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RESEARCH ARTICLE

Stepping-Up: Impacts of Armed Conflicts on Land Expansion

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Abstract
Land expansion by existing smallholder farmers (SHFs), aka stepping-up, is a major pathway to the rise of medium-scale farmers (MSFs) in Africa. In this paper, we investigate if and how armed conflicts constrain the ability of SHFs to transition to MSFs. We find that increased conflict intensity reduces the likelihood that a SHF will expand to a larger scale, especially for farmers who rely mostly on farm incomes, rather than off-farm incomes, for their livelihoods. These findings uphold other evidence that peace and stability influence private investment, including land-based investments, that are associated with economic transformation.

Keywords: Conflicts; smallholder farmers; stepping-up; Nigeria

JEL codes: Q15; Q18; F51; N57

Introduction

Traditionally, smallholder farmers (SHFs)[1] have played a crucial role in agriculture and overall economic transformation in Africa (AGRA 2017). As of the year 2000, these SHFs represented about 80 percent of the farms in Sub-Saharan Africa (SSA) and were responsible for large shares of the region's food consumption (Herrero et al., 2017; Lowder et al., 2016). However, the number of medium-scale farmers (MSFs) in Africa increased significantly in recent years (Burke, Jayne, and Sitko, 2020).[2] For example, in countries such as Ghana, Nigeria, Tanzania, and Zambia, the value share of national agricultural output accounted for by medium-scale farms rose rapidly between 2000 and 2016 (Jayne et al., 2019). Currently, the share of land under the control of MSFs is as high as 50 percent in some African countries.[3] Moreover, the values of total agricultural production and marketed crop output are on the rise for MSFs and large commercial farmers (LCFs) (Jayne et al., 2019). While both SHFs and MSFs can promote agricultural commercialization, evidence suggests that the generally larger surpluses produced by MSFs tend to attract crop buyers and farm service providers that improve market access conditions and

[1]In this context, the term, smallholder farmers (SHFs), refers to farmers whose land holdings are below 5 hectares.
[2]Emergent or medium-scale farmers (MSFs) are defined as having between 5 and 100 hectares of farmland.
[3]Jayne et al. (2019) estimate that MSFs control 20% land in Kenya, 32% in Ghana, 37% in Tanzania, and 53% in Zambia. Lowder, Sanchez, and Bertini (2021) report that according to the 2010 farm census in Nigeria, farms between 5 and 100 hectares accounted for over half of the national area under farmland use.

commercialization potential for all farms in a given area (e.g., Burke, Jayne, and Sitko, 2020; Jayne et al., 2019).

In Africa, the new wave of MSFs consists of two major groups: (1) farmers who *stepped-up*, defined as medium-scale farm operators who were originally SHFs and who later expanded their landholdings and farm operations, and (2) farmers who *stepped-into*, defined as MSFs, mostly commercial investors, with limited prior involvement in farming (Omotilewa et al., 2021). While both groups have contributed significantly to the growth of the agricultural sector in many African countries, evidence suggests that across all productivity measures, on average, stepped-up farmers (with prior farming engagement as smallholders) are more productive than their stepped-in counterparts. These productivity differentials are primarily attributed to better overall farm management experience and knowledge of agro-ecological and micro-climate of farming areas exhibited by step-up farmers, vis-à-vis step-in farmers (Omotilewa et al., 2021).

However, in many sub-Saharan African countries, step-up efforts by farmers are faced with major challenges despite their perceived importance among all MSFs. Such challenges include limited availability of cultivable land, increasing demand for land for non-agricultural purposes (Brink and Eva, 2009; Lambin and Meyfroidt, 2011), climate change and its impacts on arable land (Lambin et al., 2013), more stringent environmental regulations (Meyfroidt and Lambin, 2011), and geopolitical factors such as restrictive zoning schemes, weak rural governance, corrupt regimes, and political instability (Chamberlin, Jayne, and Headey, 2014; Lambin et al., 2013). Given the growing importance of MSFs and the role of stepping-up in their growth, it is important to clearly understand the role of existing impediments to stepping-up and identify new challenges.

The growing incidence of armed conflicts in Africa, especially in rural areas where agriculture is the economic engine, raises concerns about the barriers they pose to stepping-up. In this study, using Nigeria as a case study, we examine the effects of armed conflicts on the ability of SHFs to step up. We rely on the Agricultural Policy Research in Africa (APRA) survey for Kaduna and Ogun states of Nigeria as our primary data source since it provides information on how farmers recently made the transition to larger-scale farming. By joining the APRA survey with data on conflict incidents from the Armed Conflict Location and Event Data (ACLED) and data on climate-related factors from the Peace Research Institute Organization (PRIO), we estimate the effects of exposure to conflict shocks on the ability of SHFs to scale up.

Previous studies suggest that armed conflicts reduce the supply of cultivable land due to security risks (Eklund et al., 2017); create shortages of labor and other agricultural inputs (Bozzoli and Brück, 2009); and reduce investments in irrigation and transportation infrastructure due to fears about capital loss (Arias, Ibáñez and Zambrano, 2019). However, in the literature, the evidence base on the effects of conflicts on the ability of SHFs to scale up their operations is weak at best, as limited attention has been devoted to the nexus between conflict and SHFs land holdings. Scale expansion impacts of conflict are one of the areas of conflict impacts which remain overlooked.

Most SHFs being peasants, with limited income opportunities, they are vulnerable to socioeconomic, political, climate, conflict, and other shocks. Peasant farmers are increasingly vulnerable in light of the growing incidence of these shocks in rural areas, especially armed conflicts. For example, the Boko Haram insurgency has ravaged many rural communities in Northeast Nigeria while other areas in Nigeria have witnessed heightened incidence of farmer-herder conflicts as well as other forms of violence (ACLED, 2021; Higazi, 2016; Raleigh et al., 2010). Some of these farmers may have limited options and may have to stay in conflict zones. However, some of those farmers who have to abandon their farms in conflict zones may have few livelihood options when they reach their destinations while others with assets may acquire land and begin farming (Fadare, Zanello, and Srinivasan, 2022). These displacements may affect labor and land market outcomes, as well as competition for resources at safer locations (Fadare et al., 2022; Nnaji et al., 2023). How armed conflicts affect agricultural development needs better understanding to design policies and programs to backstop the growth and development of SHFs. Such strategies could go a long way in reducing poverty.

Our measure of conflict intensity is novel, as it includes more extreme and lethal ones such as terrorist attacks, pastoral violence and armed conflicts and the less lethal ones such as protest and riots. Since we base our study on data from Kaduna and Ogun states, two very different states in terms of conflict exposure by type, we standardize our measure of conflict exposure by focusing on fatalities from conflicts as the single indicator of conflict intensity. Given the growing evidence that climate-related factors (e.g., precipitation, temperature, and droughts) exacerbate the challenges emanating from conflict (Moore, Baldos, and Hertel, 2017; Niles and Salerno, 2018), we also explore their roles as well as those of other factors reflecting farm and household structures (e.g., education, inheritance, off-farm income, and assets).

Nigeria is an ideal laboratory to explore the added burdens facing SHFs in expanding their land bases. Muyanga et al. (2019) show that the pace of stepping-up by SHFs has been slow over the last three decades in Nigeria. Since 2009, the country has also experienced the Boko Haram insurgency, especially the Northeast States of Borno, Adamawa, Yobe, Bauchi, Gombe, and Taraba. The insurgency also resulted in over 2.5 million internally displaced persons, some of whom are now residents of formal and informal camps across the North (UNHCR, 2022). A significant proportion of displaced population also moved to and established more permanent residency in places such as Abuja, Kaduna State, and Kano State (UNHCR, 2018). More recently, these destination places have also experienced increased violence spurred by farmer-herder conflicts, as Fulani Ethnic Militia, who historically only grazed their animals seasonally are increasingly grazing there and for longer periods of time (Benjaminsen et al., 2012; Benjaminsen and Ba, 2019; George, Adelaja, and Awokuse, 2020). In addition, Northern Nigeria, including Kaduna State, has experienced growing drought incidents as a result of climate change. The insurgency in Northeast Nigeria, coupled with growing herdsmen-related conflicts, has also affected some southern Nigerian states such as Ogun. By focusing on Kaduna and Ogun states, we are able to discern the differential effects of conflict on two types of destination states with respect to their proximity to an active conflict zone.

In this paper, we find that armed conflicts negatively impact the ability of farmers to scale up their operations, especially when exposure to conflict is measured using larger buffer zones. Moreover, One, farm-led (farming activity enabled) scale-up efforts are more negatively affected than non-farm-led (external resources-related) efforts. We also find heterogeneous impacts by states, with the negative effect of conflict on the probability of transition more evident for farmers in Ogun state, vis-à-vis Kaduna state. We attribute these differences to the nature of conflict incidents experienced by both states and the relative resilience gained from previous exposure from conflicts and violence.

The rest of this paper is organized as follows. In "Understanding the impacts of armed conflict on agriculture," we review the literature on the relationships between conflict and agriculture, land, and other factors important to farm households. We also introduce the survey data from Kaduna and Ogun states along with conflict and other hypothesized exogenous factors. We then briefly explore the implication of existing research for the scale-up of farmers. In "Conceptual framework," we present a conceptual model to explain the roles of conflict shocks in farmer's decisions to expand their operations. In that section, we also present our main research questions or hypotheses: (1) "How does conflict affect the transition potential from SHF to larger operations," and (2) "How does conflict affect whether the transition is farm-led (funded through farm operations) or non-farm-led" (funded through off-farm activities). In "Empirical framework," we describe Kaduna and Ogun states, our research venues; the nature of the data;[4] our various control factors; and our empirical framework. In "Empirical results," we present and explain our main empirical results. Our conclusions and policy recommendations appear in "Conclusions and policy recommendations."

[4]The APRA sample covers three local government areas in each of Kaduna and Ogun states. We join the survey data with conflict data. More details are provided in the empirical section of this report.

Understanding the impacts of armed conflict on agriculture

In this section, we focus on four relevant issues: (1) previous studies on barriers to stepping-up, (2) etiology of conflict in our reference states, (3) previous studies on conflict impacts on agriculture and farmland, and (4) possible roles of other factor in land expansion.

Barriers to stepping-up by farmers

Several barriers to stepping-up for SHFs have been identified in the literature. Growth in human population is considered to be as a major barrier (Brink and Eva, 2009; Lambin and Meyfroidt, 2011), which increases the demand for land for non-agricultural development purposes and the price of land for farmers. Growing per capita consumption of material goods also increases the demand for land for industrial purposes, also putting upward pressures on land prices (ibid). Another factor is climate change, which reduces the amount of affordable land (Lambin et al., 2013), increases the cost of acquiring land, and reduces land affordability through its adverse effects on agricultural productivity and production. In addition, growing environmental concerns have contributed to restricted land access in many countries, spurring the introduction of forest plantations, new protected areas, and new bioenergy policy mandates (Meyfroidt and Lambin, 2011). Also important are various political and cultural factors, including zoning schemes that restrict some forms of agricultural uses, weak rural governance, autocratic and corrupted regimes, and political instability (Chamberlin et al., 2014; Lambin et al., 2013).

Micro-level challenges to stepping-up include limited off-farm income (Headey and Jayne, 2014), inadequate transportation infrastructure (Soares-Filho et al., 2006), limited irrigation and water availability (Neumann et al., 2010), and limited access to credit, agricultural inputs and local and international markets (Graeub et al., 2016; Lambin and Meyfroidt, 2011). Excessively high land conversion costs (Dejene, Lemenih, and Bongers, 2013; Powlson et al., 2011), the lack of entrepreneurial spirit (Ioffe, Nefedova, and Zaslavsky, 2004), and limited opportunities to connect to a new generation of agricultural small and medium enterprises (SMEs), which are needed along the value chain to provide services to SHFs by buying their products and selling them inputs, have been identified as barriers to the transition from SHFs to larger scales. In addition, undefined or fragmented land ownership structures scare off agribusinesses due to transaction costs and risks involved in obtaining consent from local communities (Lambin et al., 2013). Much of literature on the constraint to farmland expansion predates the period when armed conflicts started to spike in Sub-Saharan Africa. By showing that conflicts result in land idling and abandonment, Adelaja and George (2019a) suggest that the role of conflict as a barrier to stepping-up should not be ignored.

While many of the challenges facing the smallholder farmers in stepping-up are regional in nature, there are also reasons to suggest that the barriers to stepping-up could differ significantly across states in Nigeria. For example, in Kaduna state, challenges related to establishing proper land tenure systems include affordability problems related to land registration, inefficient registration processes, corruption, and inadequate skilled workforce with the human capital to implement the programs (Nwuba and Nuhu, 2018). However, such challenges are of relatively less magnitude in Ogun State owing to its geopolitical stature. We also note the relative lack of Fulani pastoralist settlements in Ogun state, which often create additional problems with respect to clear definition of land tenure systems. Farmers hosting the pastoralists prefer more traditional norms of land ownership while the herdsmen inclines toward new political/legal instruments which could potentially give them access to grazing lands (Vanger and Nwosu, 2020).

Etiology of conflict in Nigeria and Kaduna/Ogun States

We define armed conflict as a state of open, often prolonged fighting, battle, or war, arising from disagreement or disharmony between persons, groups, or ideas, where physical force is used to resolve competing claims or interests (ACLED, 2021; Raleigh et al., 2010b). While armed conflict

Table 1. Armed conflict incidents and casualties in Nigeria, 1997–2018

	Incidents				Casualties			
Year	Nigeria	Borno, Adamawa, and Yobe States	Kaduna	Ogun	Nigeria	Borno, Adamawa, and Yobe States	Kaduna	Ogun
1997	144	1	3	3	481	0	1	4
1998	155	7	6	3	1305	46	52	0
1999	205	5	10	7	1804	14	133	56
2000	169	9	24	3	3348	34	1904	3
2001	120	16	4	9	2196	50	21	24
2002	163	11	5	2	1155	70	250	10
2003	207	18	2	3	977	104	17	1
2004	277	19	4	1	2389	53	0	2
2005	198	6	2	8	108	4	4	12
2006	120	9	0	2	126	24	0	7
2007	200	14	1	1	335	18	0	0
2008	209	9	3	7	1002	29	2	7
2009	228	23	9	4	2219	819	3	25
2010	482	40	8	11	1912	44	20	12
2011	347	126	42	0	2481	544	1323	0
2012	923	301	63	17	2980	1241	270	12
2013	1,052	288	41	29	4721	2887	150	14
2014	1,513	406	63	32	11,538	7565	537	10
2015	1,674	448	49	22	10,933	8602	432	8
2016	1,406	331	58	24	4884	2871	200	98
2017	1,636	445	61	23	4850	3103	126	16
2018	1,911	430	85	25	5617	2237	293	12
TOTAL	13,339	2,962	543	236	67,361	30,359	5738	333

may involve only non-state actors, often, the term refers to violence involving at least one government (ACLED, 2021).

From 1997 to 2018, ACLED (2021) reports 13,339 incidents of violent conflicts for Nigeria alone; 2,962 for the Northeastern states of Borno, Adamawa, and Yobe, the three primary states at the center of Boko Haram's attacks; 543 incidents for Kaduna State and 236 incidents for Ogun State (see Table 1). The corresponding casualties are 67,361 (5.05 per incident), 30,359 (10.25 per incident), 5,738 (10.57 per incident), and 333 (1.41 per incident), respectively (see Table 1). Kaduna State is not located in the Northeast. However, the intensity of its exposure to conflict, measured by casualties per incident (10.57), surpasses the national average (5.04) and the average for the three northeastern states (10.25). Therefore, it is an ideal venue to observe the impacts of conflict beyond the Northeast, which was directly influenced by Boko Haram.

In addition to sporadic Boko Haram attacks, Kaduna was the venue of various violent uprisings, including ethnic, communal, religious, and farmer-herder conflicts (see appendix table A1). In contrast, Ogun State in the Southwest Region of Nigeria experienced

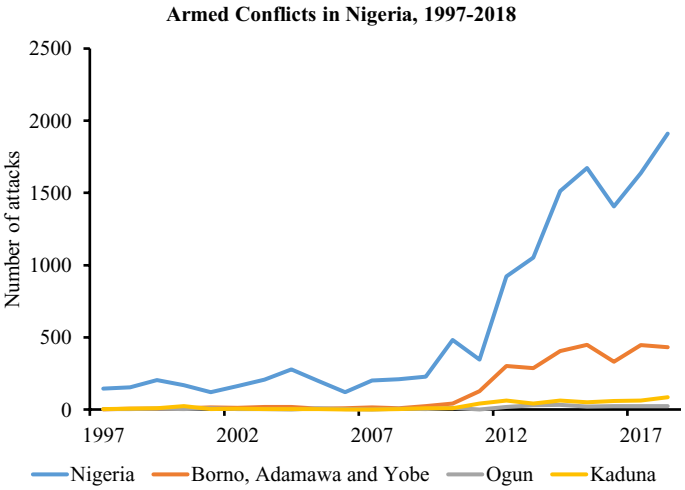

Figure 1. Armed conflict incidents in Nigeria, 1997–2018.

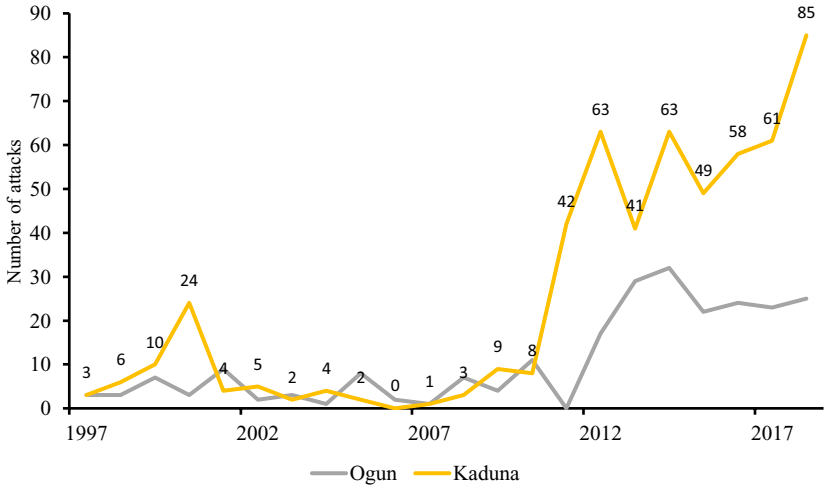

Figure 2. Fatalities from armed conflicts in Nigeria, 1997–2018.

relatively fewer conflict incidents and fatalities between 1997 and 2018, the main types of which were low-grade incidents such as protests and riots. While Kaduna featured higher levels of violence, such incidences were much lower in Ogun State. Note also the virtual absence of Christian, Muslim Militia and Boko Haram-related violence in Ogun State.

Figure 1 summarizes the trajectories of violent conflicts in Nigeria. Violent conflicts increased in all locations, but the magnitude and rates of increase in the nation and the northeastern states outpaced Kaduna and Ogun states. Figure 2 compares the numbers for Kaduna and Ogun states. In Kaduna State, violent conflict started to spike in 2010, compared with Ogun State where it started in 2011. By 2018, the number of incidents in Kaduna State was almost triple that of Ogun. Figures 3 and 4 further illustrate the greater degree of fatality in Kaduna State, vis-à-vis Ogun state.

Based on existing literature, we expect that these conflicts adversely impacted on agricultural production, outputs, efficiency, land use choices, and the agricultural crop mix. However, whether or not they affect the abilities of SHFs to scale up is an empirical question, which this paper seeks to address. While Kaduna State is not in a major conflict zone in terms of Boko Haram, the greater

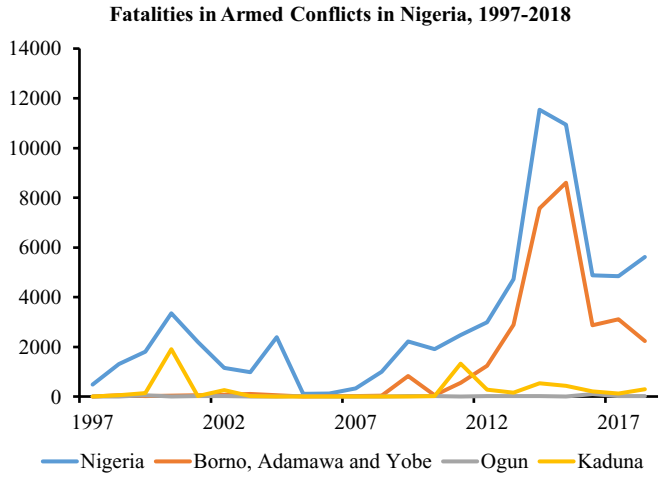

Figure 3. Fatalities from armed conflicts in Kaduna and Ogun states, Nigeria, 1997–2018.

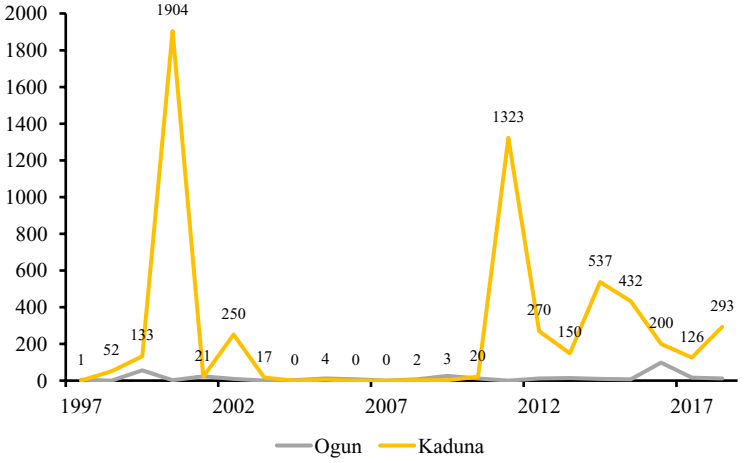

Figure 4. Armed conflict incidents in Kaduna and Ogun states, 1997–2018.

exposure to conflict, vis-à-vis Ogun State, suggests the possibility of a more discernible impact on agriculture. In other words, Ogun State can be considered a control state while Kaduna State is a medium-grade state, compared with the northeastern states.[5]

Impact of conflict on agriculture and farmland

Several recently published studies show the detrimental effects of conflicts on agriculture. Specifically, conflicts have been shown to alter cropping practices (Bozzoli and Brück, 2009), reduce agricultural productivity, reduce agricultural overall output, and reduce the outputs of specific crops (Adelaja and George, 2019a). This is partly because conflicts constrain access to labor (Kondylis, 2010) and optimal land use and allocation choices (Adelaja and George, 2019b). Conflicts also adversely affect the optimal investment choices by farmers (Arias, Ibáñez and

[5]In areas where armed conflicts are persistent, livelihoods, and food systems are significantly undermined, creating a vicious cycle, which results in extended and severe crises.

Zambrano, 2019). Anecdotal evidence also suggests that product and input markets are adversely affected, as conflicts reduce access to farm inputs, reduce market opportunities, and raise product prices. Furthermore, conflicts have been shown to have palpable human displacement effects (UNHCR, 2018), especially where they are persistent for longer periods and involve significant human casualty (van der Haar and van Leeuwen, 2019). There is also growing evidence that conflicts result in increased demand for land, even at distant places, as internally displaced persons seek to resettle and regain their livelihoods (van der Haar and van Leeuwen, 2019). The latter suggests that the land demand and use impacts of conflict can be palpable beyond a major conflict zone.

Given the high incidence of droughts in Africa**,** one cannot effectively explain the impact of conflict on scale expansion without considering other factors. Droughts, which are a key natural causes of agricultural, economic, and environmental change (Burton, Kates, and White, 1993; Wilhite and Glantz, 1985), are also a main driver of conflict. In the Northeast, Lake Chad receded by over 80%, adversely affecting the livelihood of farmers in the region. Between 1978 and 2008 in northern Nigeria, the annual average number of rainy days dropped from 150 to 120, over 350,000 square meters of an already arid region turned desert-like and desertification progressed at the rate of 0.6 km per year (Federal Ministry of Environment, 2012). In most states in Northern Nigeria, 50 to 75 percent of land areas have become desert-like (International Crisis Group, 2017).

Conceptual framework

Based on our literature review above, we hypothesize that conflicts are added barriers to the scale-up of SHFs, even in places that are distant from a major conflict zone. In the rest of this section, we conceptualize how conflict impacts on the ability of SHFs to scale.

If a farm household becomes exposed to conflict, its operations can be affected in a number of ways (Adelaja and George, 2019a, 2019b). First, as a result of possible human casualties, injuries and disabilities, labor supply and quality may be reduced. Deaths, especially of the farm operator, can throw the family in disarray, thereby reducing family labor effort (see Adelaja and George, 2019a). Injuries and disabilities can also result in reduced family effort while available hired labor can become scarce (Adelaja and George, 2019a). Furthermore, fears about possible recurrent events may encourage household members to stay close to home and not farm distant plots (Adelaja and George, 2019b). The overall reduction in labor input may result in reduced production, reduced land demand, and reduced desire to expand the farm's operations.

Second, depending on the nature and intensity of armed conflict, an affected farm household may abandon its operation and escape to other communities, thereby idling their land (Adelaja and George, 2019). On the other hand, farmers who decide to stay may have access to more land from free transfers from friends and relatives who flee. Third, farmers who later return to their fields may meet with hostile conditions which prevent them from readily resuming normal farming operations (Adelaja and George, 2019). For example, ownership can become more contestable (van der Haar and van Leeuwen, 2019). Fourth, the rental price of land should fall (Adelaja and George, 2019). Fifth, the impacts on cropping patterns should favor crops that are easier to manage and that meet subsistence needs, especially if input and output markets are adversely affected. Crops such as Cassava are easier to manage and can be left unattended for a while. (Chauveau and Richards, 2008) showed that such crops are more popular in conflict zones. Ultimately, conflict is expected to reduce the demand for land and, consequently, the desire to expand farmland use.

There are several other factors which could impact the farmers' ability to expand agricultural operations via scaling-up. For example, the type of land tenure status, value of assets, other sources of income, and farmer's education level could also influence their capabilities of scaling-up. Geopolitical factors such as differences in land tenure systems, governance factors, political

stability, and resource availability could also potentially affect the scaling-up efforts. We try to account for these factors by including multiple controls in the empirical analysis. We also undertake a state-wise analysis to analyze how geopolitical factors might contribute to the scaling-up process.

Empirical framework

Data

We mainly use three data sources: (1) the Agricultural Policy Research in Africa (APRA) 2018 survey for agricultural outcomes, (2) the Armed Conflict Location & Event Data Project (ACLED) dataset for armed conflict incidents, and (3) PRIO-GRID dataset for climate-related factors. The APRA survey covers farms in two Nigerian states, Kaduna in the north-west and Ogun in the southwest. We use the geospatial location information recorded in the survey to spatially join all units with the other two datasets, which are also geo-coded. This allows us to accurately measure the exposure of each farm household to conflict-related events and exposure to droughts.

The APRA dataset is cross-sectional in nature and records and information on household-level socioeconomic characteristics, including demographics, land holdings, assets, and agricultural production. APRA dataset is designed to correct for the under-representation of MSFs and LCFs in traditional LSMS surveys. It covers 2110 households, with 49% of them operating more than 5 ha of land. It covers three Local Government Areas each from both Ogun and Kaduna states, representing both states equally (see Muyanga et al., 2019, for a detailed description of how the data was collected). The dataset includes a special module on the ability of SHFs to transition to large scales. This allows us to construct our main dependent variables.

Our main dependent variable is a household's ability to transition from small-scale farming to medium-/large-scale farming (whether a current MSF or LCF had transitioned from being a SHF in the last five years). Such transition happened to only about 6 percent of the SHFs in the sample over the past 30 years, but to 47 percent of current MSFs (Muyanga et al., 2019). Because the specific survey question asked in which year the transition happened, we had some latitude in constructing this transition or scale-up variable. However, we selected 5 years to focus on more recent transitions and conflicts. The dependent variable is a dummy variable for which $D = 0$ indicates a current SHF who did not transition into a MSF or LCF while $D = 1$ indicates a current MSF or LCF which transitioned from being a SHF.

Other dependent variable includes a binary variable which measures whether the transition was farm- or non-farm-led. Each of these is coded as binary variable to simplify our empirical analysis.

Our main independent variable is the household's exposure to conflict, measured by the number of fatalities that took place within predefined buffer zones (2, 10, and 20 km radius) around each household during the five-year period preceding the interview date. These variables were constructed using ACLED, which provides data on armed conflict events and non-violent protests in Africa and Asia by location (Raleigh et al., 2010). ACLED codes the actions of actors (such as government, ethnic groups, active political organization, civilians, and militias), date of battle events, time precision, interaction type, number of fatalities, latitude, and longitude. In terms of attack types, it covers violent activities such as remote violence against civilians, militia interaction, protests, riots, remote violence, and battles.

Regarding the conflict variables, the mean counts for conflict incidents were 0.14 within 2 km from the farm, 3.58 within 10 km from the farm, and 11.75 within 20 km from the farm. The respective number of casualties was 0.74. 17.28 and 45.45, suggesting that on average, about 5.15 casualties per incident (CPI) happened within 2 km, 4.83 cpi within 10 km, and 3.87 cpi within 20 km. Note the diminishing casualty intensity with distance. The latter may reflect the mix of conflicts in each state and the concentration of more deadly conflicts in Kaduna State.

Our control variables include climate-related factors (drought, temperature, and precipitation) and other factors (e.g., education levels, land inherited, total asset value, off-farm income levels, and migration status). Data on the climate-related factors are extracted from the PRIO-GRID version 2.0 dataset (Tollefsen, Strand, and Buhaug, 2012). The drought variable measures the average proportion of the year the household's grid experienced drought conditions. It is obtained by dividing the number of days the grid experienced drought by 365 days in a year. It is constructed using the Standardized Precipitation-Evapotranspiration Index (Beguería, Vicente-Serrano, and Angulo-Martínez, 2010). The average precipitation variable is the yearly total precipitation (in millimeter) in the grid, based on monthly meteorological statistics (Huffman et al., 2009). The average temperature variable is the yearly mean temperature (in degrees Celsius) in the grid, developed at the Climate Prediction Center, NOAA/National Weather Service (Fan and van den Dool, 2008). Other control factors include whether or not the head of the household had completed secondary education, the numbers of hectares inherited, total asset values in thousands of naira, whether or not the household recently migrated, and net off-farm income.

In Table 2, we present the summary statistics. The total number of observations for Kaduna and Ogun states are 1045 and 1065 respectively. For the purpose of this study, we designate SHFs as those with less than 5 hectares, MSFs as those with 5 to 100 hectares, and LCFs as those with greater than 100 hectares. SHFs represent 51 percent of the database while MSFs represent 48.8 percent (same percentages in Kaduna and Ogun). Only one farm in the sample (.05 percent) had over 100 hectares. Some 22 percent of the MSFs had transitioned from SHFs within the previous 10 years. About 75 percent of all farms had acquired a part of their land through inheritance, compared to 7.6 percent through purchase and 1% from no-cost (free) transactions. Only 10 percent of the farms rent their land from others. Only 15 percent of farmers had completed primary education while only 5 percent had completed secondary education (slightly greater in Ogun State). On average, farmers in our sample inherited 12.56 hectares (slightly greater in Ogun State). The average value of assets was N38,830 (much higher in Ogun State). The average net off-farm income was N363,000 (N231,000 in Kaduna and N295,000 in Ogun).

Empirical model

We estimate the impacts of exposure to pastoral violence on an agricultural outcome variable by mainly using the following logit model:

$$\tau_i = \frac{e^{X_i'\beta}}{1 + e^{X_i'\beta}} \tag{1}$$

where τ_i represents the probability of transition from small-scale farming to larger scales for household i. X_i represents the vector of all independent variables, including the main independent variable measuring each household's exposure to armed conflicts. This variable is measured as the total number of fatalities that happened within a given radius of the individual's location during the one year preceding the interview date. We use 2, 10, and 20 km radii measures to construct the buffer zones. We also include multiple household-level control variables which could potentially impact the outcome variables, including education, land inherited, total asset value, off-farm income, and migration status. We implement the logit regressions by first pooling the data from both Ogun and Kaduna states and then treating both states separately. All regressions are estimated using standard errors clustered at the local government area level.

We note that the coefficients in a logistic regression are expressed in terms of the log odds, that is, the coefficient β implies that a one-unit change in the explanatory variable results in a β unit change in the log of the odds of the dependent variable. In other words, the use of logistic model allows us to interpret the coefficients as odds ratios using the formula $(e^{\beta}-1) * 100$, where β represents the coefficients obtained in the logistic regression models.

Table 2. Summary statistics

	Total				Kaduna				Ogun			
Variable	*N*	Mean	Min	Max	*N*	Mean	Min	Max	*N*	Mean	Min	Max
Dependent Variables												
Transition from <5 to >5 hectares	1,204	0.10	0	1	583	0.09	0	1	621	0.12	0	1
Land acquisition by inheritance	2,110	0.74	0	1	1,045	0.81	0	1	1,065	0.68	0	1
Land acquisition by purchase	2,110	0.08	0	1	1,045	0.06	0	1	1,065	0.09	0	1
Land acquisition for free	2,110	0.01	0	1	1,045	0.02	0	1	1,065	0.00	0	1
Land acquisition by rent	2,110	0.10	0	1	1,045	0.03	0	1	1,065	0.16	0	1
Farm-led transition	1,204	0.09	0	1	583	0.07	0	1	621	0.11	0	1
Non-farm-led transition	1,204	0.02	0	1	583	0.02	0	1	621	0.01	0	1
Small-scale farming (<5 hectares)	2,110	0.51	0	1	1,045	0.51	0	1	1,065	0.51	0	1
Med-scale farming (5–100 hectares)	2,110	0.49	0	1	1,045	0.49	0	1	1,065	0.49	0	1
Large-scale farming (>100 hectares)	2,110	0.00	0	1	1,045	0.00	0	0	1,065	0.00	0	1
Control variables												
Completed secondary education	2,110	0.05	0	1	1,045	0.05	0	1	1,065	0.06	0	1
Ancestral land (hectares)	2,110	12.56	0	2015	1,045	12.26	0	2015	1,065	12.87	0	2012
Asset value (1000s of Naira)	2,110	38.83	0	31,407	1,044	27.10	0	10,040	1,065	50.34	0	31,407
Whether the household migrated	2,110	0.17	0	1	1,045	0.11	0	1	1,065	0.24	0	1
Off-farm income (1000s of Naira)	2,110	263	−102	12,416	1,044	231	−66	5880	1,065	295	−102	12,416
Proportion of year in drought	2,110	0.08	0.00	0.08	1,045	0.08	0	0.08	1,065	0.08	0	0.08
Average precipitation	2,110	1536	932	1797	1,045	1287	932	1414	1,065	1781	1377	1797
Average temperature	2,110	27.26	25.25	29.09	1,045	26.15	25.25	29.08	1,065	28.35	28.20	28.45
Conflict variables												
Casualties (within 2 km radius in the previous 5 years)	2,110	0.737	0	40	1,045	1.03	0	40	1,065	0.45	0	25
Casualties (within 10 km radius in the previous 5 years)	2,110	17.28	0	434	1,045	29.35	0	434	1,065	5.44	0	41
Casualties (within 20 km radius in the previous 5 years)	2,110	45.45	0	531	1,045	77.42	0	531	1,065	14.08	0	84

The presence of other factors that can potentially affect both scale-up variable and conflict variable, endogeneity problem can arise. In our study, although we include multiple controls to account for such factors, certain problems persist. We also control for location-based factors by including controls such as drought index, precipitation, and temperature. In an additional robustness check, we include state fixed effects to control for the unobserved heterogeneities which vary across states. Although the main results held true, since the analysis is only based on two states, it takes away significant variability with respect to our conflict measurement. Hence, given these limitations, we exercise caution in interpreting the coefficients as causal evidence.

Empirical results

Effects of conflict intensity on the probability of stepping-up

Table 3 presents our results for the effects of conflict on our main dependent variable, the likelihood that a current MSF or LCF had transitioned from being a SHF within 5 years preceding the survey interview date. As shown in Table 3, the coefficients of the 2 km and 10 km conflict radii variables are statistically insignificant. However, for the 20 km conflict radii variable, the coefficients are statistically significant and negative at the 1 percent levels (−0.001 for model without controls and −0.002 for model with controls). Since we use a logit model, we can interpret the coefficients in terms of odds of the outcome. For instance, the coefficient for fatalities in a 20 km radius variable in the full specification model in Table 2 is −0.002. This means that for one-unit increase in the number of fatalities (20 km), we observe a 0.2% (obtained by the formula $(e^{-0.002}-1) * 100$) decrease in the odds of transitioning to larger scales. While these results seem modest, we also note that during our analysis period, an average household experienced 45 casualties and some households experienced up to a maximum of 1045 fatalities in their 20 km radius. This translates to an economically significant effect.

Based on combined data from Kaduna and Ogun states, only conflicts occurring within 20 km have the cumulative capacity to retard the probability of a larger farm having transitioned from SHF. This result suggests that it is the cumulative conflict in the broader area of a farm that affects the decision of the farm household not to expand its operation, not conflicts that occur in the immediate vicinity. For any given farm, the 20 km conflict count will clearly be larger than or equal to the 2 or 10 km counts. These results may suggest that it is the concern about the broader environment or area of the farm that affects scale-up decisions, not the individual farm itself.

As shown in Table 3, the drought variable, measured by the proportion of year that the grid that the household belongs to experienced drought, shows a statistically significant and negative association with the probability of a farm transitioning to a larger scale in the three models it features in. However, the relevant one is model 6, where the estimated coefficient suggests that drought conditions can impede the scaling-up process for farmers. The temperature variable is statistically significant and positive at the 10 percent level in model 6, suggesting that higher temperature locations aid the transition from SHF to larger scales. Surprisingly, high precipitation levels do not enhance household's potential to transition to large scales. We note the possibility that precipitation is not always positively related to yields and returns, as the probability of flooding increases with precipitation, depending on the landscape.

Regarding other control variables, as expected, the results suggest that secondary education and the amount of off-farm income enhance the likelihood of transitioning from SHF to larger farms. The coefficient for the education variable is 1.321 meaning that the odds of scaling-up is 275% $((e^{1.321}-1) * 100)$ higher for households with family heads who completed their secondary education than those who did not. In addition, households who migrated from other places also are more likely to undergo transition from SHF to larger scales. This means that the odds of scaling-up is 135% $((e^{0.855}-1) * 100)$ higher for households who underwent migration. We attribute this to the possibility that they face reduced inertia regarding local bottlenecks if they

Table 3. Effect of conflict intensity on transition from smallholder to medium/large-scale farming (Logit models)

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Whether the household transitioned to larger scales					
Fatalities (2 km radius)	0.034			0.054		
	(1.64)			(2.64)		
Fatalities (10 km radius)		−0.000			0.000	
		(−0.07)			(0.09)	
Fatalities (20 km radius)			−0.001***			−0.002***
			(−3.18)			(-2.58)
Completed secondary education				1.321***	1.300***	1.364***
				(2.97)	(2.93)	(2.89)
Land inherited				−0.001***	−0.001***	−0.001***
				(−2.87)	(−3.07)	(−3.42)
Asset value				0.010	0.010	0.009
				(0.81)	(0.79)	(0.74)
Migration status				0.855***	0.828**	0.911***
				(2.75)	(2.58)	(3.06)
Net off-farm income				0.001***	0.001***	0.001***
				(3.12)	(2.97)	(3.22)
Proportion of year in drought				−19.155***	−18.819***	−17.427***
				(−5.01)	(−5.83)	(−6.01)
Precipitation				0.000	−0.000	−0.000
				(0.21)	(−0.27)	(−0.31)
Temperature				0.165	0.216*	0.141*
				(1.38)	(1.77)	(1.68)
Constant	−2.171***	−2.146***	−2.099***	−6.002**	−6.979**	−4.976***
	(−14.63)	(−15.57)	(−16.84)	(−2.27)	(−2.44)	(−2.78)
N	1204	1204	1204	1204	1204	1204
Pseudo-R^2	0.00174	0.00000205	0.00224	0.0914	0.0875	0.0924

Notes: ***, **, and * signify, respectively, statistical significance at the 1 percent, 5 percent, and 10 percent levels.

are able to afford to purchase new land. Similarly, a one-unit increase in the net off-farm income could lead to a 0.1% ($(e^{0.001}-1) * 100$) increase in the odds of transitioning to larger scales. On the other hand, the amount of land inherited reduces the transition likelihood, perhaps suggesting that inheritance may be a burden which reduces the motivation to grow. This may also reflect the possibility that inherited land is often owned by the extended family, not just the farm operator. The size of existing asset value shows no significant relationship with the ability to transition. This may well hint at the possibility that the benefits of large asset holdings do not include the ability to expand land holdings for agricultural production purposes. In any case, given the finding related to inherited land, it may well be that it is the size of non-land assets that matters in the decision to acquire more land.

Table 4. Effect of conflict intensity on reasons for transitions (Logit models)

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: farm-led transition			Dependent variable: Non-farm-led transition		
Fatalities (2 km radius)	0.053***			0.038*		
	(2.71)			(1.91)		
Fatalities (10 km radius)		−0.000			0.001	
		(−0.05)			(1.21)	
Fatalities (20 km radius)			−0.003***			−0.001
			(−2.70)			(−0.54)
Completed secondary education	1.072**	1.053**	1.116**	1.950***	1.929***	1.965***
	(2.08)	(2.01)	(2.08)	(5.54)	(5.77)	(5.61)
Land inherited	−0.001**	−0.001***	−0.001***	−0.000	−0.000	−0.000
	(−2.42)	(−2.59)	(−2.71)	(-0.32)	(-0.33)	(−0.35)
Asset value	0.008	0.008	0.007	0.007*	0.007*	0.007*
	(1.00)	(0.98)	(0.91)	(1.89)	(1.89)	(1.72)
Migration status	0.961***	0.933***	1.006***	0.061	0.043	0.079
	(3.19)	(3.04)	(3.46)	(0.12)	(0.08)	(0.15)
Net off-farm income	0.000**	0.000**	0.000***	0.001	0.001	0.001
	(2.48)	(2.29)	(3.04)	(1.54)	(1.55)	(1.42)
Proportion of year in drought	−17.489***	−17.092***	−15.664***	−19.207***	−19.065***	−18.509***
	(−6.11)	(−7.55)	(−10.44)	(−3.12)	(−3.38)	(−3.28)
Precipitation	0.001	0.000	0.000	−0.002***	−0.002***	−0.002***
	(1.13)	(0.96)	(1.39)	(−2.65)	(−2.82)	(−2.82)
Temperature	0.125	0.174*	0.101**	0.244	0.279	0.254
	(1.42)	(1.83)	(2.21)	(1.33)	(1.56)	(1.33)
Constant	−5.933***	−6.860***	−4.912***	−6.505*	−7.228**	−6.509
	(−2.85)	(−2.85)	(−4.66)	(−1.75)	(−1.98)	(−1.52)
N	1204	1204	1204	1204	1204	1204
Pseudo-R^2	0.0729	0.0691	0.0740	0.123	0.122	0.122

Notes: ***, **, and * signify, respectively, statistical significance at the 1 percent, 5 percent, and 10 percent levels.

Effects of conflict intensity on how SHFs' transition is accomplished

In Table 4, we present the results of our investigation into the effects of conflict on how the transition from SHF to a larger scale was accomplished. In columns 1 to 3, the dummy variable captures whether or not the transition of a SHF is farm-led (meaning that it was financed through farm operations), while in columns 4 to 6, it captures whether or not the transition is non-farm-led (meaning that it was financed through off-farm employment and other off-farm income).[6]

[6]For farm-led transitions, the dummy variable, $D = 1$ if a MSF or LCF had gone through farm-led transition, else $D = 0$. For non-farm-led transitions, $D = 1$ if a MSF or LCF had gone through non-farm-led transition, else 0. Note that the $D = 0$ sample for both sets of regressions only includes current SHFs, as none of them went through any transition.

The results suggest that conflict retards the ability to engage in farm-led transition, but not the ability to engage in non-farm-led transition.

Regarding control variables, the results are largely consistent with those of previous studies on the scale-up process. The proportion of the year in which a farm faced drought has a significant and negative relationship with the probabilities of both farm-led and non-farm-led transitions. This suggests that droughts affect both farm operations and non-farm opportunities that are contributory to scale expansion. Also, higher temperatures are associated with greater probability of farm-led transition, but have no effects on the probability of non-farm-led transition. This is expected because temperature is more related to farm operations than to off-farm opportunities. Precipitation is found not to affect the probability of farm-led transition, but to reduce the probability of non-farm-led transition. Considering the fact that many of the farmers in the APRA sample were from areas where more modern road, transportation, and other infrastructure are limited, this finding may reflect the possibility that excessive rainfall crowds out off-farm opportunities by shutting in farmers.

As expected, again, the completion of secondary education increases the probabilities of both farm-led and non-farm-led transitions. Education has been shown to positively contribute to farm production, efficiency, and profitability and also to the ability to engage in and benefit from off-farm opportunities (Oduro-Ofori et al., 2014). While asset value does not influence the probability of farm-led transition, it increases the likelihood of non-farm-led transitions. This suggests that wealthier farmers are more able to leverage their assets against off-farm resources in financing the acquisition of additional land. Land inheritance has the opposite effect, as higher levels of land inheritance reduce the chances that a farm will engage in farm-led transition but does not affect the chances of non-farm-led transition. This may suggest that many of the farmers who had previously inherited land already had enough land to be classified as MSFs or LCFs.

Differential effects of conflict: Kaduna versus Ogun states

In Tables 5 through 7, we report results for regressions where we treat Kaduna and Ogun states separately. In Table 5, the likelihood of a farm having transitioned from a SHF to a larger scale is regressed on various independent variables, including the conflict measures. For Kaduna State, the significant and positive effect of conflict intensity (when measured at the 2 km radius from the farm) on the probability of transitioning to larger-scale farms suggests that conflicts that have more direct impact on the farm actually increase the probability of transitioning. This suggests that a conflict that can destroy a farm or displace a farmer may actually yield the result of the expanded scale. Adelaja and George (2019b) found similar results for direct attacks by Boko Haram. Other studies also find similar results with respect to agricultural outputs and investment decisions by farmers in Nigeria (Fadare et al., 2022; Kaila and Azad, 2023; Nnaji et al., 2023). These results could be attributed to the notion that farmers forced to migrate away by conflict end up leaving behind idled parcels, thereby creating opportunities for remaining or new farmers to scale up. Furthermore, the significant and negative effect of conflict intensity (measured at the 20 km radius) on the probability of transitioning by small farmers in Kaduna State suggests that conflicts occurring in the broader area could also have a detrimental effect on the probability of transitioning. This is consistent with the findings from the aggregate data.

The negative effect of conflict on the probability of transition is more evident for farmers in Ogun state, vis-à-vis Kaduna state. Specifically, it is negative for the 10 and 20 km conflict radii measures. For instance, a one-unit increase in the fatalities variable leads to a 3% $((e^{0.029}-1) * 100)$ decrease in the odds of transition from smaller land holdings to medium and large farms. This is surprising, given that the number of armed conflict incidents was significantly higher in Kaduna State. A possible explanation is that repeated exposure to violent conflicts might raise people's ability to deal with them, hinting at a resilience implication. Another is that the greater availability of cheaper labor in Kaduna state, due to displaced people from active conflict zones, makes it

Table 5. Effect of conflict intensity on transition from smallholder to medium/large-scale farming by states (Logit models)

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Whether the household transitioned to larger scales					
	Kaduna State			Ogun State		
Fatalities (2 km radius)	0.072***			0.012		
	(7.06)			(0.56)		
Fatalities (10 km radius)		0.001			−0.029***	
		(0.96)			(−92.02)	
Fatalities (20 km radius)			−0.002**			−0.028***
			(−2.04)			(−3.34)
Completed secondary education	1.791***	1.758***	1.937***	0.685	0.654	0.791
	(5.03)	(4.35)	(5.10)	(1.15)	(1.09)	(1.58)
Land inherited	−0.001***	−0.001***	−0.001***	−0.000	−0.001	−0.001*
	(−12.12)	(−26.42)	(−41.28)	(−1.02)	(−1.31)	(−1.95)
Asset value	0.002	0.002	0.001	0.042***	0.043***	0.044***
	(0.47)	(0.56)	(0.35)	(15.53)	(19.00)	(13.52)
Migration status	0.065	0.040	0.208	1.374***	1.452***	1.481***
	(0.17)	(0.10)	(0.55)	(8.90)	(8.60)	(7.00)
Net off-farm income	0.000	0.000	0.001	0.001***	0.001***	0.001***
	(0.93)	(0.97)	(1.24)	(2.84)	(2.97)	(3.00)
Proportion of year in drought	−10.90***	−10.67***	−10.58***	−24.33***	−22.59***	−20.64***
	(−16.32)	(−14.44)	(−7.19)	(−9.80)	(−9.99)	(−6.92)
Precipitation	0.003*	0.003***	0.002***	0.000	0.000	0.000
	(1.92)	(2.71)	(4.78)	(.)	(.)	(.)
Temperature	0.081**	0.205***	0.127***	1.690	2.528***	4.565***
	(2.50)	(7.88)	(2.94)	(1.10)	(3.35)	(18.83)
Constant	−7.42***	−10.93***	−7.90***	−49.22	−72.99***	−130.73***
	(−6.03)	(−7.18)	(−10.25)	(−1.14)	(−3.41)	(−18.79)
N	583	583	583	621	621	621
Pseudo-R^2	0.0669	0.0558	0.0612	0.169	0.183	0.189

Notes: ***, **, and * signify, respectively, statistical significance at the 1 percent, 5 percent, and 10 percent levels.

easier for farmers to handle conflict shocks. In addition, the marginal shock effects of an additional conflict incident would be higher for a relatively peaceful state such as Ogun when compared with Kaduna. Empirical evidence also suggests that forced displacement due to armed conflicts could lead to increased competition for land in host communities and nearby areas, which are relatively more peaceful than areas directly affected by conflicts. This could well be the case for Ogun state, which faces forced and voluntary economic migration due to instability in the Northern parts of Nigeria. Increased competition for land could mean less opportunities for

scaling-up. We also exercise caution in interpreting these results since the lack of time series data and associated methodologies prevents us from making causal interpretations about the coefficients.

In both states, drought intensity negatively affects the probability of transitioning to a larger scale. More precipitation means greater probability of transitioning in Kaduna State, but not in Ogun. This is consistent with the fact that Kaduna State experienced more severe droughts, making the marginal product of precipitation much greater in Kaduna State. Again, we confirm that prior land inheritance reduces the chances of transition in both states. As explained above, this may reflect the possibility that many farmers who inherited their land are classified already as larger farmers. Greater asset values increase the probability of scaling to larger-sized farms in Ogun State, but not in Kaduna State. For instance, in Ogun state, a one-unit increase in the asset value could result in a 4% increase in the expected log odds for transitioning. An explanation for this is the more market-oriented land use environment in Ogun State due to the proximity to the 22 million people who live in Lagos.

In Table 6, we report results for the endogenous dummy variable capturing whether the transition of a farm to a larger scale is farm-led. Again, the negative impacts of armed conflicts on farm-led transition are pronounced for Ogun State (for both the 10 and 20 km radii) while the impacts of immediate area conflict are positive for farm-led transition in Kaduna State. As in Table 5, drought adversely affects the probability of farm-led transition, but the effects are more-pronounced for Ogun State. Also, precipitation has a positive effect on farm-led transition in Kaduna State, but not in Ogun State. The effect of higher temperature on the probability of farm-led transition is mostly positive. New Ogun State migrants are more likely to transition, but new Kaduna State migrants are not. Education increases the probability of farm-led transition in Kaduna State, but not in Ogun State. As expected, the inheritance of land reduces the likelihood of farm-led transition in Kaduna State. However, this is not the case in Ogun State. Greater asset values mean greater probability of farm-led transition in Ogun State, but not in Kaduna State.

Results for non-farm-led transition reported in Table 7 suggest that conflicts (measured at the 20 km radii) reduce the probability of non-farm-led transition in both states, but more so in Ogun than Kaduna State. This is consistent with our findings that Kaduna farmers may be more resilient to conflicts due to their more persistent and violent conflict exposure. As expected, near conflicts (2 km) enhance the likelihood of non-farm-led transition in Kaduna State. The results for drought remain largely the same for non-farm-led transition – drought reduces the likelihood of non-farm-led transition more so in Ogun than in Kaduna State. The explanation for this can again be found in the fact that Ogun state farmers, who operate in nearly drought-free environment, may perceive a drought condition as a more major shock than Kaduna State farmers.[7]

Conclusions and policy recommendations

The transition of SHFs to larger scales is often viewed as the key to rural employment, poverty alleviation, economic development, and food security in SSA countries. Many SHFs in Africa are exposed to conflict which may hinder their abilities to up-scale. In this paper, we examine the impacts of conflicts on the potential for SHFs to transition to larger scales and explore the roles of other control factors. We find that conflict adversely affects the ability to transition from SHFs to larger scales when exposure to conflict is measured using larger buffer zones. In addition, the detrimental effects of conflict are greater for farm-led (farming activity enabled) transition than for non-farm-led (external resources-related) transition.

The finding in the paper adds to the literature on how conflicts retard agriculture by showing how they affect the ability of farmers to expand the scale of their operations. It also adds to the

[7]We also did a robustness check excluding less lethal incidents such as riots and protests. The main results remained the same.

Table 6. Effect of conflict intensity on farm-led transitions by states (Logit models)

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Whether the household made a farm-led transition					
	Kaduna State			Ogun State		
Fatalities (2 km radius)	0.073***			0.021		
	(9.97)			(1.22)		
Fatalities (10 km radius)		0.001			−0.021***	
		(1.44)			(−7.25)	
Fatalities (20 km radius)			−0.001			−0.023***
			(−1.48)			(−3.52)
Completed secondary education	1.598***	1.537**	1.662**	0.538	0.507	0.618
	(2.73)	(2.27)	(2.54)	(0.89)	(0.82)	(1.08)
Land inherited	−0.001***	−0.001***	−0.001***	−0.001	−0.001	−0.002
	(−4.20)	(−5.26)	(−6.70)	(−0.69)	(−0.74)	(−0.64)
Asset value	−0.005	−0.004	−0.004	0.035***	0.035***	0.036***
	(−0.60)	(−0.44)	(−0.51)	(2.97)	(3.02)	(2.92)
Migration status	0.144	0.105	0.193	1.477***	1.525***	1.550***
	(0.58)	(0.50)	(1.03)	(6.84)	(6.74)	(6.51)
Net off-farm income	−0.001	−0.001	−0.001	0.000***	0.000***	0.000***
	(-0.95)	(-0.95)	(-0.84)	(4.29)	(4.25)	(4.23)
Proportion of year in drought	−10.55***	−10.3***	−9.90***	−16.5***	−15.0***	−13.20***
	(−12.74)	(−9.19)	(−6.25)	(−7.00)	(−7.28)	(−5.25)
Precipitation	0.002*	0.003**	0.002***	0.000	0.000	0.000
	(1.75)	(2.42)	(3.07)	(.)	(.)	(.)
Temperature	0.092***	0.210***	0.168***	0.299	1.011	2.59***
	(8.90)	(9.61)	(20.83)	(0.26)	(1.37)	(4.12)
Constant	−7.21***	−10.6***	−9.03***	−10.370	−30.577	−75.5***
	(−3.74)	(−5.59)	(−8.76)	(−0.32)	(−1.46)	(−4.18)
N	583	583	583	621	621	621
Pseudo-R^2	0.0589	0.0468	0.0492	0.137	0.145	0.150

Notes: ***, **, and * signify, respectively, statistical significance at the 1 percent, 5 percent, and 10 percent levels.

literature by showing that conflicts have effects that go well beyond areas that are within a conflict zone. For example, although Kaduna State farmers did not suffer the high dose of conflicts faced in the immediate conflict zone of Boko Haram, the fact that these milder forms of conflict-affected their agricultural operations is worrisome. The tendency among policymakers is to only worry about the plight of agriculture in conflict zones and therefore to offer in- and post-conflict assistance only to farmers in such areas. This study suggests that policymakers should be

Table 7. Effect of conflict intensity on non-farm-led transitions by states (Logit models)

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Whether the household made a non-farm-led transition					
	Kaduna State			Ogun State		
Fatalities (2 km radius)	0.040***			−0.095		
	(5.03)			(−0.88)		
Fatalities (10 km radius)		−0.001			−0.768***	
		(−1.02)			(−3.27)	
Fatalities (20 km radius)			−0.003***			−0.061**
			(−3.27)			(−2.40)
Completed secondary education	2.010***	2.037***	2.287***	1.201**	1.298**	1.570***
	(5.73)	(6.09)	(6.92)	(2.34)	(2.18)	(5.13)
Land inherited	−0.338	−0.348	−0.359	0.001	0.001	0.001
	(−1.64)	(−1.61)	(−1.52)	(1.35)	(1.02)	(1.22)
Asset value	0.010**	0.010**	0.008*	0.009***	0.005***	0.010***
	(2.02)	(2.01)	(1.72)	(10.49)	(3.74)	(8.09)
Migration status	−0.458	−0.496	−0.066	0.031	−0.055	0.083
	(−0.41)	(−0.42)	(−0.05)	(0.04)	(−0.08)	(0.13)
Net off-farm income	0.002***	0.002***	0.002***	0.001***	0.001***	0.001***
	(4.58)	(4.48)	(5.98)	(5.23)	(11.43)	(4.64)
Proportion of year in drought	−5.281*	−4.834	−5.785	−44.059***	−37.564***	−40.417***
	(−1.86)	(−1.55)	(−1.26)	(−9.31)	(−29.77)	(−7.65)
Precipitation	0.004***	0.004***	0.002***	0.000	0.000	0.000
	(2.77)	(3.21)	(14.31)	(.)	(.)	(.)
Temperature	0.143	0.222	0.048	15.298***	8.441***	22.732***
	(0.78)	(1.27)	(0.35)	(11.36)	(3.14)	(4.96)
Constant	−12.845**	−14.982***	−7.752**	−435.542***	−241.210***	−646.224***
	(−2.46)	(−2.84)	(−2.31)	(−11.42)	(−3.16)	(−4.97)
N	583	583	583	621	621	621
Pseudo-R^2	0.200	0.198	0.210	0.204	0.264	0.250

Notes: ***, **, and * signify, respectively, statistical significance at the 1 percent, 5 percent, and 10 percent levels.

concerned about farmers elsewhere, rather than focus only on designated areas where major conflicts have grabbed national and global attention.

Our findings have implications for how to address rural poverty and facilitate economic development. They suggest that there are immediate impacts of conflict through the discouragement of land expansion. We argue that conflicts change the trajectory of development by blocking expansions that are so fundamental to transformation. Policymakers should therefore be cognizant that even in places facing milder incidence of conflict, there is a need to take into

consideration its growth-prevention effects and its challenge to agricultural transformation. Policies to reposition agriculture in- and post-conflict should therefore not necessarily focus only on areas well known to be in conflict zones. The finding that off-farm income, migration status, and education can help mitigate the adverse effects of already well-studied barriers to stepping-up suggests the importance of these factors in addressing barriers to SHFs' transformation.

We acknowledge the possible limitations of this study. First, our main dependent variable is based on a retrospective question in the APRA survey about whether or not a current MSF or LCF had already expanded its operations. Panel data that records periodic land holdings and the underlying factors will obviously be more valuable in studying the factors that affect the ability to scale up. Second, using the APRA dataset limits this analysis to locations in Kaduna and Ogun states. Data from more states will allow a more thorough analysis. Third, ACLED mainly collects reported incidents in newspapers and other media and could omit some of the incidents which are relatively low profile. We also limit the conflict variable to the number of fatalities which might overrepresent more lethal events and underrepresent relatively less violent events. Finally, due to data limitation and the loss of degree of freedom if we disaggregate the various conflict types, we only use the aggregate conflict and fatalities counts and did not investigate the effects of specific conflict types on scale-up ability.

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