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Farming under Fire

The Interplay of Armed Conflict and Climate-Induced Weather Disruptions in Agricultural Input Use

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Abstract

The recent surge in violent conflicts, intertwined with climate-induced drought risks, is jeopardizing decades of development progress in many low- and middle-income countries. This study investigates the compounded effects of armed conflicts and climate-induced disruptions on agricultural input use in Ethiopia, a country experiencing significant fragility due to both factors. Using a unique household- and plot-level panel dataset collected before (2019) and after (2023) the onset of a widespread conflict, we examine how these disruptions affect the use of key agricultural inputs, such as inorganic fertilizers, improved seeds, agrochemicals, compost, and manure. The analysis reveals that exposure to conflict significantly reduces the likelihood of using both inorganic and organic inputs. Conflict-affected households are 9 percentage points less likely to use both inorganic fertilizers and improved seeds, and 14 percentage points less likely to use organic fertilizers, such as compost and manure. Exposure to recurrent rainfall variability by inducing uncertainty of use of inputs further exacerbates these negative impacts, reducing fertilizer use by an additional 3 percent among drought-exposed households. These findings highlight the multifaceted challenges faced by smallholder farmers in fragile settings, where both conflict and environmental stressors undermine agricultural productivity and threaten food security. The study underscores the need for targeted anticipatory (pre-conflict) and resilience building (post-conflict) interventions to support resilience in agricultural practices within conflict-affected regions, particularly those facing climate-induced weather risks.

Keywords: Agricultural input use, armed conflict, climate-induced shocks, Ethiopia

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1. Introduction

Violent conflicts and associated fragilities are on the rise in low- and middle-income countries, threatening to reverse important development gains and posing critical challenges to ending extreme poverty and hunger (OECD, 2020)[1]. Additionally, climate-induced weather risks often intertwine with conflicts, complicating recovery efforts in post-conflict situations and exacerbating fragilities (Cappelli et al. 2024; Kimenyi et al. 2014; Maystadt et al., 2014). The World Bank estimates that by 2024, a total of 324 million extremely poor people will live in 33 countries, including Ethiopia, that are classified as fragile and conflict affected, and by 2030, nearly 60 percent of the world's extreme poor will live in these countries (World Bank, 2024).[2] Yet, despite these alarming development reversal estimates, grounded micro-empirical analysis to understand how violent conflicts undermine development efforts by intertwining with climate-induced weather risks and the mechanisms through which these effects manifest (e.g., in the context of smallholder input delivery systems and applications) is limited partly because disaggregated, real-time input application data are rarely available in such contexts. Moreover, conflict settings vary substantially across regions and countries, rendering the external validity of country-specific studies limited.

This study uses household- and plot-level data collected before (2019) and after (2023) the onset of a widespread conflict in Ethiopia to understand the malign effects of violent conflicts on households' access to inputs, mainly inorganic and organic fertilizers, improved seeds, and agrochemicals, which have been hailed as critical in improving agriculture productivity in the years before the conflict (Bachewe et al. 2018). Ethiopia in recent years has seen a resurgence of violent conflicts and recurring climate-induced weather risk, affecting the livelihoods of millions of households in several regions and unfortunately presenting suitable context to study the questions at hand. Agricultural input systems, mainly seed and inorganic fertilizers in smallholder contexts as in Ethiopia, are complex and often prone to fragilities and conflict-borne disruptions. For example, conflicts may disrupt inorganic fertilizer transport systems, restrict local seed

[1] In 2005, 1 in every 400 people was forcibly displaced. By 2022, this figure had increased to 1 in every 86 people being a refugee, an internally displaced person, or an asylum seeker (UNHCR, 2024).

[2] The World Bank classifies countries as fragile and conflict affected if they experience violent conflicts, identified on the basis of a threshold number of conflict-related deaths relative to the population and characterized as having a high level of institutional and social fragility (identified on the basis of indicators that measure the quality of policy and institutions and manifestations of fragility).

production and distribution networks, and weaken local governance, leaving farming communities further vulnerable to food insecurity, hunger, and malnutrition. In other words, in the absence or limited supply of imported inorganic fertilizers, farmers may reduce application rates and slow down intensification. Availability of alternative organic fertilizers such as manure naturally depends on access to or ownership of livestock, with important distributional implications of the disruptions. Violent conflicts during critical planting season may also limit use of locally available organic fertilizers. Likewise, in the absence of emergency seed aid, disruptions in the supply of quality seeds mean farmers would have to recycle seed stocks, with eventual reductions in yield and quality of produce. Left unmitigated, the combined malign effects on the overall livelihood and growth trajectories or deterioration of extreme poverty are likely substantial.

Understanding these relationships and the implied dynamics to food insecurity, malnutrition, and poverty is critical for policy prioritization and future action against potential reversals in the broader development outcomes. While a growing literature studies the effect of violent conflicts on crop choice and agricultural investments (Amare et al. 2025), human development (Vesco et al. 2024), agricultural land use and expansion (Adelaja et al. 2023; Adelaja and George, 2019b), outputs and value chains (Adelaja and George, 2019a; Minten et al. 2023), food insecurity (George et al. 2020; Kafando and Sakurai, 2024), and nutritional outcomes (Howell et al, 2013; Iacoella and Tirivayi, 2020), there is relatively little research to understand the layered effects of armed conflicts and climate-induced weather risks such as rainfall variabilities on smallholder agricultural input uses, as in Ethiopia, where millions are increasingly affected by both events in recent years (UNHCR, 2024; UN OCHA, 2024).

Using a unique household-panel dataset from Ethiopia that spans from before the resurgence of conflicts and to real time during and after the war, we study whether and to what extent exposure to violent conflicts disrupts agricultural input uses, mainly inorganic fertilizers, improved seeds, pesticides, compost, and manure. In fragile contexts, other disasters, such as climate-induced weather risks, often complicate post-conflict recoveries. We study to what extent exposure to violent conflicts in our study areas interacts with climate-induced rainfall variability, further undermining the use of critical agricultural inputs. While violent conflicts that erupted in parts of the country since late 2020 have cut off many areas from accessing critically needed inputs, we find that, in areas that were accessible, exposure to violent conflicts is significantly associated with reduced likelihood of using both inorganic fertilizers and improved seeds (by 9 percentage points each). Moreover, exposure to conflict is also significantly associated with a reduced likelihood of using other inputs, including compost (by 11 percentage points) and manure (by 17 percentage points). Conflicts also conspire with rainfall variability and further exacerbate these negative impacts, reducing fertilizer use by an additional 3 percent among drought-exposed households.

Further, we investigate the extent to which these compounded effects can be heterogenous across household groups and localities. For example, we find that households in already drought-stricken districts, otherwise known as Productive Safety Nets Program (PSNP) districts, experience a 20-percentage point reduction in the use of inorganic fertilizers and an 11-percentage point reduction in the use of improved seeds when exposed to conflicts, compared to those in non-PSNP villages. This suggests that these disasters disproportionately affect different localities and households differently, depending on initial conditions. These results underscore how drought risks amplify the negative impact of conflicts and can deepen crises through reducing resilience capacities and can delay recovery in post-conflicts, given that conflicts often leave weaker governments to withstand the double burden. In many similar contexts, such compounded crises are seen to have cascading impacts that further deepen and prolong conflicts, including in Somalia, Syria, and the DRC, making recuperation of national economies less likely (Barakat et al. 2023). These results suggest that anticipatory and preventive measures to reduce risks of such disasters are important to mitigating post-conflict damages.

The rest of the paper is organized as follows: Section 2 provides an overview of the study context, including the recent evolution of conflicts in Ethiopia. Section 3 describes the data, Section 4 outlines the empirical strategy, and Section 5 presents the main results. Finally, Section 6 summarizes the study's key findings and insights.

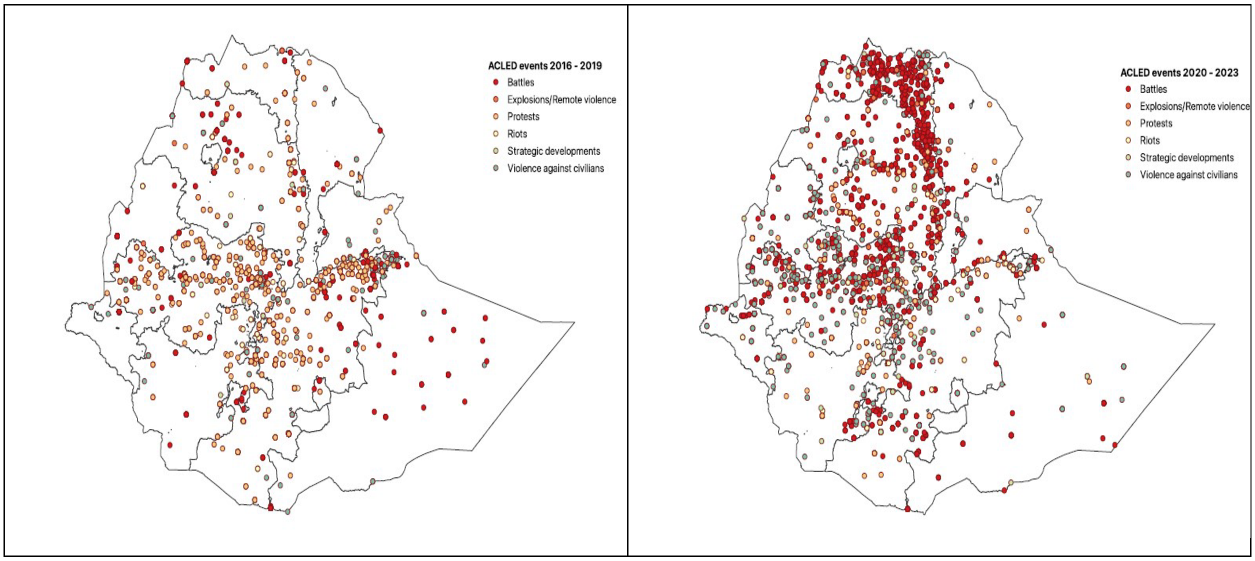
2. The Study Setting

2.1 Armed conflict and droughts in Ethiopia

While Ethiopia has made commendable progress in the past three decades in economic development, the country has also been affected by devastating conflicts and severe droughts that left more than 20 million people in need of food assistance over the study period (WFP, 2024; UN OCHA ,2024). Conflict in recent years has been widely spread in many parts of the country, including the northern regions of Tigray and Amhara, but it also covers many parts of the Oromia region, leading to devastating loss of life and destruction of social and economic infrastructure. Several parts of these conflict-stricken areas were also simultaneously affected by frequent droughts. While Ethiopia is not new to recurring droughts (Dercon and Porter, 2014; Musungu et al., 2024; Viste et al., 2013) mainly caused by climate change, such as shortage of rainfall resulting in famine and food deficiency (Di Falco and Veronesi, 2013), recent overlapping shocks means that livelihoods are significantly hampered, with millions becoming internally displaced since the onset of conflicts in 2020. Reports indicate that during the study period, about 4.5 million people were internally displaced, in addition to the more than a million refugees from neighboring countries hosted in the country (UN OCHA, 2024). The World Bank has named the period from 2020 to 2024 as the "weakest half decade of growth" since the 1990s (World Bank, 2024). Climate change and conflicts are the two major culprits contributing to such "great reversal" in economic growth. In addition, the COVID-19 outbreak and global inflation as well as tighter global financial conditions are believed to have contributed to these reversals.

Figure 1 shows major political events in Ethiopia. The country experienced a decade of instability starting from April 2014, when widespread protests in connection with the so-called Addis Ababa Master plan began. Instability reached its peak during the two-year war in Tigray, which started in November 2020 and ended in November 2022. The period in the figure is divided into two parts: before and after the onset of the war. Between 2016 and 2019, most political events involved protests and violence against civilians. This changed during the 2020 to 2023 period as battles dominated political events.

Figure 1. Conflict events: 2016–2023



Source: Armed Conflict Location Event Dataset (ACLED) data.

2.2 Conflict and disruptions in access to inputs in Ethiopia

Ethiopia's agriculture sector is characterized by a diverse range of farming practices that are heavily reliant on both rainfall and agricultural inputs, given increasingly degraded soils. Ethiopia has made important strides in modern input uses, mainly inorganic fertilizers, agrochemicals, and improved seeds, driving agriculture growth in recent years (Bachewe et al. 2018; Diao et al., 2010; Dorosh and Minten 2020). Input supplies through government parastatals and encouragements through agricultural extension programs have helped these inputs to widely diffuse since the 1990s (Abate et al., 2015; Kosmowski et al., 2020; Spielman et al., 2011).

Despite the improvements, Ethiopia's seed sector largely remains weak and traditional. While the bulk of seed supply is provided through informal channels, mainly through self-saved or farmer-to-farmer transactions, an increasing number of improved seed varieties are provided through the formal sector, including government parastatals,[3] regional and national research institutes, and the private sector (Tarekegn and Mogiso, 2020). Seed producer cooperatives also produce and multiply seeds and channel them directly or indirectly to farmers (Sisay et al., 2017). The supply

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[3] Major actors of the formal seed systems in Ethiopia include the National Agricultural Research System (NARS), which comprises the Ethiopian Institute of Agricultural Research (EIAR), Regional Agricultural Research Institutes (RARIs), and higher learning institutions (HLIs); and the Ministry of Agriculture (MoA), which includes the regional bureau of agriculture (BoAs), Ethiopian Seed Enterprise (ESE), and Regional Seed Enterprises (RSEs) (Sisay et al., 2017)

chain of inorganic fertilizers in Ethiopia involves multiple actors, including government parastatals,[4] cooperatives and unions, as well as one-stop-shop private companies. The Ethiopian Agricultural Businesses Corporation (EABC)—formerly known as the agricultural input supply enterprise (AISE)—is responsible for the importation and distribution of inorganic fertilizers to the rest of the channels, including to primary cooperatives and cooperative unions. Primary cooperatives and cooperative unions play a critical role in the distribution network of fertilizers by purchasing it in bulk from the EABC and distributing it to farmers.

During the study period, as described in Section 2, Ethiopia experienced a major armed conflict that broke out in the Tigray region and subsequently expanded to Amhara and other regions. While the conflict subsided in Tigray after a peace deal was signed in November 2022, it continued to rage in the two most populous regions, namely Amhara and Oromia. Emerging evidence suggests that the conflict has posed a major setback to Ethiopia's much-hoped-for path to agricultural transformation, disrupting agricultural infrastructure and livelihoods, breaking down critical input supply chains, and displacing millions of farm households (Abay et al., 2024; Gejea and Tolesa, 2024; Manaye et al., 2023, Weldegiorgis et al., 2023). Drought shock that hit many of these conflict-affected areas over the same period has compounded the severe effects of the conflict, leaving millions to struggle to cope with the aftermath (FEWS NET, 2023).

Among the immediate impacts of the disruptions in input supply chains are reductions in the availability and use of these inputs (Amankwah et al., 2024; Assefa, et al. 2024; MoA, 2023). For example, a 2023 assessment shows that conflict-born security concerns have disrupted transport logistics, caused delays, and increased transaction costs, making prices unaffordable (MoA, 2023). Amankwah et al. (2024), using the LSMS high-frequency phone survey data, show that nearly 25 percent of respondents who cultivated crops as of early 2024 report that they could not conduct farm activities as usual due to climate shocks (67 percent), lack of fertilizers (56 percent), and lack of seeds (25 percent).

[4] These include the EABC, regional bureaus of agriculture, and other government structures up to the kebele, the lowest administration level in Ethiopia.

Table 1: Disruptions to access to inorganic fertilizers

Questions	2019 %	2023 %
Were inorganic fertilizers available prior to the most recent Meher season (yes =1)?	57.9	49.0
Were inorganic fertilizers available in sufficient amounts to meet the needs of all farmers who wished to use them (yes = 1)?	86.6	15.0
Did conflict affect the distribution and availability of fertilizers and improved seeds? (yes = 1)	—	77.7
Observations	2,649	2,493
How were inorganic fertilizers allocated among farmers who wanted to use them?* Priority given to:		
Farmers who would pay the most	0.5	4.4
Farmers who could pay cash	3.6	35.5
Farmers who used credit to purchase fertilizers	1.1	10.5
Farmers who were approved by development agent	1.0	35.4
Farmers considered to be knowledgeable about how to use fertilizers	—	17.3
No priority	5.8	8.09
Observations	4,779	1,112

* Note that these figures do not add up to 100 percent because multiple responses were allowed. Conflict related questions were not asked in 2029.

We also asked our respondents whether fertilizers and improved seeds were available in sufficient amounts prior to the most recent planting season and directly asked whether conflict affected access to these inputs. The results show striking changes between the two periods. Table 1 and 2 summarize these findings. We note that the share of households reporting that inorganic fertilizers and improved seeds were available on time declined, respectively, by 8 (from 58 percent in 2019 to 49 percent in 2023) and 13 (from 35 percent in 2019 to 22 percent in 2023) percentage points. More strikingly, the share of households reporting that these inputs were not available in sufficient amounts has declined substantially (by 72 percentage points) for inorganic fertilizers and improved seeds (20 percentage points), suggesting quantity constraints as key barriers to adoption. Moreover, 78 percent of these households pointed out that conflict-related disruptions were the culprits for the limited availability and distribution of inorganic fertilizers and improved seeds (Table 1).

Moreover, given the limited supply of inorganic fertilizers and improved seeds, we further asked how these inputs were allocated among households who needed them.

Table 2: Disruptions to access to improved seeds

Questions	2019 %	2023 %
Was improved seed available prior to the most recent Meher season? (yes = 1)	35.0 (4,604)	21.7 (2,493)
Was improved seed available in sufficient amounts to meet the needs of all farmers who wished to use them? (yes = 1)	35.0 (1,703)	15.0 (1,112)
How was improved seed allocated among farmers who wanted to use improved seeds? Priority was given to:		
Farmers who would pay the most	1.7	15.1
Farmers who could pay cash	4.6	59.0
Farmers who used credit to purchase improved seed	1.6	5.8
Farmers who were approved by development agent	2.4	26.4
Farmers considered to be knowledgeable about how to use improved seeds	0.0	14.4
No priority	6.8	19.3
Observations	4,779	2,493

* Note that these figures do not add up to 100 percent because multiple responses were allowed. Conflict related questions were not asked in 2029.

We note that the two most important reasons that stood out in 2023 were (1) farmers who were able to pay cash upfront (36 percent), and (2) those who were approved by extension agents (35 percent) were given priority to purchase inorganic fertilizers. For improved seeds, the same responses accounted for 59 and 26 percent, respectively. These results clearly show a sizable increment (by 34 percent for fertilizers, and 24 to 54 percent for improved seeds) from that of 2019, suggesting supply constraints have led to fertilizer rationing in 2023, favoring those who can buy in cash or have approvals from the extension agent. As part of the efforts to promote agricultural input adoption, access to finance through microfinance institutions, member-based credit cooperatives, and government-backed institutional credit have shown substantial growth since the 1990s (Abate et al., 2016; Berhane and Abay, 2019; Berhane and Gardebroek, 2011; Spielman et al., 2010). However, these channels have also been severely affected by conflict, rendering them unable to provide regular services. In other words, disruption of institutions means that access to credit is also constrained, leaving households to rely on upfront cash payments. This is likely to involve distributional implications to accessing agricultural inputs in favor of better-off farmers. In addition, the presence of violent conflicts for more than two years means that normal agricultural activities, including application of organic manure and compost, are constrained.

3. Data

3.1 Data source and study area

We leverage a large and unique household- and plot-level panel dataset collected before and after the onset of the violent conflict that hit Ethiopia since 2020. These data were collected in 2019 as part of the evaluation of the Feed the Future (FtF) initiative that was implemented in 132 *woredas* or zones of influence (ZOI) in Ethiopia[5] (see Figure 2 for locations of the ZOIs and clusters covered by this program). Sampling followed a two-stage stratified cluster sampling in which 264 enumeration areas (EAs) or communities—two EAs from each woreda—were randomly drawn from a national census frame of the 132 woredas using a probability-proportional-to-size sampling design.[6]

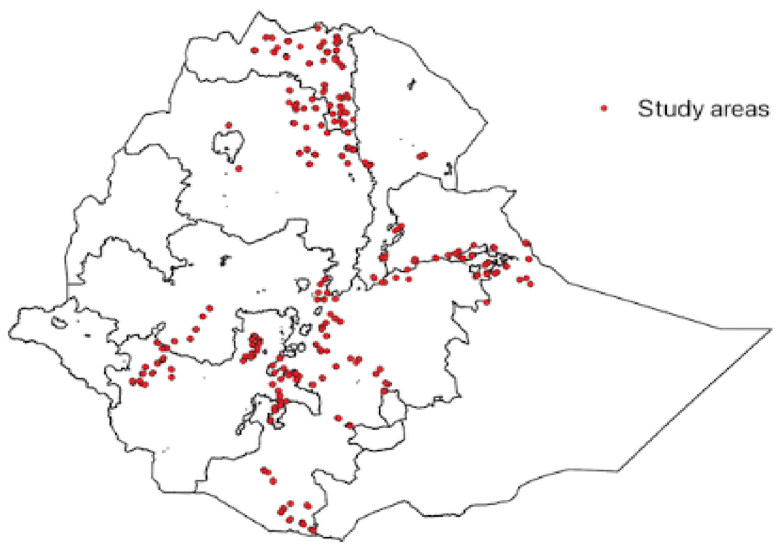

Figure 2: Distribution of sample households

Source: Baseline and endline survey data.

Next, 20 households were randomly selected from a complete list of households from each of the 264 EAs, generating a total sample of 5,280 households. The first round (baseline) survey was

[5] The FtF among others was designed to achieve reduction in poverty, hunger, and malnutrition (Bachewe et al., 2020). Figure 2 shows the different ZOI and clusters covered by this program.
[6] An EA typically comprises 150 to 200 households within a *kebele*, the lowest administration unit in Ethiopia.

conducted between October 15 and November 10, 2019. The second-round (endline) survey was conducted between December 2023 and January 2024, and only 180 of the 264 EAs were identified as accessible due to the ongoing conflict. Given the conflict, we experienced two sources of attrition. First, because the armed conflict was raging in some parts of Ethiopia, our survey team was unable to access six EAs for the endline survey. Second, we were not able to reach a small portion of households and respondents because of mobility, mortality, and dissolution of households. The household-level attrition amounts to about 14 percent of the total sample. Quick tests between those attrited and those interviewed suggest that there is no reason to believe attrition was correlated with our variables of interest. Both baseline and endline instruments covered a wide range of community-, household-, and plot-level modules, including community characteristics and access to services, household demographic characteristics, agricultural production and input use in the last planting season, and parcel-level characteristics. Specifically, our data capture the four main agricultural inputs considered in this study, mainly use of inorganic fertilizers (DAP, urea, and NPS), organic fertilizers (manure and compost), improved seed varieties, and agrochemicals (such as pesticides).

Table 3 presents descriptive statistics by round of the main variables of interest in our study. We note that inorganic fertilizer use slightly decreased from 34.3 percent in 2019 to 32.5 percent in 2023, while improved seed application decreased from 36.2 percent in 2019 to 30.6 percent in 2023. On the other hand, the percentage of people adopting compost, manure, and organic fertilizer increased. The endline survey also asked whether our sample households come from the PSNP districts. The PSNP is Ethiopia's flagship food security program, launched in 2005 to mitigate food insecurity and distress asset sales in geographically targeted, historically drought-prone woredas (Berhane et al. 2011). The PSNP operates in districts that are historically affected by and prone to recurrent droughts. Thus, households that belong to these districts are likely to be poorer and more vulnerable to frequent droughts. We use the PSNP districts as a proxy for poorer and food-insecure areas in our sample.

The summary statistics of the main variables, presented in Table A1 in the Appendix, indicate that 79 percent of households are headed by men, with the average age of household heads being approximately 50 years. The mean education level is slightly above grade two, and the average household size is more than five members. Additionally, more than 40 percent of households report exposure to conflict. We also present the summary statistics and mean differences of the main variables, disaggregated by time (pre- and post-conflict) and area (conflict affected vs. conflict unaffected).

Table 3 provides the average use of key agricultural inputs, including inorganic fertilizers, improved seeds, agrochemicals, and organic fertilizers, by survey round and households' conflict status. Conflict is defined using an indicator variable that takes the value of 1 if the household resides in an area where at least one battle occurred within a 20 kilometer (km) radius. During the baseline (2019), a comparison of the unconditional means of use of these inputs shows no significant differences between households residing in conflict-affected areas and those that did not. However, in 2023, a decrease occurs in the use of all input types except pesticides. Adoption of inorganic fertilizers decreases from 36 to 30 percent, while the use of manure and compost decreases from 33 to 18 percent, and 30 to 12 percent, respectively. These decreases are statistically significant. There is also a decrease in the adoption of improved seeds, but it is not significant. Contrary to expectations, pesticide use shows a significant increase.

Table 3: Summary statistics

	Baseline (2019)			Endline (2023)		
Variable	Conflict unaffected mean (SD)	Conflict affected mean (SD)	Pairwise t-test *p* value	Conflict unaffected mean (SD)	Conflict affected mean (SD)	Pairwise t-test *p* value
Dependent variables						
Have you used DAP, urea, NPS, or blended fertilizer? (yes = 1)	0.36 (0.02)	0.28 (0.06)	0.18	0.36 (0.03)	0.30 (0.02)	0.06*
Have you used improved seed? (yes = 1)	0.38 (0.02)	0.29 (0.05)	0.14	0.32 (0.04)	0.30 (0.03)	0.74
Have you used manure? (yes = 1)	0.16 (0.02)	0.13 (0.04)	0.62	0.33 (0.03)	0.18 (0.01)	0.00***
Have you used compost? (yes = 1)	0.06 (0.01)	0.11 (0.04)	0.31	0.30 (0.04)	0.12 (0.02)	0.00***
Have you used pesticide? (yes = 1)	0.05 (0.01	0.03 (0.02)	0.31	0.21 (0.03)	0.29 (0.02)	0.04**
Number of observations	4,223	886		1,969	3,331	

Note: * $p < .10$; ** $p < .05$; *** $p < .01$. SD = standard deviation.

In addition to the reported household-level exposure to conflict, we use secondary data that comes from ACLED. We use georeferenced identifiers to combine these data with our household-level data. ACLED provides detailed information on a wide range of conflict events, encompassing both violent and non-violent events. These events are categorized into six groups: battles, protests, riots, explosions/remote violence, violence against civilians, and strategic developments. In this paper, we use battles as the main conflict indicators given, as they were the most dominant events in Ethiopia in the study period (see Figure 1). Battle events data are aggregated for the last three years preceding the survey years of 2019 and 2023. Battle is measured both intensively as the number of battles in the last three years in a different geographic radius (measured in km), and extensively showing the occurrence of a battle within a certain radius in the same period. The battle data are available in a radius of 15 and 20 km. A household living within these radiuses is exposed to conflict. While the main analysis uses the highest tercile of battles within a 15 km radius, the Appendix contains a robustness check for the last tercile within 20 km, a dummy for the occurrence of battles within 20 km, and the number of battles within 15 and 20 km.

We also use rainfall data from the Climate Hazards InfraRed Precipitation with Station (CHIRPS) data to proxy climate-induced weather risks conspiring with conflict occurrences in the study areas (CHC, 2021). The CHIRPS data use a combination of satellite-based rainfall estimates and ground stations to create time series rainfall estimates with a resolution of 0.5^0 (Das et al. 2023; Funk et al., 2015). Yearly rainfall is calculated adding the value of rainfall in the *Meher* period, which is June, July, and August. Long-run means and standard deviations of rainfall are calculated using the yearly rainfall for the period 1981 to 2023. Coefficient of variation (CV) of rainfall, calculated as the percentage of the ratio of standard deviation and mean of rainfall, is used as a measure of the risk of drought shocks in the study sites. CV has the advantage of being independent of both measurement unit and magnitude of the data and measures rainfall variability or the risk of rain failure.

4. Empirical Strategy

In this study, we aim to understand the compounded effects of armed conflicts and climate-induced weather risks on access to and use of key agricultural inputs in Ethiopia, which after decades of peace and stability has recently seen a significant resurgence of violent conflicts coupled with persistent droughts. Conflict primarily disrupts access to and use of critical agricultural inputs during crucial planting seasons, which is particularly notable because many conflicts tend to escalate during these critical times. However, conflict-induced effects on access to inputs may vary across locations depending on the scale and intensity of the conflict in which farm households find themselves trapped, as well as the mechanisms through which farm households access these inputs (e.g., whether the input is locally sourced, as with some improved seeds or compost/manure; or transported from long distances, as with imported inorganic fertilizers). This study takes advantage of these geospatial differences in the distribution of violent conflicts and variability in precipitation levels. We start by analyzing whether exposure to conflicts, specifically measured by the intensity of battles within a defined radius, inhibit access and use of agricultural inputs during critical planting seasons and how this intertwines with climate-induced rainfall variabilities.

Climate-induced rainfall variability exacerbates these challenges in many ways, including through reduced purchasing power as input prices skyrocket during conflicts, households consume own stored seeds, or households' resilience capacities are weakened in the aftermath of such shocks. Following this, we proceed to investigate the combined effects of household exposure to both conflict and rainfall variabilities on agricultural input uses, mainly use of inorganic and organic fertilizers, improved seeds, and agrochemicals. To do this, we combine three rich datasets: a household- and parcel-level longitudinal dataset, the location-specific conflict events (ACLED) data, and a gridded satellite-based CHIRPS data,[7] which enable us to compare use of these inputs at the household and parcel levels before and while the conflict rages in many parts of the study areas. We begin by estimating a standard fixed-effects model of the following specification[8]:

$$Y_{pit} = \beta_h + \beta_1 Round_t + \beta_2 Battle_{it} + \beta_3 X_{it} + \varepsilon_{ipt} \tag{1}$$

where Y_{pit} represents our outcome variables, which include indicator variables for use of inorganic or organic fertilizers, improved seeds, pesticides, compost, and manure by household i on parcel

[7] CHIRPS is a rainfall database covering 40 years and spanning the area between 50° S and 50° N. The data resolution is 0.05°, so that each pixel is about 5.5 × 5.5 km. The CHIRPS data are generated by the Climate Hazard Center (CHC) at the University of California at Santa Barbara and the United States Geological Survey with funding from the United States Agency for International Development (USAID), the National Aeronautics and Space Administration (NASA), and the National Oceanographic and Atmospheric Administration (NOAA) (CHC, 2021).

[8] Household decisions on the use of agricultural inputs can be affected by a range of factors, some of which may be observable and some not. This variability can introduce potential selection and endogeneity biases into our analysis. To address these issues, we use a fixed-effects regression model. This approach accounts for household-specific effects that could be directly correlated with the adoption of agricultural inputs, allowing us to more accurately isolate the impact of these inputs on household decisions.

p observed in round t. β_h denotes household-specific fixed effects. $Round_t$ is a round fixed effect, and β_2 captures the impact of armed conflict on the use of agricultural inputs. $Battle_{it}$ is an indicator that takes the value of 1 if household *i* at time *t* is in the highest tercile of conflicts (i.e., battles) that occurred within a specific radius (15 and 20 km) of household residence in the last three years preceding each survey round. For the baseline data, we calculate conflict from November 2016 to November 2019, and for the endline data, from November 2020 to November 2023. Ethiopia experienced a significant increase in battles following the outbreak of the war in Tigray in November 2020. Initially, the conflict was concentrated in Tigray but later spread to neighboring regions of Amhara and Afar and continued in the Amhara and Oromia regions. The detailed data from ACLED enable us to pinpoint each battle and match them with household surveys using geocoordinates. If the identifying parallel trends assumption holds, the fixed-effects estimator in Equation (1), β_2, identifies the impact of exposure to the highest tercile of battles on use of agricultural inputs. X_{it} is a vector of observed time-varying household and parcel level covariates of use of agricultural inputs. Specifically, we control for household-specific variables, including household age, gender, and education; household size; plot size; etc. ε_{ipt} is an error term assumed to be random that captures other unobservable factors that may affect adoption of agricultural inputs.

Although we lack sufficient pre-war data to test the pre-conflict trends, there are compelling reasons to believe that households had limited control over exposure to such large-scale armed conflicts and the subsequent disruptions of access to critical agricultural inputs considered in this study. In the past three years, battles in Ethiopia have involved large-scale engagements with a range of state and regional actors, including the federal army, regional armies, organized militia groups, and regional powers. Many of these conflicts have been fueled by ethnic tensions and disputes over land claims. Consequently, it is reasonable to anticipate that such armed conflicts disrupt input supply chains directly through violence or indirectly by weakening the state capacity that provides these services. That said, we note that while the fixed-effects specification enables us to control for potential time-invariant unobserved heterogeneities that may arise due to household (e.g., specific innate and entrepreneurial abilities within the households) and location fixed-effects (e.g., unique parcel-level biophysical characteristics) and also control for some important observable time-varying household and individual characteristics, we concur we are far from claiming clean causality, as our estimates may suffer from potential time-varying unobserved heterogeneities, including dynamic behavioral responses to the conflict. However, we probe into this by running several sensitivity analyses to our conflict measure and find consistent results (more on this later).

Many parts of Ethiopia have also experienced climate-induced weather risks over the same period, exacerbating conflict-induced negative outcomes. In addition to the direct effect of battles (armed conflict) on the adoption of agricultural inputs, including inorganic fertilizer, improved seed, agrochemicals, manure, and compost, we are also interested in examining the combined impacts of households' exposure to conflict and rainfall variability, an important proxy for precipitation risk that is critical in input use decisions (Abay et al., 2022; Alem et al., 2010). We anticipate that exposure to risk of droughts may amplify the impact of conflict on input use. To explicitly test this hypothesis, we extend the empirical specification in Equation (1) by including interaction terms, as shown below:

$$Y_{pit} = \beta_h + \beta_1 Round_t + \beta_2 Battle_{it} + \beta_3 Drought_{it} + \beta_4 Battle_{it} \# Drought_{it} + \beta_5 X_{it} + \varepsilon_{ipt} \qquad (2)$$

where all terms except $Drought_{it}$ are as defined above. $Drought_{it}$ stands for a risk of drought proxied by the CV of rainfall. β_4 captures the combined effect of exposure to conflict and rainfall variability on the use of agricultural inputs discussed earlier. We also explore additional heterogeneities, estimating Equation (2), considering other differences including gender of the household head and whether the village in which the household resides is part of the drought-prone (PSNP) districts. In addition, we also conduct internal validity checks using different measures of conflict, assessing exposure to battles within 10 and 15 km.

5. Results and Discussion

This section presents the key findings based on the empirical estimation presented in Section 3. We first analyzed the impact of conflict on input use, including inorganic fertilizers, improved seeds, pesticides, compost, and manure at the parcel level. We then examined whether exposure to the intertwined shocks of conflict and precipitation risk had an effect on parcel-level input uses.

5.1 Effect of conflict on input use

Table 4 presents the impact of armed conflict on the use of input, including inorganic fertilizer, improved seeds, pesticides, compost, and manure, at the parcel level. Exposure to armed conflict is measured by an indicator variable that takes the value of 1 if the household resides in the highest terciles of the total number of battle events (armed conflicts) that occurred within a 15 km radius in the last three years, and 0 otherwise. We focus on battles for several key reasons. First, over the past three years, more than half of the conflict events recorded by ACLED in Ethiopia have involved battles between state and non-state actors. Second, these battles typically involve large-scale confrontations between heavily armed state-level actors, making them largely exogenous and beyond the control of individual households. While battles might be anticipated at broader regional levels, their specific occurrence across different communities and villages is unpredictable and outside the influence of households. This contrasts with intra-community disputes and conflicts, which can be shaped by local actors and households.

Columns 1 and 2 of Table 4 present the impact of conflict on inorganic fertilizer use at the parcel level, both with and without control variables.[9] In columns 3 and 4, we investigate whether conflict affects households' use of improved seeds on their parcels, again considering the models with and without controls. Similarly, columns 5 and 6 present effects of conflict on the likelihood of pesticide use, with and without controls. Columns 7 and 8 focus on the impact of conflict on compost use, also analyzed with and without controls. Finally, columns 9 and 10 present effects of conflict on manure use. As outlined in Section 3, all specifications include controls for household and parcel-level characteristics and round (year) fixed effects.

The results indicate that exposure to conflict has statistically strong negative effects on the use of various agricultural inputs. Specifically, conflict reduces the likelihood of using inorganic fertilizers and improved seeds, each by 9 percentage points, corresponding to a decrease of 26.5 and 45 percent, respectively. The results also reveal that conflict significantly lowers the use of organic fertilizers, mainly manure and compost. In particular, exposure to conflict significantly reduces the likelihood of compost use by 11 percentage points (a decrease of 157.1 percent) and manure use by 13 percentage points (a decrease of 86.7 percent). However, no significant impact was observed on pesticide use. A possible explanation for the null effect is that farmers in conflict-affected areas may consider pesticides less essential or may rely less on them compared to other inputs, such as fertilizers and seeds, especially in small-scale or subsistence farming systems.

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[9] These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; price of inorganic fertilizer; and a dummy variable for drought.

These findings consistently suggest that conflict disrupts agriculture input uses profoundly.[10] The data indicate that the disruption caused by conflict extends beyond immediate physical and economic damage, affecting long-term agricultural practices and productivity. Farmers in conflict-affected regions may face increased risks and uncertainties that discourage investment in improved agricultural technologies and inputs. This underscores the profound and multifaceted impact of conflict on agricultural systems. The reduction in the use of essential inputs like fertilizers and improved seeds can lead to decreased agricultural productivity, which in turn affects food security and livelihoods.

[10] Despite conflict significantly deterring the adoption of inputs, we did not observe a significant effect of conflict on the quantity of input used per hectare at the intensive margin. We estimate a double-hurdle model to investigate the effect of conflict both at the extensive and intensive margins. The coefficients for conflict are not statistically significant for both inorganic and organic fertilizers as well as improved seeds, indicating that while conflict affects the decision to adopt these inputs, it does not significantly impact the amount used by those who do adopt them.

Table 4: Effects of conflict on agricultural input uses

Variable	Inorganic fertilizer (1)	(2)	Improved seed (3)	(4)	Pesticides (5)	(6)	Compost (7)	(8)	Manure (9)	(10)
Conflict	−0.09***	−0.09**	-0.09***	-0.09***	0.04	0.04	−0.13***	−0.11***	−0.16***	−0.13***
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.04)	(0.04)
Constant	0.36***	0.36***	0.21***	0.17**	0.11***	0.06	0.17***	0.09***	0.24***	0.21***
	(0.01)	(0.08)	(0.01)	(0.07)	(0.01)	(0.06)	(0.01)	(0.03)	(0.01)	(0.07)
Baseline mean outcome	0.34	0.34	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control variables	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	10,278	9,782	10,278	9,782	10,278	9,973	10,278	9,973	10,278	9,782

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control for household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (measured in tropical livestock units); and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. FE = fixed effects.
* $p < .10$; ** $p < .05$; *** $p < .01$.

5.2 Heterogeneous effects of conflict

The use of agricultural inputs, such as fertilizers, pesticides, and improved seeds, is shaped by a range of socioeconomic factors and household-level characteristics. Among these, exposure to risk of drought and whether households reside in the drought-prone PSNP[12] districts are particularly important. Below, we explore whether the impact of conflict on agricultural input use differs depending on whether the household resides in the drought-prone PSNP districts. Ethiopia has experienced numerous climate-induced persistent droughts that not only have challenged agricultural productivity but also have exacerbated the negative outcomes of conflict. These dual pressures complicate the ability of households to sustain agricultural practices, making it essential to understand the combined effects of drought and conflict on the adoption of agricultural inputs. We assess the combined effects of conflict and drought on the use of fertilizer, pesticides, and improved seeds. We use the CV of rainfall as a proxy for drought incidence in our analysis.

Table 5 presents these results. Specifically, row 1 of Table 5 presents the key findings on the combined effects of conflict and climate-induced shocks (measured by CV of rainfall) across various agricultural inputs at the parcel level. Columns 1 and 2 report effects on inorganic fertilizer use, while columns 3 and 4 focus on the adoption of improved seeds. Columns 5 and 6 assess the effect of these factors on pesticide use, and Columns 7 and 8 examine their impacts on compost use. Finally, columns 9 and 10 analyze the impact of conflict and drought on manure use.

[12] The PSNP is Ethiopia's flagship social protection program that has operated since 2005 to assist poor, food-insecure households residing in moisture-deficient and drought-prone areas. The PSNP was designed to bridge consumption shortfalls of food-insecure households in times of need and hence protect distress asset sales. It is important to note that because it is a government-run program, the PSNP itself has been subject to disruptions and was less responsive to the twin shocks of conflict and drought (Lind et al. 2024). As a result, we use the PSNP to identify drought-prone areas in Ethiopia.

Table 5: Combined effects of conflict and drought on agricultural input uses

	Inorganic fertilizer		Improved seed		Pesticides		Compost		Manure	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conflict × rainfall CV	−0.01**	−0.01**	−0.01	−0.01	−0.01	−0.01	−0.01	−0.00	−0.01***	−0.01***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Conflict	0.17	0.16	0.07	0.06	0.18*	0.15	0.00	−0.02	0.13	0.15
	(0.13)	(0.13)	(0.10)	(0.10)	(0.10)	(0.10)	(0.09)	(0.08)	(0.11)	(0.11)
Rainfall CV	0.00	0.01	0.06**	0.07*	−0.03	−0.07*	0.04	0.05**	−0.05	−0.03
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.04)	(0.04)
Constant	0.30	0.19	−1.02*	−1.12*	0.62	1.34**	−0.50	−0.81*	1.15*	0.92
	(0.65)	(0.73)	(0.57)	(0.66)	(0.58)	(0.65)	(0.42)	(0.42)	(0.68)	(0.74)
Mean outcome	0.34	0.34	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control variables	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	10,278	9,782	10,278	9,782	10,278	9,973	10,278	9,973	10,278	9,782

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control for household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (measured in tropical livestock units); and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. CV = coefficient of variation; FE = fixed effects.

* $p < .10$; ** $p < .05$; *** $p < .01$.

Our findings show that households affected by conflict are disproportionately impacted by drought. Specifically, as shown in columns 1 and 2, households facing both conflict and drought are 1 percentage point (or 3 percent) less likely to use inorganic fertilizers compared to those who are exposed to only conflict without drought. Furthermore, we examine the potential heterogeneity in the effects of conflict on the use of organic fertilizers (mainly manure), as presented in columns 9 and 10. The results demonstrate that households experiencing both conflict and drought are 1 percentage point (or 6 percent) less likely to use manure on their land compared to those exposed to armed conflict only. However, we do not observe any heterogeneity effect on compost use and the direct effect of rainfall variability on compost use for households in statistically significant conflict-affected areas. This suggests that organic inputs may be more resilient to environmental stressors and less risky to use in the face of rainfall variability, compared to inorganic fertilizers. Climate-related shocks may have less impact on organic fertilizers because they are typically produced within the household. Consequently, households relying on organic inputs are less dependent on external supply chains, unlike those using inorganic inputs. This self-sufficiency makes organic inputs less vulnerable to disruptions caused by environmental challenges. Therefore, the reduced use of organic inputs like manure and compost shown by the estimates in conflict-affected areas is more likely attributed to conflict-induced disruptions, rather than the direct effects of rainfall variability. We note that the unconditional means (for these inputs) in Table 3 suggest increases in these inputs between the two rounds. This does not hold anymore after controlling for household and location fixed effects in our estimation.

These findings underscore the compound challenges faced by farmers dealing with both conflict and drought. The reduced likelihood of adopting inorganic fertilizers and improved seeds suggests that the combined stressors of conflict and drought significantly heighten the risks and uncertainties in agricultural production. This, in turn, likely discourages farmers from investing in these essential agricultural inputs. Our findings highlight the critical need for targeted interventions that address the unique challenges of farmers in conflict and drought-prone areas. Policies and programs that provide financial support, access to resilient agricultural technologies, and resources to manage risk could help mitigate the adverse effects of these compounded stressors. By enhancing the resilience of agricultural practices, it is possible to improve food security and sustain the livelihoods of farmers in these vulnerable regions.

In addition to drought, we investigate whether the effect of conflict varies by whether the household resides in PSNP beneficiary districts. Table 6 presents the heterogeneous effects of conflict based on whether or not the household is residing in a PSNP beneficiary district. The results presented in columns 1 and 2 indicate that households residing in beneficiary districts and experiencing armed conflict are 20 percentage points (or 58.8 percent) less likely to use inorganic fertilizer compared to those in non-PSNP districts who are also exposed to conflict. This significant reduction in fertilizer use could be attributed to the fact that PSNP is often implemented in districts where households lack sufficient financial resources to support themselves, making it difficult for them to invest in agricultural inputs like fertilizers. The reduced use of inorganic fertilizers in these vulnerable communities underscores the compounded challenges faced by households in PSNP districts during times of conflict. Besides, like any government program, the PSNP itself was largely disrupted by the conflict and did not provide the much needed help in those conflict-affected areas.

A similar pattern emerges when examining the use of improved seeds. As shown in columns 3 and 4, households residing in PSNP districts that are affected by conflict are disproportionately impacted compared to those in non-PSNP districts that are also exposed to conflict. Specifically, households in PSNP districts experiencing conflict are 11 percentage points (or 55 percent) less likely to use improved seeds than their counterparts in non-PSNP districts. This disparity suggests that the vulnerabilities associated with living in PSNP districts, combined with the effects of conflict, significantly hinder the adoption of improved agricultural practices. However, our analysis did not find any significant evidence of differences in the use of pesticides, compost, or manure between households in PSNP and non-PSNP districts under similar conditions of conflict exposure.

In addition to examining the heterogeneous effects of conflict based on households' exposure to drought and whether they reside in resource-poor districts (PSNP beneficiary areas), we also test the potential differential impact of conflict based on the household head's gender.

Table 6: Heterogeneity effects of conflict on agricultural input uses based on being from the drought-prone districts

	Inorganic fertilizer		Improved seed		Pesticides		Compost		Manure	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conflict × PSNP	−0.18***	−0.20***	−0.08*	−0.11**	−0.08	−0.07	−0.00	0.04	−0.08	−0.05
	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.08)	(0.08)
Conflict	0.06	0.08	−0.01	−0.00	0.11**	0.10*	−0.13***	−0.13**	−0.10	−0.09
	(0.06)	(0.06)	(0.04)	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)	(0.07)	(0.07)
Constant	0.36***	0.37***	0.20***	0.17**	0.10***	0.06	0.17***	−0.01	0.24***	0.22***
	(0.01)	(0.08)	(0.01)	(0.07)	(0.01)	(0.06)	(0.01)	(0.06)	(0.01)	(0.07)
Mean outcome	0.34	0.34	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control variables	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	10,278	9,782	10,278	9,782	10,278	9,782	10,278	9,782	10,278	9,782

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control for household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (measured in tropical livestock units), and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. FE = fixed effects; PSNP = Productive Safety Nets Program.

* $p < .10$; ** $p < .05$; *** $p < .01$.

Table 7: Heterogenous effects of conflict on agricultural input uses across female- versus male-headed households

	Inorganic fertilizer		Improved seed		Pesticides		Compost		Manure	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conflict × male head	−0.16***	−0.15***	−0.10**	−0.05	−0.06	−0.04	−0.04	−0.01	−0.03	−0.03
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)
Conflict	0.04	0.06	−0.00	−0.04	0.08*	0.07	−0.10**	−0.13***	−0.14***	−0.14***
	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)	(0.03)	(0.04)	(0.05)
Constant	0.37***	0.33***	0.21***	0.16**	0.10***	0.06	0.17***	0.07	0.25***	0.26***
	(0.01)	(0.08)	(0.01)	(0.07)	(0.01)	(0.06)	(0.01)	(0.05)	(0.01)	(0.07)
Mean outcome	0.34	0.34	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control variables	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	9,737	9,268	9,737	9,268	9,737	9,268	9,737	9,268	9,737	9,268

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (measured in tropical livestock units); and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. FE = fixed effects.
* $p < .10$; ** $p < .05$; *** $p < .01$.

Table 7 presents the test results on whether the effect of conflict on input use varies on the basis of household head's gender. In columns 1 and 2, we test whether conflict effects on inorganic fertilizer use vary with household head's gender, without and with control variables, respectively. Similarly, columns 3 and 4 examine the heterogeneity effect of conflict on the improved seed use based on household head's gender. In columns 5 to 10, we test whether the effect of conflict on pesticides, compost, and manure use varies on the basis of household's head gender, without and with control variables, respectively.

Results indicate that the effect of conflict on inorganic fertilizer and agrochemical use (pesticides) varies significantly on the basis of household head's gender. Households that were male headed at the baseline are more likely to reduce their agricultural input use during times of conflict. Male-headed households are 15 percentage points (equivalent to a 44.1% reduction) less likely to use inorganic fertilizers compared to female-headed households during conflict.

These findings may be attributed to several factors. First, male-headed households are generally more likely to participate directly in the conflict, which could limit their capacity to manage agricultural activities effectively. The absence of male heads of households—who are often the primary decision-makers for agricultural inputs—can lead to a significant decline in the use of these critical inputs. In some cases, these individuals may be unavailable because they are involved in the conflict or are killed during or after the hostilities. The results highlight how gender dynamics influence decision-making and resource allocation in times of crisis.[13]

5.3 Robustness checks

In Tables 4–6, we examine the impact of armed conflicts on agricultural input use, as well as the variation in this impact based on a household's exposure to drought and the presence of social protection programs in the village. Conflict is measured using an indicator that equals 1 if household *i* at time *t* falls within the highest tercile of conflict (battle) distributions, determined by the number of battles that occurred within 15 km of the household's residence in the three years preceding the survey rounds. To probe into the robustness of our results, we assess the conflict variable in both extensive terms (a dummy variable indicating the occurrence of any armed conflict

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[13] Despite finding a heterogeneous effect of conflict on the use of inorganic fertilizers and pesticides, we did not observe any differences between male- and female-headed households regarding the impact of conflict on the use of improved seeds, manure, and compost.

within a 20 km radius, as well as an indicator variable that equals 1 if household *i* at time *t* is in the highest tercile of conflict distributions, based on the number of battles within 20 km) and intensive terms (the number of battles within 15 and 20 km of the household's residence).

The findings in the Appendix, particularly in Tables B1 to B5, reinforce the results from Table 4. They demonstrate that households exposed to armed conflict—whether assessed by the number of battles within 15 and 20 km or by the extensive margin—are less likely to use agricultural inputs. The data indicate that exposure to armed conflict leads to a reduction in the use of inputs such as inorganic fertilizer, improved seeds, agrochemicals, compost, and manure.

6. Discussion and Conclusions

The resurgence of violent conflicts in recent years, intertwined with climate-born shocks, is threatening to erode decades of hard-won development progress in several low- and middle-income countries. We investigate the simultaneous impacts of these shocks on key agricultural input uses using two rounds of unique household- and parcel-level panel data spanning before and after shocks in Ethiopia. The country has been hailed for over two decades as one of the fastest-growing economies in Sub-Saharan Africa, mainly due to improvements in its agriculture sector, but has faced challenges recently. We focus on the impacts of violent conflict along with the variability of rainfall on the application of inorganic fertilizers, improved seeds, agrochemicals, and organic fertilizers, mainly manure and compost.

Three important findings stand out from the econometric estimation that controls for household- and parcel-level fixed effects. First, our analysis reveals that exposure to violent conflict leads to a significant reduction in the use of essential agricultural inputs, including inorganic fertilizers, improved seeds, compost, and manure. Specifically, households in conflict-affected areas are 9 percentage points less likely to use both inorganic fertilizers and improved seeds. Additionally, the likelihood of using compost drops significantly, with reductions of 11 percentage points, and manure use drops 13 percentage points. These findings are consistent with the descriptive evidence of reduced input supply reported earlier and highlight that conflicts cause substantial damage in terms of reversing important agricultural practices introduced over the years. This may severely impact agricultural productivity and hence food security. Second, our findings underscore the compound effects of climate-induced rainfall risks on the already fragile agricultural systems in conflict-affected areas. Our study shows that households experiencing both conflict and drought risks are 1 percentage point less likely to use inorganic fertilizers, pesticides, and manure compared to those facing only conflict. These results suggest that the uncertainties caused by climate-induced rainfall variabilities amplify the negative impact of conflict on critical agricultural input uses. They undermine farmers' ability to restore resilience after conflicts hit and make it difficult to maintain productive agricultural practices. The interaction between conflict and rainfall variability highlights the need for integrated approaches to address these combined stresses. Third, the study also reveals significant heterogeneity in the impact of conflict based on socioeconomic factors, particularly in relation to areas considered less resilient to droughts and that are part of the PSNP than those that are outside the PSNP areas. Government safety net programs like the PSNP fail to operate when conflict breaks out between state and non-state actors. In the absence of the program, households in the drought-prone PSNP districts experience a 20-percentage-point reduction in the use of inorganic fertilizers and an 11-percentage-point reduction in the use of improved seeds when exposed to conflict, compared to those in non-PSNP districts. This disparity indicates that households in PSNP districts that are already financially constrained are disproportionately affected by conflict, further limiting their ability to invest in critical agricultural inputs.

Addressing these challenges may require anticipatory pre-conflict and targeted post-conflict interventions to support agricultural resilience in conflict-affected regions. In short, well-aligned short- and long-term recovery policies are essential to maintain and rebuild resilience. Such interventions could include providing emergency agricultural input (e.g., emergency seed aid) and access to finance and financial assistance in post-conflict contexts without crowding out similar local initiatives; facilitating access to agricultural inputs; and ensuring the safety and security of farming communities. By doing so, it is possible to mitigate the adverse effects of conflict on agriculture and help restore and enhance productivity in these vulnerable areas.

Our findings are consistent with evidence from conflict studies in Nigeria, which demonstrate that the Boko Haram insurgency causes substantial impacts on agricultural production, including the destruction of agricultural livelihoods, thereby slowing down or total destroying agricultural systems. Such disruptions are likely to generate a large number of unemployed youths, who may become potential conscripts for conflict actors (Adelaja and George, 2019a; Adelaja and George, 2019b). The findings highlight the need for comprehensive strategies to address the challenges faced by farmers in conflict zones. Policymakers and development agencies must prioritize agricultural resilience and productivity through targeted support, ensuring that farmers can continue to sustain their livelihoods and contribute to food security despite the adversities posed by conflict.

In light of these findings, it is crucial for policymakers and development practitioners to design and implement targeted interventions that address the unique challenges faced by farmers in conflict- and drought-prone regions. Strategies should include enhancing access to agricultural inputs, providing financial support, and ensuring the safety and security of farming communities. Additionally, improving resilience through risk management and adaptive agricultural practices can help mitigate the adverse effects of both conflict and climate-induced weather risks. Addressing these compounded challenges may restore and enhance agricultural productivity, improve food security, and sustain livelihoods in vulnerable regions. Overall, our analysis seeks to provide a comprehensive understanding of how the interaction between these two adverse conditions affects agricultural strategies and outcomes at the household level. By examining the combined impact of these challenges, we seek to offer insights into how households adapt their agricultural practices under such compound pressures.

References

Abate, T., Shiferaw, B., Menkir, A., Wegary, D., Kebede, Y., Tesfaye, K., Kassie, M., Bogale, G., Tadesse, B. and Keno, T., 2015. Factors that transformed maize productivity in Ethiopia. *Food security*, *7*, pp.965-981.

Abate, G.T., Rashid, S., Borzaga, C. and Getnet, K., 2016. Rural finance and agricultural technology adoption in Ethiopia: does the institutional design of lending organizations matter? *World Development*, *84*, pp.235-253.

Abay, K., Assefa, T. W, Berhane, G., Abate, G.T. and Hebebrand, C. 2024. Grappling with compounding crises in domestic fertilizer markets in Africa: The case of Ethiopia.

Abay, K.A., Koru, B., Chamberlin, J. and Berhane, G., 2022. Does rainfall variability explain low uptake of agricultural credit? Evidence from Ethiopia. *European Review of Agricultural Economics*, *49*(1), pp.182-207.

Adelaja, A. and George, J., 2019a. Effects of conflict on agriculture: Evidence from the Boko Haram insurgency. *World development*, *117*, pp.184-195.

Adelaja, A. and George, J., 2019b. Terrorism and land use in agriculture: The case of Boko Haram in Nigeria. *Land Use Policy*, *88*, p.104116.

Adelaja, A., George, J., Jayne, T., Muyanga, M., Awokuse, T., Aromolaran, A. and Liverpool-Tasie, L.S.O., 2023. Stepping-Up: Impacts of Armed Conflicts on Land Expansion. *Journal of Agricultural and Applied Economics*, *55*(4), pp.748-769.

Alem, Y., Bezabih, M., Kassie, M. and Zikhali, P., 2010. Does fertilizer use respond to rainfall variability? Panel data evidence from Ethiopia. *Agricultural economics*, *41*(2), pp.165-175.

Amankwah, A., Ambel, A.A., Gourlay, S., Kilic, T., Markhof, Y.V. and Wollburg, P.R., 2024. *Fertilizer Price Shocks in Smallholder Agriculture: Cross-Country Evidence from High-Frequency Phone Surveys in Sub-Saharan Africa* (No. 10842). The World Bank.

Amare, M., Abay, K.A., Berhane, G., Andam, K.S. and Adeyanju, D., 2025. Conflicts, crop choice, and agricultural investments: Empirical evidence from Nigeria. *Land Use Policy*, *148*, p.107391.Assefa, T., Berhane, G., Abate, G.T. and Abay, K., 2024. *Revisiting the demand and profitability of chemical fertilizers amid global fuel-food-fertilizer crisis: Evidence from Ethiopia*. Intl Food Policy Res Inst.

Bachewe, F.N., Berhane, G., Minten, B. and Taffesse, A.S., 2018. Agricultural transformation in Africa? Assessing the evidence in Ethiopia. *World Development*, *105*, pp.286-298.

Bachewe, Fantu, Guush Berhane, John Hoddinott, Bethelehem Koru, Alemayehu Seyoum Taffesse, Abdulazize Wolle, and Abenezer Wondwossen 2020. *Feed the Future Ethiopia 2.0 Zone of Influence Baseline Report 2019.* International Food Policy Research Institute.

Barakat, S., Cochrane, L. and Vasekha, I., 2023. The humanitarian-development-peace nexus for global food security: Responding to the climate crisis, conflict, and supply chain disruptions. *International Journal of Disaster Risk Reduction*, *98*, p.104106.

Berhane, G. and Abay, K.A., 2019. Rural finance and smallholder farming in Ethiopia. In Cheru, F., Cramer, C. and Oqubay, A. eds., 2019. *The Oxford handbook of the Ethiopian economy*. Oxford University Press. Pp. 487.

Berhane, G. and Gardebroek, C., 2011. Does microfinance reduce rural poverty? Evidence based on household panel data from northern Ethiopia. *American Journal of Agricultural Economics*, *93*(1), pp.43-55.

Berhane, G., Hoddinott, J.F., Kumar, N., Taffesse, A.S., Diressie, M.T., Yohannes, Y., Sabates-Wheeler, R., Handino, M., Lind, J., Tefera, M. and Sima, F., 2011. Evaluation of Ethiopia's food security program: documenting progress in the implementation of the productive safety nets programme and the household asset building programme.

Cappelli, F., Costantini, V., D'Angeli, M., Marin, G. and Paglialunga, E., 2024. Local sources of vulnerability to climate change and armed conflicts in East Africa. *Journal of Environmental Management*, *355*, p.120403.

Climate Hazard Center (CHC), 2021. *CHIRPS: Climate Hazards Group InfraRed Precipitation with Station data*. University of California, Santa Barbara.

Chrimes, T., Gootjes, B., Kose, M.A. and Wheeler, C., 2024. The Great Reversal: Prospects, Risks, and Policies in International Development Association Countries.

Das, U., Di Falco, S., & Mahajan, A. 2023. Adaptive capacity and subsequent droughts: evidence from Ethiopia. *Environment and Development Economics*, *28*(6), 511-537.

Dercon, S., & Porter, C. 2014. Live aid revisited: long-term impacts of the 1984 Ethiopian famine on children. *Journal of the European Economic Association*, *12*(4), 927-948.

Di Falco, S., & Veronesi, M. 2013. How can African agriculture adapt to climate change? A counterfactual analysis from Ethiopia. *Land Economics*, *89*(4), 743-766.

Diao, X., Hazell, P. and Thurlow, J., 2010. The role of agriculture in African development. *World development*, *38*(10), pp.1375-1383.

Dorosh, P.A. and Minten, B., 2020. *Ethiopia's agrifood system: Past trends, present challenges, and future scenarios*. Intl Food Policy Res Inst.

FEWS NET. 2023. Ethiopia Food Security Outlook Update August 2023. Food security emergency persists across Ethiopia in aftermath of severe shocks.

Funk, C., Peterson, P., Landsfeld, M., Pedreros, D., Verdin, J., Shukla, S., Husak, G., Rowland, J., Harrison, L., Hoell, A. and Michaelsen, J., 2015. The climate hazards infrared precipitation with stations—a new environmental record for monitoring extremes. *Scientific data*, *2*(1), pp.1-21.

Gejea, Y.M. and Tolesa, S.F., 2024. The impact of national and international war on agriculture in Ethiopia: a review. *International Journal of Social Science, Management and Economics Research*, *2*(4), pp.55-68.

George, J., Adelaja, A. and Weatherspoon, D., 2020. Armed conflicts and food insecurity: evidence from Boko Haram's attacks. *American Journal of Agricultural Economics*, *102*(1), pp.114-131.

Howell, E., Waidmann, T., Birdsall, N., Holla, N. and Jiang, K., 2020. The impact of civil conflict on infant and child malnutrition, Nigeria, 2013. *Maternal & child nutrition*, *16*(3), p.e12968.

Iacoella, F. and Tirivayi, N., 2020. Child nutrition during conflict and displacement: evidence from areas affected by the Boko Haram insurgency in Nigeria. *Public health*, *183*, pp.132-137.

Kafando, W.A. and Sakurai, T., 2024. Armed conflicts and household food insecurity: Effects and mechanisms. *Agricultural Economics*, *55*(2), pp.313-328.

Kimenyi, M., Adibe, J., Djiré, M., Jirgi, A.J., Kergna, A., Deressa, T.T., Pugliese, J.E. and Westbury, A., 2014. The impact of conflict and political instability on agricultural investments in Mali and Nigeria. *Brook. Afr. Growth Initiat. Work. Pap*, *17*.

Kosmowski, F., Alemu, S., Mallia, P., Stevenson, J. and Macours, K., 2020. Shining a brighter light: Comprehensive evidence on adoption and diffusion of CGIAR-related innovations in Ethiopia. *SPIA Synthesis Report*.

Lind, J., Sabates-Wheeler, R., Carter, B. and Tefera Taye, M., 2024. *Conflict disruptions to social assistance in a multi-hazard context: Assessing responses to the northern ethiopia crisis*

(2020–22). BASIC Research Working Paper 28, Brighton: Institute of Development Studies, DOI: 10.19088/BASIC.

Manaye, A., Afewerk, A., Manjur, B. and Solomon, N., 2023. The Effect of the war on smallholder agriculture in Tigray, Northern Ethiopia. *Cogent Food & Agriculture*, *9*(1), p.2247696.

Maystadt, J.F., Tan, J.F.T. and Breisinger, C., 2014. Does food security matter for transition in Arab countries?. *Food Policy*, *46*, pp.106-115.

Minten, B., Goeb, J., Win, K.Z. and Zone, P.P., 2023. Agricultural value chains in a fragile state: The case of rice in Myanmar. *World Development*, *167*, p.106244.

MoA (Ministry of Agriculture), 2023. Alert Ethiopia #02 (April 2023). Stichting Wageningen Research Ethiopia, Addis Ababa. SWRE-RAISE-FS-23-004

Musungu, A.L., Kubik, Z. and Qaim, M., 2024. Drought shocks and labour reallocation in rural Africa: evidence from Ethiopia. *European Review of Agricultural Economics*, p.jbae020.

OECD. 2020. States of Fragility 2020. Paris: OECD.

Sisay, D. T., Verhees, F. J. H. M., & van Trijp, H. C. M. 2017. Seed producer cooperatives in the Ethiopian seed sector and their role in seed supply improvement: A review. *Journal of Crop Improvement*, *31*(3), 323–355. https://doi.org/10.1080/15427528.2017.1303800

Spielman, D.J., Byerlee, D., Alemu, D. and Kelemework, D., 2010. Policies to promote cereal intensification in Ethiopia: The search for appropriate public and private roles. *Food policy*, *35*(3), pp.185-194.

Spielman, D.J., Kelemwork, D. and Alemu, D., 2011. Seed, fertilizer, and agricultural extension in Ethiopia. *Food and agriculture in Ethiopia: Progress and policy challenges*, *74*, p.84.

Tarekegn, K. and Mogiso, M., 2020. Assessment of improved crop seed utilization status in selected districts of Southwestern Ethiopia. *Cogent Food & Agriculture*, *6*(1), p.1816252.

UN OCHA, 2024. High-Level Pledging Event on the Humanitarian Situation in Ethiopia. Available at: https://www.unocha.org/events/high-level-pledging-event-humanitarian-situation-ethiopia

UNHCR. 2024. *Global Trends Report 2024*. Available at: https://www.unhcr.org/pl/wp-content/uploads/sites/22/2024/06/Global-Trends-Report-2024-ENG.pdf

Vesco, P., Baliki, G., Brück, T., Döring, S., Eriksson, A., Fjelde, H., Guha-Sapir, D., Hall, J., Knutsen, C.H., Leis, M.R. and Mueller, H., 2025. The impacts of armed conflict on human development: A review of the literature. *World Development*, *187*, p.106806.

Viste, E., Korecha, D. and Sorteberg, A., 2013. Recent drought and precipitation tendencies in Ethiopia. *Theoretical and Applied Climatology*, *112*, pp.535-551.

Weldegiargis, A.W., Abebe, H.T., Abraha, H.E., Abrha, M.M., Tesfay, T.B., Belay, R.E., Araya, A.A., Gebregziabher, M.B., Godefay, H. and Mulugeta, A., 2023. Armed conflict and household food insecurity: evidence from war-torn Tigray, Ethiopia. *Conflict and Health*, *17*(1), p.22.

World Bank. 2024. *The Great Reversal: Prospects, Risks, and Policies in International Development Association (IDA) Countries.* Washington, DC: World Bank. License: Creative Commons Attribution CC BY 3.0 IGO.

World Food Program (WFP) Ethiopia. (2024) *Ethiopia*. Available at: https://www.wfp.org/countries/ethiopia

Appendix

Appendix A: Descriptive Statistics

Table A1: Summary of main variables

Variable	Number of observations	Mean	Standard deviation
Dependent variables			
Have you used DAP, urea, NPS, or blended fertilizer? (yes = 1)	10,409	0.333	0.471
Have you used improved seed? (yes = 1)	10,409	0.334	0.472
Have you used manure? (yes = 1)	10,409	0.196	0.397
Have you used compost? (yes = 1	10,409	0.13	0.337
Have you used pesticide? (yes = 1)	7,516	0.159	0.366
Drought measure			
Rainfall CV	10,409	18.854	5.377
Exposure to armed conflict			
Is the household exposed to conflict? (yes = 1)	10,409	0.405	0.491
Control variables			
Is the household head male? (yes = 1)	10,409	0.79	0.407
Age of household head, years	10,052	49.833	15.438
Education of household head, grades	10,409	2.39	3.949
Is the household head married? (yes = 1)	10,409	0.784	0.412
Household size, members	10,055	5.258	2.157

Note: CV = coefficient of variation.

Appendix B: Effect of conflict on input use with different conflict measures

Table B1: Effect of conflict on input use (last tercile of the number of battles within 20 km)

	Inorganic fertilizer		Improved seed		Pesticides		Compost		Manure	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conflict	−0.10***	−0.12***	−0.08***	−0.09**	0.00	0.01	−0.13***	−0.11***	−0.13***	−0.10***
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)
Constant	0.37***	0.38***	0.21***	0.17**	0.11***	0.03	0.17***	0.10***	0.24***	0.21***
	(0.01)	(0.08)	(0.01)	(0.07)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)	(0.07)
Mean outcome	0.34	0.34	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	10,278	9,782	10,278	9,782	10,278	9,973	10,278	9,973	10,278	10,278

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control for household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (in tropical livestock units) , and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. FE = fixed effects.
* $p < .10$; ** $p < .05$; *** $p < .01$.

Table B2: Effect of conflict on input use (dummy for battles within 20 km)

	Inorganic fertilizer		Improved seed		Pesticides		Compost		Manure	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conflict dummy	−0.05*	−0.07**	−0.06**	−0.07**	0.01	0.00	−0.12***	−0.08***	−0.13***	−0.11***
	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)	(0.04)	(0.04)
Constant	0.36***	0.38***	0.20***	0.18**	0.11***	0.04	0.18***	0.10***	0.25***	0.24***
	(0.01)	(0.09)	(0.01)	(0.08)	(0.01)	(0.02)	(0.01)	(0.03)	(0.02)	(0.08)
Mean outcome	0.34	0.34	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	10,278	9,782	10,278	9,782	10,278	9,973	10,278	9,973	10,278	9,782

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control for household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (measured in tropical livestock units); and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. FE = fixed effects.
* $p < .10$; ** $p < .05$; *** $p < .01$.

Table B3: Effect of conflict on input use (dummy for battles within 15 km)

	Inorganic fertilizer		Improved seed		Pesticides		Compost		Manure	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conflict dummy	−0.03**	−0.03**	−0.01	−0.00	0.02*	0.02	−0.03***	−0.03***	−0.04***	−0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.35***	0.36***	0.19***	0.14**	0.11***	0.02	0.15***	0.08***	0.22***	0.20***
	(0.01)	(0.08)	(0.00)	(0.07)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.07)
Mean outcome	0.34	0.34	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	10,278	9,782	10,278	9,782	10,278	9,973	10,278	9,973	10,278	9,782

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control for household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (measured in tropical livestock units); and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. FE = fixed effects.
* $p < .10$; ** $p < .05$; *** $p < .01$.

Table B4: Effect of conflict on input use (intensive margin: Number of battles within 20 km)

	Inorganic fertilizer		Improved seed		Pesticides		Compost		Manure	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conflict numbers	−0.02**	−0.03**	−0.00	−0.00	0.02***	0.03***	−0.03***	−0.03***	−0.04***	−0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.36***	0.36***	0.19***	0.14**	0.11***	0.03	0.15***	0.08***	0.23***	0.20***
	(0.01)	(0.08)	(0.00)	(0.07)	(0.00)	(0.02)	(0.01)	(0.02)	(0.01)	(0.07)
Mean outcome	0.35	0.35	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	10,057	9,698	10,057	9,698	10,057	9,871	10,057	9,871	10,057	9,698

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control for household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (measured in tropical livestock units); and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. FE = fixed effects.
* $p < .10$; ** $p < .05$; *** $p < .01$.

Table B5: Effect of conflict on input use (intensive margin: Number of battles within 15 km)

	Inorganic fertilizer		Improved seed		Pesticides		Compost		Manure	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conflict numbers	−0.02*	−0.02*	−0.00	−0.00	−0.05***	−0.04***	−0.03***	−0.03***	−0.04**	−0.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Constant	0.35***	0.34***	0.18***	0.14**	0.42***	0.28***	0.15***	0.07***	0.22***	0.19***
	(0.00)	(0.08)	(0.00)	(0.07)	(0.00)	(0.03)	(0.00)	(0.02)	(0.01)	(0.07)
Mean outcome	0.34	0.34	0.20	0.20	0.03	0.03	0.07	0.07	0.15	0.15
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	10,278	9,782	10,278	9,782	10,278	9,973	10,278	9,973	10,278	9,782

Note: In columns 1 and 2, the dependent variable is an indicator for inorganic fertilizer use, while in columns 3 and 4, it indicates whether households use improved seeds on their parcels. In columns 5 and 6, the dependent variable is a dummy variable for pesticide use, and in columns 7 and 8, it indicates compost use. In columns 9 and 10, the dependent variable is manure use. In columns 1, 3, 5, 7, and 9, we estimate the effect of conflict on organic fertilizer and pesticide use without control variables. In contrast, in columns 2, 4, 6, 8, and 10, we control for household characteristics. These characteristics include the household head's gender, age, maximum years of education, household size, and marital status; parcel size in hectares; fertilizer price; Livestock (measured in tropical livestock units); and a dummy variable for drought. Standard errors, clustered at the enumeration area (village) level, are reported in parentheses. FE = fixed effects.
* $p < .10$; ** $p < .05$; *** $p < .01$.

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