ Household level information**

Please use given codes for the following household level information.

**[B1]** Household family type? (1=Nuclear, 0=Extended) _____

**[B2]** Number of household members? _____

**[B21]** No. of household members aged less than 15 years _____

**[B22]** No. of household members aged 65 years and above _____

**[B3]** Time taken from household to the largest farm plot by usual transport? (minutes)

**[B4]** Time taken from household to the closest source of inputs by usual transport? (minutes)

**[B5]** Time taken from household to the closest output market by usual transport? (minutes)

**[B6]** Does household have access to electricity? (1=Yes, 0=No)

**[B7]** House wall material? (1=Cemented 2= Wooden, 3= Earthen,

**[B71**=others specify (_____))

**[B8]** In general, how much was your total household income in 2018? (₦)_____

**[B81]** Total Farm income? (₦)_____

[**B82]** Total Production Costs? (₦)_____

**[B83]** Total Off-farm income? (₦) _____

**[B84]** Total Farm Gross Revenue? (₦)_____

**[B85]** Did you receive money or food/non-food items any of your family or friends living outside your community? (1=Yes, 0=No)

**[B851]** If yes above, what form did you receive assistance from your family or friends living outside your community? (1=Cash, 2=non-cash, 3=both)

**[B852]** If yes above, how much did you receive? (₦) _____

**[B9]** Does household head have access to credit? (1=Yes, 0=No)

**[B91]** What type of credit? 1= Formal credit, 2= Informal credit (e.g. Esusu), 3= Traditional money lender, 4 =NGO or governmental credit, **[B911]** =others specify (_____)

**[B92]** Time taken from household to closest source of credit by usual transport? (minutes)

**[B10]** Does the household own a Tractor/ Farm Machinery (e.g. ploughs or planters)? _____ (1=Yes, 0=No). **[B101]** A Car? _____ (1=Yes, 0=No). **[B102]** A mobile phone? _____ (1=Yes, 0=No). **[B103]** A Motorbike? _____ (1=Yes, 0=No). **[B104]** Refrigerator? _____ (1=Yes, 0=No). **[B105]** Radio? _____ (1=Yes, 0=No). **[B106]** A TV? _____ (1=Yes, 0=No). **[B107]** A Computer_____ (1=Yes, 0=No). **[B108]** Animal Cart? _____ (1=Yes, 0=No).

**[B11]** How do you perceive the road condition from your village to your largest plot of farmland? (1=Good, 0=Not good) _____

**[B111]** How do you perceive the road condition from your village to the closest source of input? (1=Good, 0=Not good) _____

**[B112]** How do you perceive the road condition from your village to the closest output market? (1=Good, 0=Not good) _____

**C/ Household Farm-level characteristics**

**[C1]** How many farmland parcels does your household have access to? _____

**[C2]** What is the predominant soil type in your farmland? (1=Clay, 2=Loam, 3=Clay loam, 4=Sandy loam, 5=Silt loam, **[C21]** others specify (_____)

**[C3]** Do you think your farmland is fertile? (1=fertile, 0=otherwise) _____

**[C4]** Fertiliser use? (1 = Organic (e.g. farmyard manure), 2 = Chemical (e.g. NPK, Urea), 3 = both Organic and Chemical, 4 = none) _____

**[C41]** Amount of money spent on organic fertilisers in 2018? (₦) _____

**[C42]** Amount of money spent on chemical fertilisers in 2018? (₦) _____

**[C5]** Irrigation source? (1=Only Rain, 2=Canal, 3=Tube well, 4=Canal+ Tube well, 5=Small dam, 6=Dug wells, 7=Turbines, **[C51]**=others specify (_____)

**[C6]** Do you use improved seeds? (1=Yes, 0=No) _____

**[C61]** Amount of money spent on improved seeds in 2018? (₦) _____

**[C7]** Do you use pesticides? (1=Yes, 0=No) _____

**[C71]** Amount of money spent on pesticides in 2018? (₦) _____

**[C8]** Type of cultivation? (1=Commercial, 2=Subsistence, 3= Both) _____

**[C81]** What percentage of household output is sold in the market? _____

**[C9]** Type of cropping? _____ (1=Perennial, 2=Seasonal, 3=Both)

**[C10]** Type of crops grown? _____ (1=Cash crop, 2=Food crop, 3=Both)

**[C11]** Please indicate the crops your household produces in the table below

| **Type of crop** | (1=Yes, 0=No) | **Type of crop** | (1=Yes, 0=No) | **Type of crop** | (1=Yes, 0=No) |
|---|---|---|---|---|---|
| **[C111]** Cassava | | **[C117]** Cashew | | **[C1113]** Corn | |
| **[C112]** Yams | | **[C118]** Cocoa | | **[C1114]** Sorghum | |
| **[C113]** Soybeans | | **[C119]** Palm fruit | | **[C1115]** Groundnuts | |
| **[C114]** Beans | | **[C1110]** Rice | | **[C1116]** Potato | |
| **[C115]** Vegetables | | **[C1111]** Fruits | | **[C1117]**Plantain/Banana | |
| **[C116]** Millet | | **[C1112]**Sugarcane | | **[C1118]** Melon | |
| [C119] Others | | | | | |

**[C12]** Is your household engaged in livestock farming? (1=Yes, 0=No) _____

**[C121]** If yes, what are the types of livestock kept? (1= Poultry, 2=sheep & goat, _____

3=Cattle, 4=Pigs, 5=Rabbit, 6=Snail, 7=Grasscutter [**C122]** =others specify (_____))

**[C13]** Do you have visits from extension agents? (1=Yes, 0=No) _____

**[C131]**Time taken from household to closest extension agent office by usual transport? (mins)

_____

Do any of the following have access to extension agents? (1=Yes, 0=No)

| **[A132]** Neighbour's farm | **[A133]** closest friend's farm | **[A134]** Relative's farm |
|---|---|---|
| | | |

**[C14]** What type of farming system do you practice? (1= Crop rotation, 2=Mixed Farming,

3=Agroforestry, 4=Nomadic pastoralism, 5=Monocropping, 6=shifting cultivation)

**D/ Access to Land**

**[D1]** Tenancy Status of cultivated land? (2=Owner and tenant, 1=Owner, 0=Tenant) _____

**[D2]** If tenant, then what form does the tenancy take? (1=Fixed rent,

2=Sharecropping, 3=both) _____

**[D3]** What is the total area of farmland you own? (acres) _____

**[D31]** What area of your farmland is cultivated? (acres) _____

**[D32]** What area of your farmland is not cultivated? (acres) _____

**[D4]** What area of land did you rent from someone else for cultivation? (acres) _____

**[D41]** What area of land did you rent out to other farmers? (acres) _____

**[D5]** If you are involved in sharecropping, what area of land was sharecropped? (acres)_____

**[D6]** If you practiced irrigation, what area of your farmland is irrigated? (acres) _____

**[D61]** What area of your farmland is not irrigated? (acres) _____

**[D7]** If you rented land for cultivation, how much rent did you pay in 2018 (₦)_____

**[D71]** If you rented your land to someone else, how much were you paid in 2018? (₦)_____

**[D8]** Is household located in the same village as your farmland? (1=Yes, 0=No) _____

**E/ Tenure Security Index**

**[E1]** Do you have title certification to your land? (1=Yes, 0=No) _____

| **Breadth of Property rights** | | |
|---|---|---|
| | | 1=Yes, 0=No |
| **[E21]** | Right to use open access grazing | |
| **[E22]** | Right to gather natural resources (thatch and firewood) on land? | |
| **[E23]** | Right to gather perennial produce (oil palm, cocoa breadfruit etc.) on land? | |
| **[E24]** | Right to use the land during the planting season? | |
| **[E25]** | Right to use this land throughout the year? | |
| **[E26]** | Right to choose what crops to grow? | |
| **[E27]** | Right to bequeath this land? | |
| **[E28]** | Right to fence off the land? | |
| **[E29]** | Right to exclude other people's livestock from grazing on the land | |
| **[E210]** | Right to make permanent improvements on the land? (e.g. establish irrigation, building etc. ) | |
| **[E211]** | Right to lease out your land? | |
| **[E212]** | Right to sell land? | |

**Assurance of property rights**

Do you have:

**[E31]** Land map/Blueprint for your farmland? (1=Yes, 0=No) _____

**[E32]** Informal registration? (1=Yes, 0=No) _____

**[E33]** Formal land title? (1=Yes, 0=No) _____

**F/ Resource-use Conflict (farmer-herdsmen conflict)**

**Incidence and severity of conflict**

**[F1]** Has there ever been any farmer-herdsmen conflict in your community in the last 5 years?
1=Yes, 0=No _____

If yes, did the conflict lead to any of the following?

| **[F21] Injury to household member** 1=Yes, 0=No | **[F22] Death of household member** 1=Yes, 0=No | **[F23] Death of neighbour, friend/relative** 1=Yes, 0=No | **[F24] Loss of yield** 1=Yes, 0=No | **[F25] Destruction of farmland & property** 1=Yes, 0=No | **[F26] Scarcity of food** 1=Yes, 0=No | **[F27] Injuries to livestock** 1=Yes, 0=No |
|---|---|---|---|---|---|---|
| | | | | | | |

**[F3]** Number of farmer-herdsmen conflicts in your community in 2018?

**As a result of farmer-herdsmen conflict in the last year, have you/your household:**

**[F41]** Changed farmland use? (1=Yes, 0=No) _____

**[F42]** Changed type of crop cultivated? (1=Yes, 0=No) _____

**[F43]** Changed to off-farm work? (1=Yes, 0=No) _____

**[F44] C**hanged from perennial to seasonal cropping? (1=Yes, 0=No) _____

**[F45]** Changed from commercial to subsistence farming? (1=Yes, 0=No) _____

**[F46]** Others please specify? _____

**Risk perception of Conflict**

**[F5]** Are you aware of any farmer-herdsmen clash in your community or neighbouring community? (1=Yes, 0=No) _____

**All respondents are to answer the following questions**

**[F6]** Considering farmer-herdsmen conflicts, I have a made a list of concerns people may have about possible conflict and would like you to indicate which of these you are afraid could affect your household. Responses (1=not worried, 2=slightly worried, 3=moderately worried, 4=very worried, 5=extremely worried)

| | **Risks** | **Response** | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **[F61]** | Loss of crop and farm income | | | | | |
| **[F62]** | Destruction of farmland and property | | | | | |
| **[F63]** | Crop failure | | | | | |
| **[F64]** | Scarcity of food / Hunger | | | | | |
| **[F65]** | Injury to livestock | | | | | |
| **[F66]** | Danger to human life and death | | | | | |
| **[F67]** | High market prices for food | | | | | |
| **[F68]** | Physical insecurity and violent conflict | | | | | |
| **[F69]** | Village Chiefs sell land indiscriminately and are corrupt | | | | | |
| **[F610]** | Others ( ) | | | | | |

**[F7]** Of those you indicated some level of concern, please rank the risks from greatest worry to least:

| | **Risks** | **Rank** |
|---|---|---|
| **[F71]** | Loss of crop and farm income | |
| **[F72]** | Destruction of farmland and property | |
| **[F73]** | Crop failure | |
| **[F74]** | Scarcity of food / Hunger | |
| **[F75]** | Injury to livestock | |
| **[F76]** | Danger to human life and death | |
| **[F77]** | High market prices for food | |
| **[F78]** | Physical insecurity and violent conflict | |
| **[F79]** | Village Chiefs sell land indiscriminately and are corrupt | |
| **[F710]** | Others ( ) | |

**[F8] Instrumental Variables for Farmer-Herder conflict**

**[F81]** Distance from household to nearest police station? (km) _____

**[F811]**Time taken to travel from household to closest police station by usual transport?(mins)

**[F82]** Availability of local vigilante service? (1=Yes, 0=No) _____

**[F83]** Private means of protecting household (e.g. personal vigilante service)? (1=Yes, 0=No)

**[F84]** Distance between household and nearest neighbour? (km) _____

**[F841]** Time taken from household to nearest neighbour by usual transport? (minutes) _____

**[F9]** What role do you think the government can play in preventing or mitigating farmer-herdsmen conflicts?

……

……

**G/ Food Security**

**[G1]** How many months in 2018 was it difficult for you to feed your household? _____

**[G2]** Household Food Insecurity Access Scale (HFIAS)

| | In the past 30 days, how often did this happen… | **0. Never**<br>**1. Rarely (once or twice in the past 30 days)**<br>**2. Sometimes (three to ten times in the** |
|---|---|---|
| [G21] | Did you worry that your household would not have enough food due to a lack of resources? | |
| [G22] | Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources? | |
| [G23] | Did you or any household member have to eat a limited variety of foods due to a lack of resources? | |
| [G24] | Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to | |
| [G25] | Did you or any household member eat a SMALLER MEAL than you felt you needed because there was not enough food? | |
| [G26] | Did you or any household member eat FEWER MEALS in a day because there was not enough food? | |
| [G27] | Was there ever no food at all in your household because there were no resources to get more? | |
| [G28] | Did you or any household member go to sleep at night hungry because there was not enough food? | |
| [G29] | Did you or any household member go a whole day without eating because there was not enough food? | |

**[G3]** Coping Strategy Index (CSI)

| **If there have been times in the past 30 days when you did not have enough food or enough money to buy food, has your household had to:** | | **How often have you had to do this in the past 30 days?**<br>0. Never<br>1. Hardly at all (<1 time/week)<br>2. Once in a while (1-2 times/week)<br>3. Pretty often (3-6 times/week)<br>4. Always (every day) |
|---|---|---|
| **[G31]** | Rely on less preferred or less expensive food? | |
| **[G32]** | Borrow food, or rely on help from a relative? | |
| **[G33]** | Purchase food on credit? | |
| **[G34]** | Gather wild foods, "famine foods", hunt, or harvest immature crops? | |
| **[G35]** | Consume seed stock that will be needed for next season | |
| **[G36]** | Send household members to eat elsewhere? | |
| **[G37]** | Send household members to beg? | |
| **[G38]** | Limit portion size at mealtimes? | |
| **[G39]** | Restrict consumption by adults in order for small children to eat? | |
| **[G310]** | Reduce number of meals eaten in a day? | |
| **[G311]** | Skip entire days without eating? | |

Time interview concluded: _____

# Appendix B

# Human Ethics Approval

**Research Management Office**

T 64 3 423 0817
PO Box 85084, Lincoln University
Lincoln 7647, Christchurch
New Zealand
www.lincoln.ac.nz

**29 March 2019**

**Application No: 2019-11**

**Title:** Access to Land, Gender and Conflict: Implications for food security of rural households in Nigeria

**Applicant:** A Nnaji

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*The Lincoln University Human Ethics Committee has reviewed the above noted application.*
Thank you for your response to the questions which were forwarded to you on the Committee's behalf.

I am satisfied on the Committee's behalf that the issues of concern have been satisfactorily addressed. I am pleased to give final approval to your project.

Please note that this approval is valid for three years from today's date at which time you will need to reapply for renewal.

Once your field work has finished can you please advise the Human Ethics Secretary, Alison Hind, and confirm that you have complied with the terms of the ethical approval.

May I, on behalf of the Committee, wish you success in your research.

Yours sincerely

Grant Tavinor
Chair, Human Ethics Committee

**PLEASE NOTE:** The Human Ethics Committee has an audit process in place for applications. Please see 7.3 of the Human Ethics Committee Operating Procedures (ACHE) in the Lincoln University Policies and Procedures Manual for more information.

# Appendix C

# Empirical Results Summary Table

## Summary of Results

| **Chapter 3: Gendered Access to Land and Household Food Insecurity: Evidence from Nigeria** | | |
|---|---|---|
| Dependent Variable | Significant Independent Variables | Sig |
| Food insecurity | Farm size | - |
| | Gender | + |
| | Gender*Land | - |
| | Education | - |
| | Farm income | - |
| | Fertilizer use | - |
| | Soil quality | - |

| **Chapter 4: Farmer-herder conflicts and food insecurity: Evidence from rural Nigeria** | | | | | | |
|---|---|---|---|---|---|---|
| Dependent Variables | Significant Independent Variables | Sig | Significant Independent Variables | Sig | | Sig |
| *Incidence of FH conflict* | *First stage* | | *HFIAS* | | *CSI* | |
| | Age | - | Incidence of FHC | + | Incidence of FHC | + |
| | Gender | - | Asset index | - | Formal land title | + |
| | | | Incidence of FH | | | |
| | Household size | + | Formal land title | + | Household size | - |
| | Crop diversification | + | Household size | - | Crop diversification | - |
| | Road quality | - | Crop diversification | - | Land tenure | - |
| | Land tenure | + | Land tenure | - | | |
| | Time to police station | + | | | | |
| *Severity of FH conflict* | *First stage* | | *HFIAS* | | *CSI* | |
| | Farm size | - | Severity of FH conflict | + | Severity of FH conflict | + |
| | Household size | - | Asset index | - | Formal land title | + |
| | Crop diversification | + | Formal land title | + | Crop diversification | - |
| | Road quality | + | Crop diversification | - | Land tenure | - |
| | Distance to police | + | Road quality | - | | |
| | | | Land tenure | - | | |

**Chapter 5: Risk Perception, Farmer-Herder Conflicts, and Production Decisions: Evidence from Nigeria**

| *Fertilizer use* | *Sig* | *Fertilizer investment* | *sig* | *Rented-in Land* | *sig* | *Income ratio* | *sig* |
|---|---|---|---|---|---|---|---|
| RPI | - | RPI | - | Asset index | + | RPI | + |
| Gender | - | Gender | - | Religion | - | | |
| Farm income | + | Farm income | + | Farm income | + | Asset index | - |
| Household size | - | Household size | - | Road quality | - | Religion | + |
| Extension visits | + | Extension visits | + | Land tenure | - | Household size | + |
| Location | + | Location | + | | | | |

| *Fertilizer use* | | *Fertilizer investment* | *sig* | *Rented-in Land* | *sig* | *Income ratio* | sig |
|---|---|---|---|---|---|---|---|
| Risk-averse | - | Risk-averse | - | Risk-averse | - | Gender | - |
| Gender | - | Gender | - | Asset index | + | Asset index | - |
| Farm income | + | Farm income | + | Religion | - | Household size | + |
| Household size | - | Household size | - | Farm income | + | | |
| Extension visits | + | Extension visits | + | Road quality | - | | |
| Location | + | Location | + | Land tenure | - | | |

**Chapter 6: Determinants of the Risk Perception of Farmer-Herder Conflicts: Evidence from Rural Nigeria**

| Dependent Variable | Model 1 | | Model 2 (With the frequency of FH conflict) | | Model 3 (With conflict and gender interaction) | |
|---|---|---|---|---|---|---|
| Risk perception of FHC | Age | - | Age | - | Age | - |
| | Language | + | Language | + | Language | + |
| | Farming experience | + | Farming experience | + | Farming experience | + |
| | Farm size | - | Farm size | - | Farm size | - |
| | Crop diversification | + | Crop diversification | + | Crop diversification | + |
| | Livestock diversification | + | Livestock diversification | + | Livestock diversification | + |
| | Distance to closest neighbour | + | Distance to closest neighbour | + | Distance to closest neighbour | + |
| | Migration status | - | Migration status | - | Migration status | - |
| | Formal land title | - | Formal land title | - | Formal land title | - |
| | FH conflict exposure | + | FH conflict exposure | + | FH conflict exposure | + |
| | | | | | Frequency of FHC * Gender | + |
| | Location | + | Location | + | Location | + |

| Dependent Variable | Food production and supply | Sig | Physical insecurity and wellbeing | Sig |
|---|---|---|---|---|
| Risk perception of FHC | Age | - | Education | + |
| | Language | + | Household size | - |
| | Farming experience | + | Household income | + |
| | Crop diversification | + | Farming experience | + |
| | Distance to closest neighbour | + | Farm size | - |
| | Migration status | - | Crop diversification | + |
| | Formal land title | - | Livestock diversification | + |
| | FH conflict exposure | + | Distance to city | + |
| | Location | + | Distance to closest neighbour | + |
| | | | Formal land title | - |
| | | | Location | + |