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Conflict and Agricultural Performance: Evidence from Myanmar

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ABSTRACT

Recent years have witnessed an escalation in conflict, especially in developing countries where a significant proportion of the population relies on agriculture. It is crucial to understand how these conflicts impact agricultural production, given its importance for food security and agricultural transformation in these regions. However, research exploring how persistent conflicts affect agriculture is still nascent. Our study adds to this body of research by establishing a causal link between ongoing conflicts and their impact on paddy production, a primary staple crop in Myanmar. This analysis is based on data from a nationally representative phone survey conducted amidst active conflicts. We find that conflict adversely affects paddy production in various ways, including decreases in production and yield, as well as decreases in farmgate prices and the value of production. Our analysis reveals that conflict events, particularly those targeting civilians, have more pronounced negative effects on paddy production, yield, farmgate prices, and the value of production compared to non-targeted conflict incidents that do not purposively target civilians but could potentially disrupt input and output markets. The timing of conflict also significantly affects paddy production, with incidents occurring in mid-season, and during pre-planting and planting periods being the most damaging. Conflict leads to a decrease in the land area devoted to paddy cultivation, lowered probability and intensity of compound fertilizer usage, and an increased reliance on possibly lower quality seeds and exchange labor use. Our findings provide timely and informative insights for development partners and policy frameworks, highlighting the need for emergency assistance and intervention strategies to mitigate the impact of conflict and enhance resilience in areas vulnerable to conflict and instability.

1. INTRODUCTION

Understanding the linkages between conflict and agricultural production is critical for two reasons. First, conflict is increasingly prevalent in many parts of the world. An estimated 1.7 billion people—approximately a quarter of the world's population—were affected by violent conflict in 2023 (ACLED, 2023). Second, developing countries, which have a high proportion of the population living in extreme poverty and are dependent on agriculture, are the most affected by fragility and conflict-affected situations (FCS) (World Bank, 2020). Identifying the nature of how conflict affects agriculture is thus enormously important.

Literature on the microeconomic relationship between conflict and agriculture has three key strands. The first strand of literature attempts to quantify the impact of conflict on agricultural production. Past studies have consistently found that conflict decreases agricultural production and productivity, outputs of specific crops, agricultural wages, and increases land ownership (Adelaja & George, 2019a; Adelaja & George, 2019b; George, Adelaja, & Awokuse, 2021; MAPSA, 2023). The second strand of literature highlights how conflict modifies the behaviors of farmers. These studies have revealed that conflict reduces the hours of hired labor, increases fallow land, decreases farm investment, and changes crop and livestock portfolios and composition (Adelaja & George, 2019a; Adelaja & George, 2019b; Arias, Ibáñez, & Zambrano, 2019; Rockmore, 2012; Rockmore, 2020). Ample evidence suggests that farmers' responses to conflict often lead to sub-optimal allocations such as the choices of crop portfolios with low-risk, and low-return activities, which could affect the agricultural development outlook in the long term (Martin-Shields & Stojetz, 2019; Rockmore, 2020).

The third strand of literature explores the strategies households adopt to cope with tradeoffs between productivity, food security, and safety. Studies have found that due to conflict, households resort to various measures such as destroying or hiding visible assets, changing crop and cattle portfolios, reducing market participation, altering land use pattern, reallocating labor, and cooperating with local organizations (Bozzoli & Brück, 2009; Brück, d'Errico, & Pietrelli, 2019; Fernández, Ibañez, & Peña, 2014; Gáfaro, Ibáñez, & Justino, 2014; George, Adelaja, & Awokuse, 2021; Menon & van der Meulen Rodgers, 2015; Verpoorteen, 2009). Overall, these past studies suggest that agricultural production could be affected by conflict through 1) looting, theft, or destruction, 2) changing households' production and allocation decisions, and 3) impacting access to and availability of land, labor, capital, and farm inputs (Blattman & Miguel, 2010; Nillesen, 2016; MAPSA, 2023).

Despite this ample evidence, the academic debate on the causal linkages between conflict and agriculture remains contested. One limitation of past studies is their reliance on cross-sectional data, primarily due to the challenges of collecting and accessing longitudinal data during conflict. However, establishing causal evidence using cross-sectional data is difficult as the effects of conflicts are specific to time-varying information as well as individual and household heterogeneities. Thus, a major gap in microeconomic literature is the scarcity of research that builds causal linkages between conflict and agricultural performance using longitudinal data (Verwimp, Justino, & Brück, 2019). A few exceptions to this include recent studies by Adelaja & George (2019a, 2019b), and George, Adelaja, & Awokuse (2021).

To fill this gap, we study the microeconomic impacts of conflicts on agricultural performance using the nationally representative phone survey data collected during the ongoing conflicts in Myanmar. This survey, conducted in 2022, collected household-level information for the monsoon 2021 and monsoon 2022 agricultural seasons. Using this information, we construct a retrospective panel dataset. We complement this household-level data with a geo-coded conflict dataset from the Armed Conflict and Location Event Data Project (ACLED). By controlling for household and year fixed effects, time-varying household characteristics, and district specific time-varying trends, we establish the causal relationship between conflict and agricultural performance using paddy production in Myanmar as a case example.

Myanmar has sustained internal conflicts since its independence in 1948. However, the internal conflicts have been increasingly intensified and become more widespread following the military coup in February 2021. Currently, Myanmar ranks highest in the ACLED conflict index based on the level of violence. The military coup, coupled with the widespread conflict, has profound effects on many economic sectors including agriculture, which employs approximately half of Myanmar's workforce (World Bank, 2022). Evidence suggests that the agricultural sector has faced multiple challenges such as difficulties in accessing land and labor, skyrocketing input prices, and disruption of basic services following the coup (Tun, 2022). The focus on paddy production is significant for two reasons. First, paddy is an important food security crop, contributing to approximately 51 percent of urban and 62 percent of rural calorie intake (MAPSA, 2022). Second, paddy is a major crop for many farmers, especially in the main growing season (monsoon), accounting for roughly 40 percent of the total agricultural production in gross value (FAO, 2023).

We explore four research objectives in this study. First, we quantify the causal effects of conflict on paddy production, yield, production value, production value per acre, and input and output prices. The intensity of effects and pathways of impacts could vary by type and timing of conflict, and testing these forms of heterogeneous effects is our second and third objectives, respectively. We categorize conflict incidents into two types: 1) conflict that directly targets civilians (i.e., violence against civilians and burning villages/looting/property destruction), and 2) conflict incidents that do not purposively target civilians but affect agricultural production via disruptions in input and output markets (i.e., battles, explosions, and demonstrations/riots). We refer to these two types of conflicts, respectively, as civilian-targeted conflict and non-targeted conflict. As the second research question, we assess the differential effects of these two types of conflicts on agricultural production. Third, we hypothesize that conflict impacts on agricultural outcomes vary by the timing of its occurrence for both agronomic and economic reasons. Agronomically, plant health and physical growth are sensitive to the quantity, quality, and timing of inputs and activities, which may be impacted by the timing of conflict during the agricultural season. Economically, farmers' responses related to input decisions could be different between conflict incidents that happen before and after the input decisions are finalized. To empirically test this, we divide the paddy growing season into three critical periods—pre-planting and planting, mid-season, and harvesting—as per the region-specific farming calendar. By studying the differential impact of conflict by the growing period, we aim to identify the most critical time during the growing season when the effects of conflict are more detrimental to paddy production. Finally, we identify the pathways through which conflict impacts agricultural outcomes. Specifically, we investigate how conflict changes land, labor, capital, and input decisions.

This study contributes to the literature in three ways. First, we add to a growing microeconomics literature on conflict and agricultural production using a nationally representative retrospective panel dataset collected during ongoing conflicts in Myanmar. Second, to the best of our knowledge, few studies identify differential impacts of conflict. We extend the literature by investigating how the magnitude of effects and impact pathways vary by the type of conflict. Third, we also contribute to the literature by examining the most critical periods in the agricultural season during which the impact of conflict is more sensitive. Finally, this study provides critical insights for the policy debate on transforming agriculture in fragile states as well as the implementation of effective targeted interventions to support people affected by conflict and fragility.

Our data reveal the negative effects of conflict on several indicators of paddy farming. Overall, an increase in one additional conflict (of any type) per 1,000 inhabitants at the township level leads to a decrease in household paddy production, on average by 15 percent, yield by 10 percent, output value by 20 percent, and output value per acre by 15 percent. To put this in perspective there were on average 32 conflicts per township with an average of 170,000 inhabitants or 0.19 conflict per 1,000 people in 2021. An increase of one conflict per 1,000 inhabitants would imply an average of 1.19 conflict incidents per 1000 people, which is more than a six-fold increase in conflict incidents. This is on the conservative side of the magnitude of the increase in conflict incidents observed between pre-coup years (2010–2020) to post-coup years (which was more than 13-fold increase). Thus, the implied six-fold increase in conflict to observe the estimated effects on paddy production, yield, value of production, and value of production per acre is within the realm of observed trends in recent years. Additionally, we find evidence of adverse effects on paddy prices, with farmgate prices declining about 14 percent for every additional conflict incident (of any type) per 1,000 people.

Targeted conflict exhibits more profound effects compared to non-targeted conflict, suggesting that conflict incidents such as violence against civilians, looting, destruction of farms and properties, and burning villages are more harmful to paddy production than conflicts that disrupt markets (i.e., battles, explosions, and demonstrations/riots). Furthermore, we find that any type of conflict occurring during the mid-season when most of the agricultural input application is happening has the most severe effects on agricultural outcomes followed by conflict in the pre-planting and planting period. However, the effects of timing vary by the type of conflict, with conflict targeting civilians showing significant effects in mid-season, whereas the non-targeted conflict has more profound effects in the pre-planting and planting period when most farmers make input purchase decisions.

Regarding the pathways through which conflict potentially affects outcomes, we find that an additional conflict (of any type) per 1,000 people reduces the total area of land production by 8 percent, increases the likelihood of using (possibly lower quality) grains obtained from other farmers as seeds by 7 percentage points, lowers the probability and the intensity of using compound fertilizer by 10 percentage points and 69 percent, respectively, and increases the use of exchange labor by 10 percentage points. Although the targeted conflict affects the pathways similarly to the non-targeted conflict, the intensity of effects is significantly larger for the targeted conflict, consistent with the more significant and larger effects of targeted conflict on agricultural outcomes than non-targeted conflict.

The paper proceeds as follows. In the next section, we provide important background information on conflict and paddy production in Myanmar. In Section 3, we present the conceptual framework and model that assess the relationship between conflict and agricultural performance. Section 4 describes data and key definitions. We present econometric specifications in Section 5 and the empirical results in Section 6, followed by conclusions and policy implications in Section 7.

2. BACKGROUND

2.1 History of Conflicts

Myanmar has sustained internal conflict between the majority Burman-led military and ethnic minority groups over political power and resource allocations for many decades since its independence from the British colony in 1948. Myanmar remained under a military dictatorship except for a brief period under the quasi-democratic system from 2010 to 2020. During this period, the country experienced rapid economic growth. This was accompanied by a significant poverty reduction and a structural transformation with the expansion of various sectors including natural resource exports, the garment and textile industry, telecommunication, and service sectors. The national poverty rate declined from 48 percent in 2005 to 25 percent in 2017 (CSO et al., 2019).

However, the military coup in February 2021 led the country to widespread violence and overturned the development process. In the aftermath of the coup, the military violently cracked down on nationwide peaceful protests, and arrested and killed numerous opposition politicians, activists, and civilians. This crackdown resulted in the emergence of many new armed groups and the escalation of internal conflicts (Horsey, 2023). According to ACLED, the number of battles in Myanmar surged by 67 percent from 2021 to 2022, making it the country with the highest number of battles globally in 2022 outside Ukraine. Violence targeting civilians by the state forces was also widespread with a total of more than 23,000 people arrested, 50,000 forced evictions, and 38,000 houses destroyed since the coup (AAPP, 2023; UN Human Rights, 2022). Consequently, approximately 1.85 million people have been internally displaced since February 2021 (UNHCR, 2023).

Following the coup, the pattern of the Myanmar conflict has changed. Before 2020, conflicts were primarily in Myanmar's border regions, home to a significant population of ethnic minorities. However, after the coup, the conflict had spread throughout the entire country, including main agricultural hubs previously considered relatively stable such as Sagaing, Magway, and Mandalay Regions (See Figure 1).[1] Battles are widespread in many parts of the country. The army also commits many violence targeting civilians such as burning and bombing villages in rural areas (Peck & Harmer, 2023). Violence also extends beyond the rural areas. Explosions in targeted areas connected to the military are also widespread in the cities (VoA, 2021).

2.2 Conflict and Agriculture

Agriculture plays a crucial role in Myanmar's economy, employing nearly half of the working population (World Bank, 2022). Paddy, a major staple and a key food security crop, contributes to 51 percent of urban and 62 percent of rural calorie consumption (MAPSA, 2022). In 2021, paddy production accounted for 19 percent of the total harvested area and 40 percent of the total agricultural production in gross values (FAO, 2023). Paddy is grown across diverse agro-ecological zones, including lower Myanmar (Delta and Mon), upper Myanmar (Mandalay, Magwe, Nay Pyi Taw, and Sagaing), coastal areas (Rakhine, Tanintharyi), and the Hills and Mountain zones (Chin, Kachin, Kayah, Kayin, and Shan) (MAPSA, 2023). However, it is predominant in the Delta regions (Yangon, Bago, Ayeyarwady) in the lower Myanmar. Approximately 56 percent of the total monsoon paddy area in 2021 was from these regions (ADPC, 2022). The intensification of internal conflict has had adverse effects on the agricultural sector. It is estimated that the agricultural sector contracted by approximately 10 percent in fiscal year 2021 compared to 2020 (World Bank, 2022).

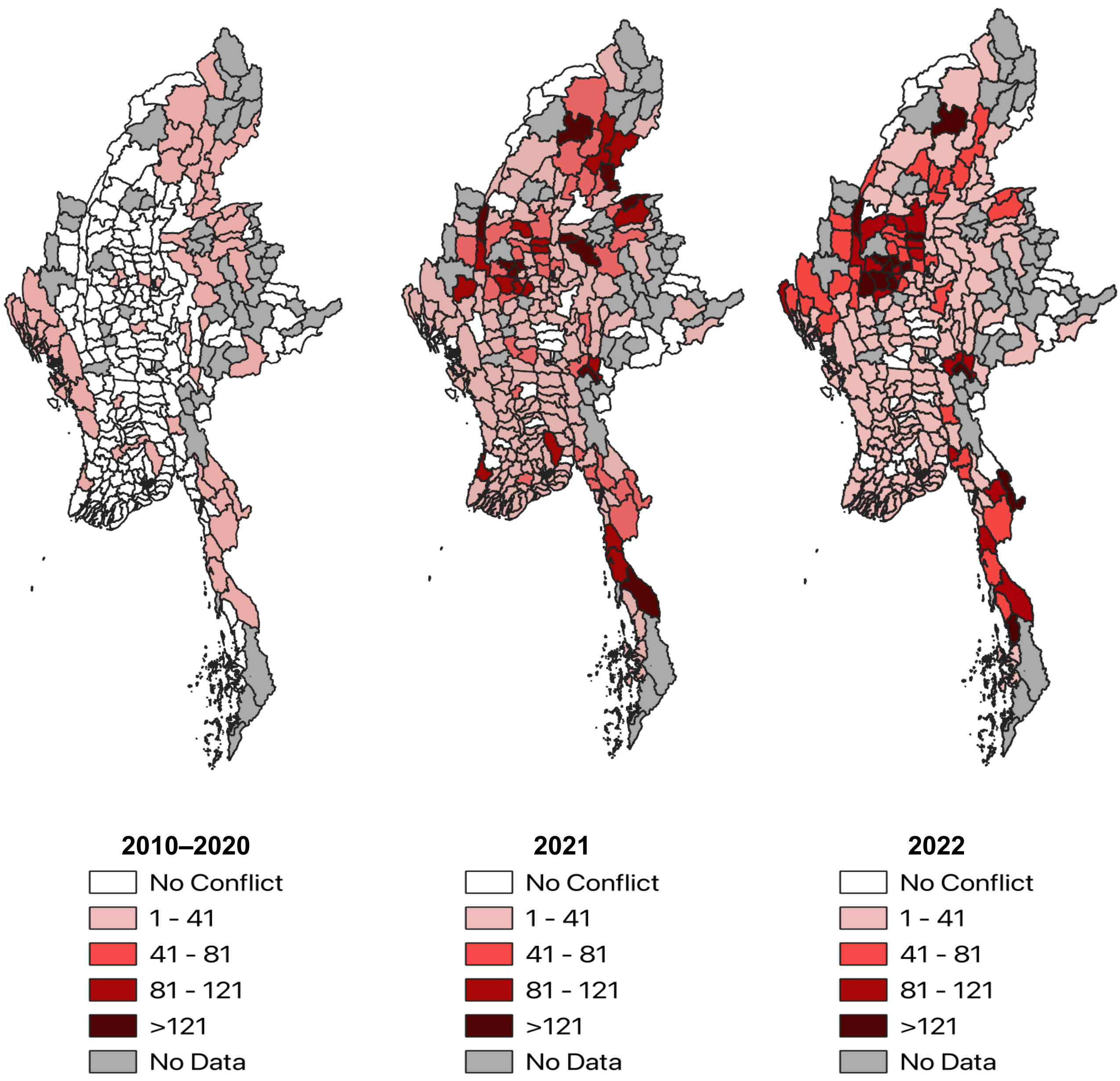
The agricultural sector in conflict-affected regions of Myanmar has been challenged in multiple aspects including land, labor, capital, and access to basic services (Tun, 2022). In some conflict regions, farmers were unable to do farming as farms became battlefields (Naing, 2022). Farmers were forced to flee their homes and abandon their fields due to military raiding, burning down villages, and looting (Frontier Myanmar, 2022; Frontier Myanmar, 2023a). Farmers also lost their seeds, inputs, and harvest due to theft, confiscation, and destruction. According to a farmer phone survey, a higher percentage of households in severely conflict-affected states and regions reported that they could not complete their harvests (World Bank, 2022).

Some evidence shows that the flow of goods and services, and market access have become more difficult due to conflict. Due to movement restrictions and security reasons, microfinance institutions and banks could not reach farmers to recollect previous loans and provide new loans (World Bank, 2022). Farmers in conflict areas also reportedly experienced labor shortages during harvest season as workers refused to go to work in conflict-affected regions (Frontier Myanmar, 2023b). Due to fights, mining, and several security checkpoints, transportation of inputs and outputs to conflict areas becomes more difficult (Frontier Myanmar, 2022). Because of the difficulties in

[1] Sagaing, Magway, and Mandalay are the third, fifth, and sixth largest producers of rice among 15 states/regions in Myanmar (USDA, 2018.). Source: https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Rangoon_Burma%20-%20Union%20of_4-6-2018.pdf)

market access, in some instances, farmers had to sell their crops at lower prices. However, the effects on agricultural markets are mixed. Some evidence indicates that the decrease in production in war zones has driven up paddy prices and incentivized farmers to grow more paddy in more stable places (USDA, 2023).

Figure 1. Distribution of conflict events in monsoon season in the survey region, pre-coup (2010–2020) and post-coup (2021, 2022)



Source: Authors' calculation.
Note: The total conflicts here are aggregated from pre-planting up to harvesting of monsoon season.

The evidence to date suggests that conflict has had severe disruptive effects on agricultural production. However, much of this evidence is based on anecdotal knowledge, and the causal evidence on how much ongoing conflict adversely affects agriculture is extremely limited. This study aims to address this limitation by quantifying the causal impacts of conflict on agriculture in Myanmar and provides timely and informative insights for the development community to design evidence-based interventions as required.

3. RELATIONSHIP BETWEEN CONFLICT AND AGRICULTURAL PERFORMANCE

3.1 Conceptual Framework

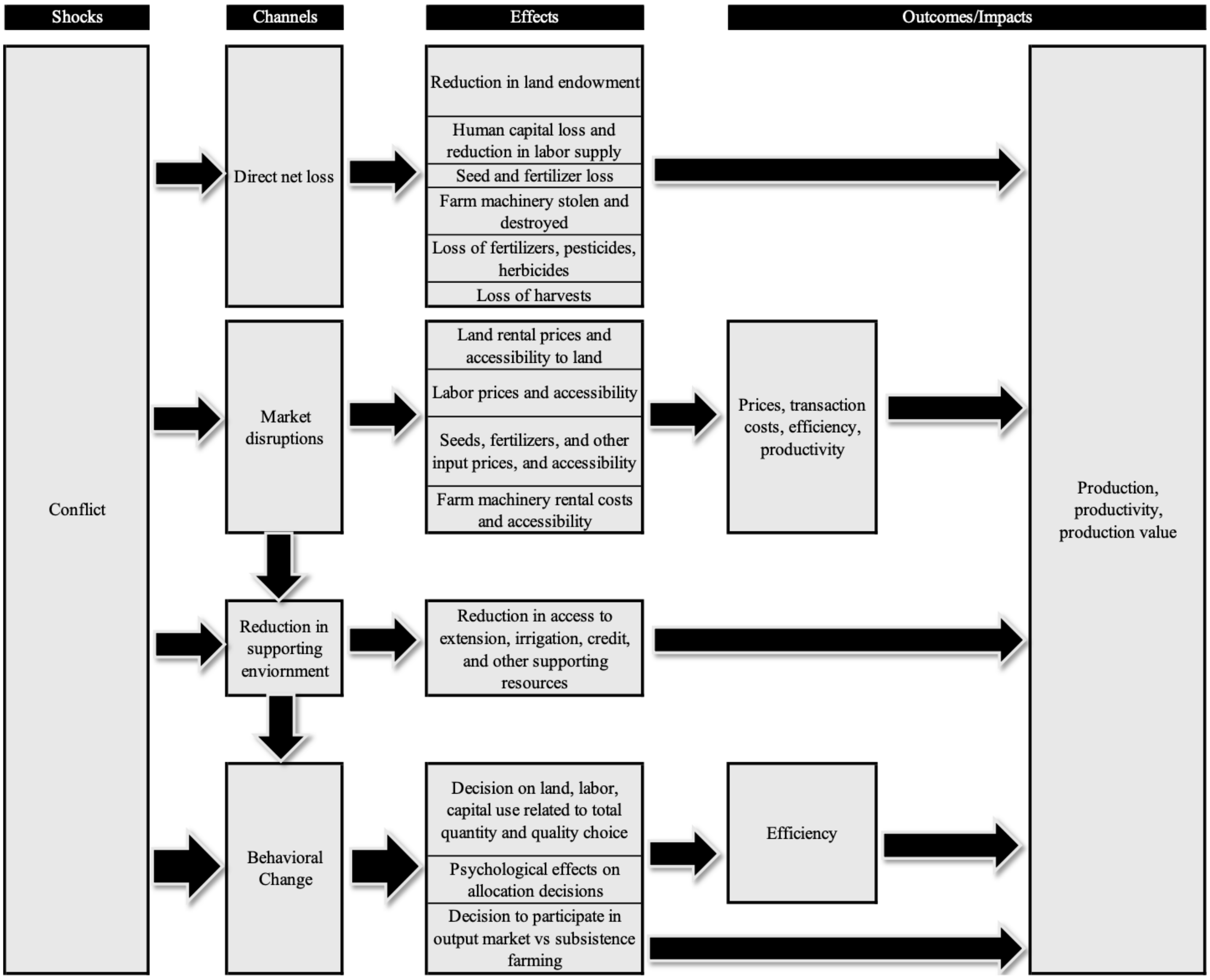
The process through which conflict affects agricultural performance is dynamic and complex. Conflict can affect agricultural outcomes through multiple channels, either separately or concurrently. Capturing the entirety of conflict's dynamic impact on agricultural outcomes using a simple model is challenging. In this study, our goal is not to separate and analyze each channel of influence but rather to understand the overall effects of conflict on agricultural outcomes. Nonetheless, we posit that adopting a simple conceptual framework—highlighting potential channels and understanding their individual impact on outcomes—will enhance our understanding of the final effects and offer valuable insights for policy decisions related to conflict and agriculture.

In this study, we conceptualize four channels through which conflict could affect agricultural performance (Figure 2). They are (i) direct net loss (ii) market disruption (iii) disruption in the supporting environment, and (iv) behavioral change. Each channel will have differential effects on the availability of, access to, and cost of factors of production, which will reduce efficiency, output, productivity, and value of production. These conceptual relationships are depicted in Figure 2 and include:

- **(i) Direct net loss**: Losses in agricultural inputs and outputs due to conflict. For example, landmines reducing farming land, family and hired labor shortages, and destruction or theft of resources, which negatively impact production (Adelaja & George, 2019a; Brück & Schindler, 2009).
- **(ii) Market disruption**: Conflict disrupts markets, complicates transportation, increases transaction costs, and affects market prices, which in turn can reduce the efficiency and productivity of agriculture.
- **(iii) Disruption in the supporting environment**: Conflict can destroy infrastructure and hinder services like credit, irrigation, communication networks, and extension, subsequently decreasing the efficiency and productivity of agriculture.
- **(iv) Behavioral change**: Conflict leads to changes in farm management decisions, like labor use and crop choices, driven by trade-offs between productivity, food security, and safety, often resulting in less efficient resource allocation, lowered productivity, and a reduction in market participation (Adelaja & George, 2019a; Adelaja &George, 2019b; Arias, Ibáñez, & Zambrano, 2019; Rockmore, 2020).

Beyond the four mechanisms outlined in Figure 2, we posit that the **timing of conflict** significantly influences its impact on agricultural production, with both agronomic and economic factors at play. Dividing a season into three cropping periods—pre-planting and planting, mid-season, and harvesting—we highlight different vulnerabilities. For agronomic reasons, the vulnerability of plants to shocks and their ability to recover varies across these stages. For example, paddy crops are highly sensitive to harvest timing, with late harvesting leading to greater losses and reduced quality. Conflicts during or near harvest time can, therefore, cause significant damage. Mid-season stages are critical for managing weeds, pests, and diseases, and conflict during these times can also have severe impacts. However, the specific stages where conflict has the most detrimental effects remain unclear, emphasizing the need for empirical research on the heterogeneous effects of conflict timing.

Figure 2. Conceptual map



Source: Authors.

Economically, the timing of conflict affects production differently. The occurrence of conflict in the early stages may allow farmers to adjust input allocations more efficiently in anticipation of disruptions, potentially offsetting the negative effects of conflict on productivity and resulting in insignificant overall productivity effects. Conversely, conflict occurring after input application can prevent timely adjustments, negatively affecting productivity. For instance, if conflict precedes mid-season, when urea is typically applied for paddy, farmers have an opportunity to modify their fertilizer use. However, conflict occurring immediately before or after this application leaves little room for adjustment, leading to varied effects on productivity based on the timing of the conflict.

Finally, we argue that the channels through which conflict affects these different agricultural outcomes could also vary by the type of conflict. While conceptually we suggest that civilian-targeted conflicts are likely to have effects through direct net loss and behavioral change, and non-civilian targeted conflicts through market disruption and diminishing support networks, pinpointing the exact channels is challenging due to their interconnected nature. Therefore, we opt to empirically investigate the potential differential impacts by conflict type, rather than theoretically delineating them.

3.2 Conceptual Model

We define a simple Cobb-Douglas production function such that:

$$Q_{it} = \exp(-A_{it})({X_{it}}^{\alpha}) \quad (1)$$

where i denotes farmer and t denotes season. Q_{it} is the total agricultural output; X_{it} is the vector of inputs, and A_{it} is the indicator of total factor productivity (TFP). Adapting a theoretical framework by Gollin & Udry (2021), we decompose A_{it} into three different components as follows:

$$A_{it} = \beta C_{it} + \gamma \phi_{it} + \epsilon_{it} \quad (2)$$

First, C_{it} represents the total conflict incidents that occur in a particular season t. We further distinguish the conflicts occurring at different production phases. More specifically, we use $C_{it}^1, C_{it}^2, C_{it}^3$ to denote the total number of incidents that occur during the pre-planting and planting, mid-season, and harvesting, respectively. As we argue in our conceptual framework, we expect differential effects of C_{it}^1, C_{it}^2, and C_{it}^3. Secondly, ϕ_{it} is a set of observable characteristics at the individual and community level which are important in driving productivity. Farmer characteristics include gender, age, experience, and other qualifications that affect productivity. The community characteristics capture the factors that determine productivity including shocks such as rainfall, drought, and pest, and other observable community-level characteristics such as road access, distance to market, extension, and irrigation. The final component ϵ_{it} represents the other shock that is unobservable but affects productivity. This could be the effects of conflict on productivity due to missing the optimal harvesting time.

Conflict can also affect the efficiency and productivity of input. This effect could be captured in terms of effective input unit X_{it}, which we define as $X_{it} = X_{it}^a \exp(-\delta C_{it} - \varepsilon_{it})$.$X_{it}^a$ is the observed or actual input applied on farm (i.e., total number of labor hours used, or total kilogram of urea applied). X_{it} translates the actual input application into total amount of inputs effectively used in the production.[2] It captures the loss of productivity due to changes in quality of input use or misalignment of optimal input application timing. It can also be efficiency loss because of the inefficient input allocation resulting from the trade-off between security and livelihood. The term ε_{it} represents classical measurement error or other unobserved factors that affect effective input units. An example of this could be the indirect psychological effects. Even if farmers are not directly exposed to conflict within their community, their labor productivity may suffer due to feelings of insecurity or fear.

If we incorporate this into production function, we now have:

$$Q_{it} = \exp(-\beta C_{it} - \gamma \phi_{it} - \epsilon_{it}) \, [X_{it}^a \exp(-\delta C_{it} - \varepsilon_{it})]^{\alpha} \quad (3)$$

As discussed above, one of the effects of conflict on agriculture occurs through market disruptions. We argue that the effects of market disruptions will happen through an increase in transaction costs. We define two types of transaction costs specific to input and output, separately. Let T_{it}^Q and T_{it}^X be the transaction cost specific to output and inputs, respectively. We define transaction cost as a function of conflict shock and household characteristics. We assume that transaction costs will increase due to conflict (C_{it}), and they also vary according to household characteristics (Z_{it}^Q, Z_{it}^X). For example, transaction costs faced by households in remote areas will be different from those faced by households living closer to the market. Thus, $T_{it}^Q = f(C_{it}, Z_{it}^Q)$ and$T_{it}^X = f(C_{it}, Z_{it}^X)$.

[2] For instance, suppose 10 kg of urea are applied on farm, but only 9 kg are effective for plant growth due to quality problems or missing the right timing applying inputs. In this case, the actual application 10 kg is X_{it}^a and 9 kg is effective input use, X_{it}.

Let p_{it}^{Q} and p_{it}^{X} be prices of output and inputs. Due to transaction cost, farmers will receive the output price as $p_{it}^{Q} - T_{it}^{Q}(C_{it}, Z_{it}^{Q})$ but pay the input price as $p_{it}^{X} + T_{it}^{X}(C_{it}, Z_{it}^{X})$.The household profit maximization problem now becomes:

$$\pi = [p_{it}^{Q} - T_{it}^{Q}(C_{it}, Z_{it}^{Q})]\ Q_{it} - [p_{it}^{X} + T_{it}^{X}(C_{it}, Z_{it}^{X})]X_{it}^{a} \tag{4}$$

$$subject\ to$$

$$Q_{it} = \exp(-\beta C_{it} - \gamma\phi_{it} - \epsilon_{it})\,[X_{it}^{a}\exp\,(-\delta C_{it} - \varepsilon_{it})]^{\alpha} \tag{5}$$

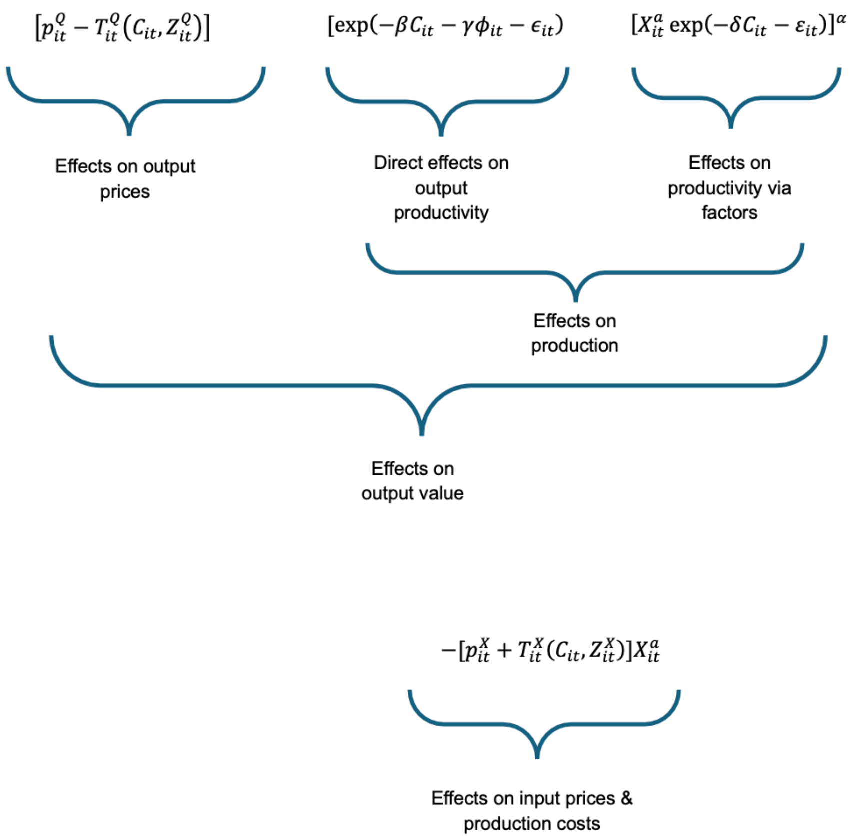
Unconstrained profit maximization problem is:

$$\pi = [p_{it}^{Q} - T_{it}^{Q}(C_{it}, Z_{it}^{Q})][\exp(-\beta C_{it} - \gamma\phi_{it} - \epsilon_{it})\,[X_{it}^{a}\exp(-\delta C_{it} - \varepsilon_{it})]^{\alpha} \tag{6}$$

$$-[p_{it}^{X} + T_{it}^{X}(C_{it}, Z_{it}^{X})]X_{it}^{a}$$

The different effects of conflict on agricultural production can be decomposed as shown in Figure 3. Conceptually, we show that the adverse effects of conflict on paddy production occur through its effects on (i) output prices (ii) output productivity (iii) output productivity through factors, and (iv) input prices. The impact of conflict on production and output prices will decrease total production value while production cost will also increase due to an increase in input prices associated with higher transaction costs. As a result, the gross margins are expected to decline, leading to the welfare loss for farmers.

Figure 3. Conceptual decomposition of conflict effects



Source: Authors.

4. DATA AND DEFINITIONS

4.1 Data

We utilize Round 3 data of the Myanmar Agricultural Performance Phone Survey (MAPS). This is a nationally representative dataset collected by the International Food Policy Research Institute (IFPRI) in collaboration with Michigan State University. This survey was conducted during the active conflicts in Myanmar in 2022. We focus exclusively on paddy-growing households, given the availability of data for this crop and its economic importance.

The survey collected agricultural information at the household level for the 2022 monsoon and retrospectively for the 2021 monsoon season. MAPS has multiple rounds of data. The information for the monsoon 2021 paddy season is also available in Round 1. However, due to high attrition rates (i.e., only 17 percent of households in Round 3 are in Round 1), we use Round 3 data and construct the retrospective panel data instead. We have balanced panel data with approximately 2,914 households with ≈5,828 observations spanning two monsoon seasons—2021 and 2022.

In Appendix Figure A.1, the survey timeline and recall periods are outlined. The recall period for agricultural values, except for paddy and inputs prices is monsoon 2021 and monsoon 2022. Farmgate prices were recorded during the 2022 survey month. Due to the absence of price data for 2021 in Round 3, we utilize information from Round 1. We merged Round 1 and Round 3 datasets across different administration levels starting from households and extending to the state level.[3] For households present in both Round 1 and Round 3, we merged the data at the household level and applied the 2021 price data to them, affecting 15 percent of households. For households absent in Round 1, we averaged the 2021 prices at the village tract level and allocated these prices to the respective households, which constituted about 40 percent of our sample. The process was then extended to higher administrative levels, using township-level averages for another 40 percent, district-level prices for about 5 percent, and state-level prices for less than 0.1 percent of the sample.

We complement this survey data with ACLED data for the key explanatory variable (conflict). ACLED is a global dataset that provides all types of reported political violence and protest events around the world. For rainfall data, we extract the Climate Hazards Center InfraRed Precipitation with Station Data (CHIRPS) available at ClimateSERV website. This dataset provides high-resolution rainfall estimates for 0.05 x 0.05-degree pixels.

4.2 Key Explanatory Variable: Conflict

Using the ACLED dataset, we count the number of conflict incidents occurring at the township level and then use the latitude and longitude data to match survey and conflict data at the township level.

The ACLED dataset has 5 types of conflict events: 1) battles, 2) explosions/remote violence, 3) violence against civilians, 4) demonstration/riot events, and 5) strategic developments (ACLED, 2021). The details of the sub-events in each category are outlined in Appendix Table A.1. We include all conflict types in our analysis to assess the overall effects of conflict on agricultural production. To study the heterogeneous effects by the type of conflict, we subcategorize the conflict incidents into two main groups—the non-targeted conflict and the targeted conflict. We define non-targeted conflict as conflict that does not purposively target civilians but could potentially disrupt agricultural production through input and output markets. Three of the five categories in the ACLED dataset fall under this category. They are battles, explosions, and demonstration/riot events.

The targeted conflict is defined as conflict that directly targets civilians. These conflicts include violence against civilians and strategic developments. According to ACLED, strategic developments

[3] In Myanmar administrative structure, state/region is the largest administrative divisions followed by district, townships, town/village tract, ward/village.

are defined as important events which contribute to future political violence. Some of the examples under this category are looting, property destruction, incursions, and arrests of officials. In ACLED Myanmar data, more than 70 percent of events under this category are looting and property destruction/burning villages between 2021 and 2022 (Authors' calculation). Following the coup, these incidents of burning and destruction of properties are increasingly perpetrated by the military junta as a threat to prevent any anti-junta activities (Diplomat, 2023; Guardian, 2022). These events are most common in rural areas. We hypothesize that violence against civilians and burning villages/destruction of properties will affect productivity and production at the household level. Household-level agricultural activities are disrupted as violence is inflicted directly on farmers. As a result of property destruction, farmers are compelled to flee and/or are constrained in their ability to attend to their paddy fields at critical times, which affects paddy production. In Table 1, we summarize our definitions of two conflict groups and their respective impact hypotheses.

Table 1. Definition of conflict and related hypotheses

Type	Sub-type	Description	Hypothesis
Civilian targeted conflict	Violence against civilians	Violence inflicting upon unarmed non-combatants (i.e., civilians)	Violence target civilians directly, which affects production and yield through direct net loss and changes in farm management decisions. The availability and accessibility of quantity and quality of productive assets could also be limited, leading to a decline in production and productivity.
	Strategic developments	Non-violent incidents that capture important information that may contribute to political dynamics (looting, property destruction, burning villages, peace talks)	
Civilian nontargeted conflict	Battles	Violent interaction between armed groups	Violence does not target civilians directly, but it affects access to and availability of input and output markets, and potentially also input and output prices.
	Explosions	One-sided violent events using explosive devices	
	Demonstration events/riots	Public demonstration against government and private entities, organizations, and policies (can be both violent and peaceful)	

Source: ACLED (2021) and authors.

The major monsoon paddy production in Myanmar starts in May and ends in October. However, depending on the agroecological zones, monsoon season could vary. To define a season, times for planting and harvesting information from the survey data would be ideal. However, the information for planting time is not available in the survey data. Even if this information is available, it could be endogenous as almost all the households in 2021 were already exposed to conflict.

In this study, we use the information from qualitative interviews with Myanmar agronomists to define the monsoon season at the state/region level. Three key pieces of information are considered in defining the season: a) the type of variety grown, b) start of the rainy season, and c) the amount of rain received. These factors are interrelated, with farmers' choices of paddy varieties being influenced by the onset and quantity of rainfall specific to their state or region. The variety selected (short, medium, or long-duration) dictates the length of the season. Rainfall timing affects the season's start, with variations across states or regions. Moreover, rainfall amount influences cultivation practices such as seedling methods (transplanting vs. broadcasting), which in turn affects the season's duration. For instance, in the Dry Zone, where rains come late and are scarce, short-duration varieties are preferred, and broadcasting is the prevalent seeding method due to the short monsoon season. Conversely, in the Delta region, where rains are early, long-duration varieties are common, and transplanting is favored due to the longer monsoon and risk of flooding.

We collected data on variety selection and rainfall by state/region, detailed in Appendix Table A.2, and consulted agronomists to create a seasonal calendar (Figure 4). Myanmar has 15 states/regions, but they can be grouped into 6 distinct seasons based on their climatic and agricultural patterns (See Figure 4). Agronomists also segmented each season into three critical phases: pre-planting and planting, mid-season, and harvesting, each marked by specific agricultural activities. Pre-planting and planting involve land preparation, planting, and basal fertilizer application. Mid-season is characterized by intensive activities like manual or mechanical weeding, and application of herbicide, pesticide/fungicide, and fertilizer. Harvesting marks the end of the season when paddy is harvested and collected from the field. Table 2 presents a summary of these cultivation activities and decisions for each period.

Figure 4. Paddy growing season by states/regions

<table>
<tr><th></th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sept</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>Kachin & Chin</td><td></td><td colspan="2">Pre-planting</td><td>Planting</td><td colspan="4">Mid-season</td><td>Harvesting</td><td></td></tr>
<tr><td>Kayah & Bago</td><td colspan="2">Pre-planting</td><td>Planting</td><td colspan="4">Mid-season</td><td>Harvesting</td><td></td><td></td></tr>
<tr><td>Kayin, Tanintharyi, Mon, Yangon, Ayeyarwady</td><td colspan="2">Pre-planting</td><td colspan="2">Planting</td><td colspan="4">Mid-season</td><td>Harvesting</td><td></td></tr>
<tr><td>Sagaing, Magway, Mandalay, Shan</td><td></td><td colspan="2">Pre-planting</td><td>Planting</td><td colspan="3">Mid-season</td><td>Harvesting</td><td></td><td></td></tr>
<tr><td>Rakhine</td><td></td><td colspan="2">Pre-planting</td><td>Planting</td><td colspan="5">Mid-season</td><td>Harvesting</td></tr>
<tr><td>Nay Pyi Taw</td><td colspan="2">Pre-planting</td><td>Planting</td><td colspan="3">Mid-season</td><td>Harvesting</td><td></td><td></td><td></td></tr>
</table>

Source: Authors' discussion with agronomists.
Note: For total value and value per acre analysis, the season is defined up to survey months as the paddy prices reflect the current prices in the survey month. The survey was conducted from December to March. Even though the season covers the post-harvesting months (i.e., from harvesting to survey month) for total value and value per acre analysis, we do not show post-harvesting months in the above figure as the post-harvesting months vary by household level instead of by state/region level.

Table 2. Cultivation activities and decisions by planting period

Period	Activities	Decisions
Pre-planting & Planting	Land preparation	Land allocation
	Planting	Labor allocation
	Basal fertilizer application	Input purchase
		Type of seedling methods
		Type of seed sources
		Machinery use
Mid-season	Manual or mechanical weeding	Labor allocation
	Fertilizer application	Input purchase
	Pesticide/fungicide application	Method, quantity, and timing of input use
		Machinery use
Harvesting	Harvesting	Labor allocation
		Machinery use
		Method, quantity, and timing of harvest

Source: Authors' discussion with agronomists.

Table 3 outlines the main variables used in our study, focusing on four primary outcomes: 1) total output (kg), 2) yield (kg/acre), 3) total output value (MMK'000), and 4) total output value per acre (MMK'000/acre). Data for these variables were collected for both the largest paddy plot and the entire farm.

Table 3. Description of key variables

Variable	Unit	Description	Level
Panel A: Outcome Variables			
Output	Kg	Total production	Entire farm, largest paddy plot
Yield	Kg/acre	Total production per acre	Entire farm, largest paddy plot
Output value	MMK ('000)	Total production value, adjusted for inflation (measured in 2020 MMK)	Entire farm, largest paddy plot
Output value/acre	MMK ('000)/acre	Total production value per acre, adjusted for inflation (measured in 2020 MMK)	Entire farm, largest paddy plot
Panel B: Prices			
Paddy prices	MMK/kg	Paddy prices per kg, adjusted for inflation (measured in 2020 MMK)	Entire farm
Urea prices	MMK/kg	Urea prices per kg, adjusted for inflation (measured in 2020 MMK)	Entire farm
Compound prices	MMK/kg	Compound prices per kg, adjusted for inflation (measured in 2020 MMK)	Entire farm
Panel C: Decision Variables			
Area cultivated	Acre	Total area cultivated for paddy	Entire farm, largest paddy plot
Transplanting	0 and 1	1=If seedling method was transplanting and 0 otherwise	Largest paddy plot
Broadcasting	0 and 1	1=If seedling method was broadcasting and 0 otherwise	Largest paddy plot
Seeds from retailers	0 and 1	1=Main seed source was from input retailers or government and 0 otherwise	Largest paddy plot
Seeds from farmers	0 and 1	1=Main seed source was from other farmers and 0 otherwise	Largest paddy plot
Saved seeds	0 and 1	1=Main seed source was saved from previous harvest and 0 otherwise	Largest paddy plot
Urea	0 and 1	1=If household used urea and 0 otherwise	Largest paddy plot
Urea amount	Kg/acre	Total quantity of urea used per acre	Largest paddy plot
Compound fertilizer	0 and 1	1= If household used compound and 0 otherwise	Largest paddy plot
Compound fertilizer amount	Kg/acre	Total quantity of compound fertilizer used per acre	Largest paddy plot
Tractor	0 and 1	1= If household used either two-wheel or four-wheel tractor and 0 otherwise	Largest paddy plot
Combine harvester	0 and 1	1=If household used combine harvester and 0 otherwise	Largest paddy plot
Family labor	Number/acre	Total family labor used per acre	Entire farm
Hired labor	0 and 1	1= If household hired non-family labor and 0 otherwise	Largest paddy plot
Exchange labor	0 and 1	1= If household used exchange labor and 0 otherwise	Largest paddy plot
Expenditure	MMK ('000)/acre	Total expenditure used on farm per acre, adjusted for inflation (measured in 2020 MMK)	Largest paddy plot

Source: MAPSA Survey.

Our study also investigates the impact of conflict on agricultural input decisions to understand if these factors serve as conduits for conflict's influence on agricultural production. We analyze several key variables, including 1) the area of paddy cultivation (acres), 2) seedling methods (binary variables), 3) sources of seeds (binary variables), 4) the use of inputs and technology (measured as binary and continuous variables), 5) labor usage on the farm (both as a count and as binary indicators), and 6) total farm expenditure (MMK'000/acre).[4] Data for these decision variables are primarily available for the largest paddy plot, with the exceptions being the cultivated area, available for both the largest plot and the entire farm, and family labor used, available for the entire farm. Additionally, we assess the effects of conflict on input and output markets, focusing on how conflicts affect prices of paddy, urea, and compound fertilizer (MMK/kg).

5. EMPIRICAL STRATEGY

The empirical analysis aims to estimate the effects of conflict shock on agricultural outcomes. We deploy the following fixed-effects panel regression model:

$$y_{ivjdt} = \theta C_{jdt} + \delta X_{ivjdt} + \sum_{m=3}^{12} \omega_m Precip_{vjdt}^{m} + \phi_i + \phi_t + \phi_d t + \varepsilon_{ivjdt} \quad (7)$$

where i denotes the farmer, v denotes village tract, j denotes the township, d denotes district, and t denotes the year.

The main outcome variables y_{ivjdt} are log of total output, log of yield, log of total output value, and log of total output value per acre. To understand the conflict effects on input and output prices, we analyze three outcome variables, for which y_{ivjdt} represents log of paddy, urea, and compound prices. To identify possible channels through which conflict might influence agricultural performance, we utilize a fixed effects model akin to equation (7), where y_{ivjdt} represents key input decisions impacting production and yield. Initially, we examine the log of area (measured in acres) dedicated to paddy cultivation. Regarding seedling methods, we include binary variables to indicate whether households employed broadcasting or transplanting methods. Furthermore, we investigate the impact of conflict on three sources of seeds: households acquired seeds from retailers or the government, obtained seeds from other farmers, or used seeds saved from the previous harvest. These are also represented as binary variables, with 1 indicating a particular choice was made and 0 otherwise.

In the technology category, we consider two binary indicators reflecting the use of tractors and combine harvesters. To examine the impact of conflict on the usage of inputs, we analyze two binary variables related to the use of urea and compound fertilizers, as well as two continuous variables measuring the total quantity of urea and compound fertilizers used. We then analyze three variables to assess the conflict's impact on labor decisions, including the total family labor used (a count variable) adjusted for adult equivalent ratios, and the employment of hired and exchange labor (a binary variable). Finally, we assess the impact of conflict on the log of total farm expenditure.

Our primary variable of interest is C_{jdt}, representing conflict incidents at the township level. To adjust for variations in conflict incidents due to population density, we normalize the total number of violent incidents by the township's population (in thousands). The aggregation period for conflict incidents varies based on the dependent variable being analyzed. For the log of total output and productivity, C_{jdt} encompasses all conflict incidents from pre-planting to harvesting time, as shown in Figure 4. Given that the paddy and input prices were collected during the survey months, for the log of total production value, production value per acre, and paddy, urea, and compound prices, conflict is aggregated from pre-planting to the survey months to encompass all relevant time periods that could impact the input and output prices.

[4] The number of female and child labor used are already standardized to be able to compare with male labor. The adult equivalent ratio we used here are as follows: $1\ female = 0.85\ male$; $1\ child = 0.7\ male$ (Source: Claro, R. M., Levy, R. B., Bandoni, D. H., & Mondini, L. (2010). Per capita versus adult-equivalent estimates of calorie availability in household budget surveys. *Cadernos De Saude Publica*, *26*(11), 2188–2195.)

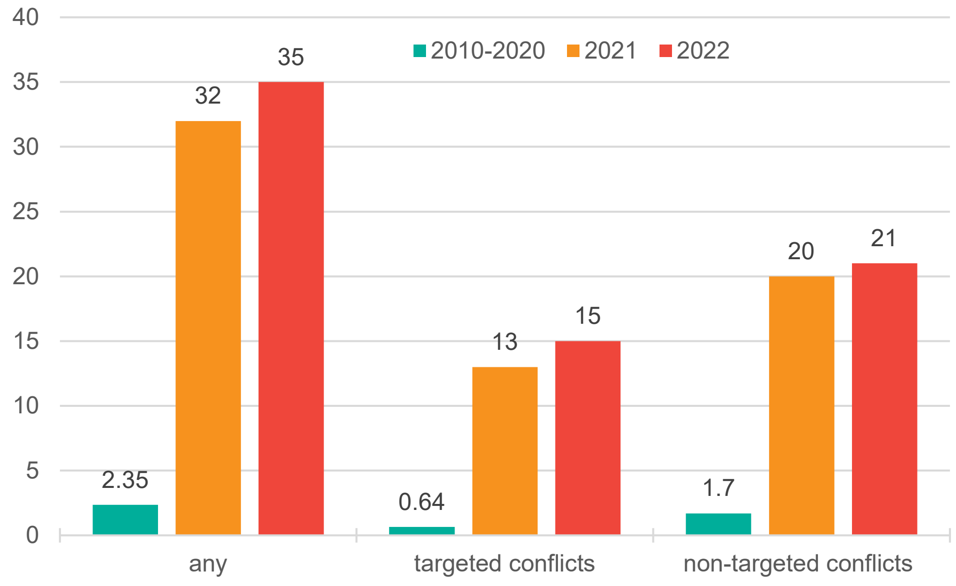
In analyzing the impact of conflict on input decisions, the conflict aggregation timeline is tailored to the input decision-making timeline. For the variables related to land, seed, and tractor usage, conflict is aggregated during the pre-planting and planting period as decisions regarding these inputs are made then and are influenced by conflict occurring in this timeframe. For labor variables and the log of total farm expenditure, conflict is aggregated from pre-planting up to the harvesting period, reflecting varied stages of decision-making for these inputs. For other inputs like urea and compound fertilizers, conflict is aggregated during the mid-season, while for combine harvester usage, conflict is aggregated during the harvesting period.

In this study, we are also interested in learning how the timing of conflict plays a role in determining the effects of conflict shock on agricultural outcomes. To empirically examine this, we use a model akin to equation (7), with one key modification: C_{jdt} is now conceptualized as a vector, representing conflict incidents in the a) pre-planting and planting period, b) mid-season, and c) harvesting for the log of production and yield. For the log of production value and production value per acre, we add (d) post-harvesting time up to survey month in addition to (a), (b), and (c) categories.

To mitigate the potential bias due to the omission of observed and unobservable factors that may be correlated with C_{jdt}, we include a robust set of control variables. First, we include the set of household fixed effects ϕ_i to control for time invariant farmer and household characteristics such as farming ability, education, knowledge, risk attitudes, personality, soil quality, etc. We include year-fixed effects, θ_t to capture the nationwide events common to all farm households such as Covid-19 and policy change by year. We also include $\phi_d t$, district-specific time trends to control for location-specific time-varying trends. These time trends could capture year-specific weather, temperature, drought, and pests that vary across districts. Additionally, we add a set of time-varying household and farm characteristics X_{ivjdt}. This set includes possible drivers of agricultural outcomes that could have been affected by conflict, such as household size (count variable), number of rice plots (count variable), total farmland operated (total acres for any crops), and a set of binary indicators such as whether the household had access to irrigation, access to extension, and took credit in year t. Additionally, we control for a set of village tract-month-year precipitation (measured in millimeters). $Precip_{vjdt}^{m}$, where $m \in \{3, 6, .., 12\}$ denotes the month in monsoon season.[5] In the model that estimates the output value and output value per acre, we also control for survey months. In all the estimations, we cluster standard errors at the township level.

[5] Approximately 16 percent of our sample does not have village tract codes. For them, we use the township-level rainfall.

Figure 5. Average number of conflict events in the survey townships in pre-coup (2010–2020), and post-coup (2021 and 2022)



Source: Authors' calculation.
Note: The total conflicts here are aggregated from pre-planting up to harvesting of monsoon season.

Figure 1 displays the geographical spread of conflict incidents in our sampled townships, annually, showing a nationwide escalation in conflicts between 2021 and 2022, diverging from the historical pattern of 2010 to 2020 where conflicts were primarily concentrated in the border areas and ethnic states. Figure 5 contrasts the average number of conflicts during the monsoon season before the coup (from 2010 to 2020) with the conflict figures for the monsoon seasons of 2021 and 2022 in the surveyed townships.[6] The data reveals a significant surge in conflict occurrences in 2021 and 2022, far exceeding the historical average of 2.35 incidents, soaring to 32 and 35 incidents, respectively. This increase is consistent across both targeted and non-targeted conflicts. Table A3 provides the average conflict statistics across four cropping periods (pre-planting and planting, mid-season, harvesting, and post-harvesting) alongside the average population per township. Additionally, Table 4 summarizes the main outcome variables for 2021 and 2022, while Table 5 details the summary statistics of control variables.

[6] The earliest date available for Myanmar conflict data in ACLED is 2010.

Table 4. Summary statistics of dependent variables by year

	2021					2022				
	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
Panel A: Whole farm										
Output (kg)	2,914	6,371	10,176	0.00	355,300	2,913	6,082	10,128	0.00	355,300
Yield (kg/acre)	2,914	1,198	517	0.00	3,135	2,913	1,146	540	0.00	3,135
Output value (MMK'000)	2,914	2,499	4,122	0.00	146,812	2,913	4,867	8,312	0.00	275,275
Output value/acre (MMK'000)	2,914	480	238	0.00	2,058	2,913	918	491	0.00	3,747
Paddy area cultivated (acres)	2,914	5.55	9.38	0.25	350	2,914	5.56	9.63	0.20	350
Family labor used on farm (Number/acre)	2,914	0.80	0.90	0.00	8.78	2,914	0.80	0.89	0.00	10.89
Paddy price (MMK/kg)	2,914	405	100	198	893	2,914	797	158	470	1,273
Urea price (MMK/kg)	2,121	1,193	366	192	3,109	2,110	2,730	591	1,388	4,164
Compound price (MMK/kg)	998	1,303	217	622	3,213	991	2,775	777	1,342	7,229
Panel B: Largest plot										
Output (kg)	2,913	1,589	1,469	0.00	15,048	2,914	1,510	1,391	0.00	21,736
Yield (kg/acre)	2,913	1,265	561	0.00	3,135	2,914	1,204	572	0.00	3,135
Output value (MMK'000)	2,913	644	625	0.00	6,715	2,914	1,221	1,178	0.00	16,239
Output value/acre (MMK'000)	2,913	507	256	0.00	1,762	2,914	963	512	0.00	3,747
Paddy area cultivated (acres)	2,914	1.34	1.12	0.01	9.00	2,914	1.33	1.08	0.01	8.60
1=Transplanting	2,914	0.52	0.50	0.00	1.00	2,914	0.52	0.5	0.00	1.00
1=Broadcasting	2,914	0.44	0.50	0.00	1.00	2,914	0.44	0.5	0.00	1.00
1=Used tractor	2,914	0.83	0.38	0.00	1.00	2,914	0.83	0.38	0.00	1.00
1=Seeds from input retailers or government	2,914	0.23	0.42	0.00	1.00	2,914	0.23	0.42	0.00	1.00
1= Seeds from farmers	2,914	0.19	0.39	0.00	1.00	2,914	0.18	0.38	0.00	1.00
1=Seeds saved from the previous harvest	2,914	0.58	0.49	0.00	1.00	2,914	0.58	0.49	0.00	1.00
1=Used urea	2,914	0.74	0.44	0.00	1.00	2,914	0.72	0.45	0.00	1.00
Total urea used per acre (kg)	2914	39.81	68.87	0.00	2,000	2,914	36.83	54.36	0.00	2,000
1=Used compound	2,914	0.33	0.47	0.00	1.00	2,914	0.33	0.47	0.00	1.00
Total compound used per acre (kg)	2,914	11.57	60.06	0.00	2,367	2,914	11.62	60.34	0.00	2,315
1=Used combine harvester	2,914	0.50	0.50	0.00	1.00	2,914	0.5	0.5	0.00	1.00
1=Hired labor	2,914	0.78	0.41	0.00	1.00	2,914	0.16	0.36	0.00	1.00
1=Used exchange labor	2,914	0.22	0.41	0.00	1.00	2,914	0.19	0.39	0.00	1.00
Total expenditure/acre (MMK'000)	2,894	253	143	34.54	925.28	2,878	350	199	46.26	1,157

Source: Authors' calculation.
Note: The values are adjusted for inflation and measured in MMK 2020.

Table 5. Summary statistics of control variables by year

Variable	2021 N	Mean	Std. dev.	Min	Max	2022 N	Mean	Std. dev.	Min	Max
Household size	2,914	4.68	1.78	1	17	2,914	4.63	1.78	1	15
1=Took credits for farm	2,914	0.52	0.50	0	1	2,914	0.52	0.50	0	1
1=Had access to extension	2,914	0.31	0.46	0	1	2,914	0.34	0.47	0	1
1=Had access to irrigation	2,914	0.39	0.49	0	1	2,914	0.40	0.49	0	1
Number of paddy plots	2,914	9.20	10.56	1	70	2,914	9.18	10.49	1	72
Total farmland operated (acres for any crops)	2,914	7.17	10.18	0.29	350	2,914	7.27	10.40	0.29	350

Source: Authors' calculation.

6. EMPIRICAL RESULTS

This study aims to explore four key research inquiries: 1) the impact of conflict on agricultural outcomes, 2) the variation of these effects based on the type of conflict (civilian targeted vs. untargeted), 3) the influence of conflict timing, and 4) the mechanisms through which conflict affects agricultural outcomes. Our primary explanatory variable is the number of conflict incidents per 1,000 inhabitants recorded in the current monsoon season at the township level. In our analysis, results are presented from regression models that incorporate household and year fixed effects, rainfall metrics, time-varying household characteristics, and district-specific time trends. For outcomes measured in monetary terms, we additionally control the timing of the survey.

Table 6. Estimated effects of any conflict on agricultural outcomes

	Entire farm				Largest plot			
	Output (log)	Yield (log)	Output value (log)	Output value/ acre (log)	Output (log)	Yield (log)	Output value (log)	Output value/ acre (log)
Conflict	-0.16***	-0.10**	-0.22***	-0.16**	-0.06	-0.05	-0.16**	-0.15**
	(0.04)	(0.04)	(0.07)	(0.07)	(0.05)	(0.04)	(0.07)	(0.07)
Household size	0.01	0.01	0.02	0.02	-0.02	-0.01	-0.01	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
1=took credit	0.04	0.02	0.04	0.02	0.02	0.01	0.02	0.01
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
1=received extension	0.04	0.04*	0.04	0.04	0.05*	0.06***	0.05*	0.06**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
1=had irrigation access	-0.00	0.02	-0.00	0.02	0.04	0.10**	0.04	0.11*
	(0.07)	(0.04)	(0.07)	(0.06)	(0.06)	(0.05)	(0.07)	(0.06)
Number of plots	0.02***	-0.00	0.02***	-0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total farmland operated (acres for any crops)	0.04***	-0.01**	0.04***	-0.01*	0.01	-0.00	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Observations	5,781	5,781	5,781	5,781	5,767	5,767	5,767	5,767
Number of households	2,913	2,913	2,913	2,913	2,913	2,913	2,913	2,913
R-squared	0.17	0.10	0.63	0.65	0.09	0.10	0.64	0.67
Mean of dependent variable	6,226	1,172	3,683	699	1,550	1,234	933	735

Source: Authors' calculation.

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we also control household fixed effects, year fixed effects, monthly rainfall, and district-specific time trends. For output value and output value per acre, we additionally control for the survey month to reflect its effect on prices.

6.1 Effects of Any Conflict on Agricultural Outcomes

Table 6 reports regression results based on the entire farm (the first four columns) and the largest plot (the last four columns). The overwhelming result is that conflict has adversely affected paddy production in Myanmar (Table 6). These effects are both economically and statistically significant for the entire farm. Specifically, an increase in one additional conflict (of any type) per 1,000 inhabitants at the township level leads to a decrease in household paddy production, on average by 15 percent.[7] Paddy yield for the entire farm is also reduced by about 10 percent while paddy production value and production value per acre decline by 20 percent and 15 percent, respectively. To put this in perspective there were on average 32 conflicts per township with an average of 170,000 inhabitants or 0.16 conflict per 1,000 people in 2021. An increase of one conflict per 1,000 inhabitants would imply an average of 1.16 conflict incidents per 1000 people, which is 631 percent increase in conflict incidents. This is on the conservative side of the magnitude of the increase in conflict incidents observed between pre-coup years (2010–2020) to post-coup years, which was more than 13-fold (Figure 5). Thus, the implied six-fold increase in conflict to observe the estimated effects on paddy production, yield, and value of production is within the realm of observed trends in recent years.

For the largest plot, we find statistically significant effects only on output value and output value per acre at p<0.05. The results indicate that an increase in one conflict per 1,000 inhabitants leads to about 15 percent and 14 percent decline in output value and output value per acre, respectively. The fact that these effects are more pronounced and significant for the entire farm compared to the largest plot could be explained by the likelihood that farmers allocate more resources toward the largest plot to minimize the adverse impact of conflict on paddy production.

[7] Results were derived using the formula $(e^{\theta} - 1) * 100)$ where θ represents the coefficients of the conflict estimated from the regression equation in section 5.

Table 7. Estimated effects of targeted conflict on agricultural outcomes

	Entire farm				Largest plot			
	Output (log)	Yield (log)	Output value (log)	Output value/ acre (log)	Output (log)	Yield (log)	Output value (log)	Output value/ acre (log)
Conflict	-0.45***	-0.28**	-0.62**	-0.51**	-0.33**	-0.25**	-0.56**	-0.50**
	(0.12)	(0.12)	(0.26)	(0.24)	(0.13)	(0.12)	(0.22)	(0.22)
Household size	0.01	0.01	0.02	0.02	-0.02	-0.01	-0.01	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
1=took credit	0.04	0.02	0.03	0.02	0.02	0.01	0.01	0.01
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
1=received extension	0.04	0.05*	0.04	0.04	0.05**	0.06***	0.05*	0.06**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
1=had irrigation access	0.00	0.02	-0.00	0.02	0.04	0.10**	0.04	0.11*
	(0.07)	(0.04)	(0.07)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)
Number of plots	0.02***	-0.00	0.02***	-0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total farmland operated (acres for any crops)	0.04***	-0.01**	0.05***	-0.01*	0.01	-0.00	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Observations	5,781	5,781	5,781	5,781	5,767	5,767	5,767	5,767
Number of households	2,913	2,913	2,913	2,913	2,913	2,913	2,913	2,913
R-squared	0.17	0.10	0.63	0.66	0.10	0.11	0.64	0.67
Mean of dependent variable	6,226	1,172	3,683	699	1,550	1,234	933	735

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we also control household fixed effects, year fixed effects, rainfalls, and district-specific time trends. For output value and output value per acre, we additionally control for the survey month to reflect its effect on prices.

6.2 Heterogeneous Effects by Type of Conflict

In this section, we present the results of conflict analysis differentiated by two conflict categories: 1) targeted conflict, shown in Table 7, and 2) non-targeted conflict, displayed in Table 8.

Targeted conflict significantly impacts all four agricultural outcomes for both the entire farm and the largest plot (Table 7). On the whole farm level, each additional targeted conflict per 1,000 people at the township level reduces production and yield by 36 percent and 24 percent, respectively. Furthermore, the output value falls by 46 percent, and the output value per acre decreases by 40 percent. These effects are similarly observed for the largest plot.

Non-targeted conflict also substantially influences all measured outcomes for the entire farm (Table 8). An increase of one non-targeted conflict per 1,000 people at the township level corresponds to decreases of 15 percent in total production, 10 percent in yield, 20 percent in output value, and 15 percent in output value per acre. For the largest plot, significant effects are observed only for the output value, where an increase in one conflict leads to a 12 percent reduction both in production value and production value per acre at a 10 percent significance level.

Table 9 assesses how conflict impacts input and output prices, specifically focusing on farmgate prices of paddy and two prevalent fertilizers—urea and compound. The findings indicate that conflict negatively impacts paddy prices, with a 14 percent decrease in farmer-received prices for every additional conflict incident per 1,000 people. The decrease in paddy prices is more pronounced during targeted conflict, with a 39 percent reduction, compared to a 13 percent decrease from non-targeted conflict. However, no statistically significant effects of conflict on the prices of urea and compound fertilizers are detected.

Table 8. Estimated effects of non-targeted conflict on agricultural outcomes

	Entire farm						Largest plot	
	Output (log)	Yield (log)	Output value (log)	Output value/ acre (log)	Output (log)	Yield (log)	Output value (log)	Output value/ acre (log)
Conflict	-0.16***	-0.10**	-0.22***	-0.16**	-0.03	-0.03	-0.13*	-0.13*
	(0.05)	(0.04)	(0.07)	(0.07)	(0.06)	(0.05)	(0.08)	(0.07)
Household size	0.01	0.01	0.02	0.02	-0.02	-0.01	-0.01	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
1=took credit	0.04	0.02	0.04	0.02	0.02	0.01	0.02	0.01
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
1=received extension	0.04	0.04*	0.04	0.04	0.05**	0.06***	0.05*	0.07**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
1=had irrigation access	-0.00	0.02	-0.00	0.02	0.03	0.10**	0.04	0.10*
	(0.07)	(0.04)	(0.07)	(0.06)	(0.06)	(0.05)	(0.07)	(0.06)
Number of plots	0.02***	-0.00	0.02***	-0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total farmland operated (acres for any crops)	0.04***	-0.01**	0.04***	-0.01*	0.01	-0.00	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Observations	5,781	5,781	5,781	5,781	5,767	5,767	5,767	5,767
Number of households	2,913	2,913	2,913	2,913	2,913	2,913	2,913	2,913
R-squared	0.16	0.10	0.62	0.65	0.10	0.10	0.64	0.67
Mean of dependent variable	6,226	1,172	3,683	699	1,550	1,234	933	735

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we also control household fixed effects, year fixed effects, rainfalls, and district-specific time trends. For output value and output value per acre, we additionally control for the survey month to reflect its effect on prices.

Table 9. Estimated effects on input and output prices

	Any conflict			Targeted conflict			Non-targeted conflict		
	Paddy price (log)	Urea price (log)	Compound fertilizer price (log)	Paddy price (log)	Urea price (log)	Compound fertilizer price (log)	Paddy price (log)	Urea price (log)	Compound fertilizer price (log)
Conflict	-0.15***	-0.13	0.07	-0.49***	-0.28	0.21	-0.14***	-0.15	0.07
	(0.05)	(0.08)	(0.06)	(0.18)	(0.18)	(0.21)	(0.05)	(0.10)	(0.07)
Observations	5,828	4,231	1,989	5,828	4,231	1,989	5,828	4,231	1,989
Number of households	2,914	2,259	1,123	2,914	2,259	1,123	2,914	2,259	1,123
R-squared	0.92	0.88	0.89	0.92	0.88	0.89	0.92	0.88	0.89
Mean of dependent variable (MMK)	600	1,936	2,035	600	1,936	2,035	600	1,936	2,035

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we control time-varying household characteristics such as whether the household took credit, household received an extension, the household had irrigation access, the number of plots, and total farmland area operated (total acres for any crops), household fixed effects, year fixed effects, monthly rainfalls, and district-specific time trends, and the survey month.

6.3 Timing of Conflict and Effects on Agriculture

In this section, we present the results from regression analyses investigating the potential heterogeneous effects of conflicts occurring at various crop production phases. The findings reported in Table 10 reveal noticeable heterogeneous effects.

For the entire farm, the adverse impacts of conflict incidents on paddy production and yield are most acute during the mid-season. According to Table 10, mid-season conflict results in a 28 percent decline in both paddy production and paddy yield, while paddy output value and output value per acre drop by approximately 33 percent each. The mid-season is a critical period for agricultural activities like weed management and application of fertilizers and pesticides, as outlined in Table 2. Conflicts during this period disrupt labor and input use, affecting both the availability and timing of these resources. The effects are also significant during the pre-planting and planting seasons, albeit less severe than in mid-season, with reductions of 9 percent in production, 20 percent in output value, and 12 percent in output value per acre.

Table 10. Estimated effects of any conflict by timing

	Entire farm				Largest plot			
	Output (log)	Yield (log)	Output value (log)	Output value per acre (log)	Output (log)	Yield (log)	Output value (log)	Output value per acre (log)
Conflicts in…								
Pre-planting + planting	-0.10**	-0.01	-0.22**	-0.13*	0.08*	0.09**	-0.04	-0.03
	(0.05)	(0.05)	(0.09)	(0.08)	(0.04)	(0.04)	(0.08)	(0.07)
Mid-season	-0.33**	-0.34**	-0.40**	-0.42**	-0.38***	-0.41***	-0.49***	-0.51***
	(0.15)	(0.13)	(0.19)	(0.18)	(0.13)	(0.12)	(0.16)	(0.15)
Harvesting	0.14	0.36	-0.02	0.19	0.07	0.39	-0.06	0.26
	(0.31)	(0.29)	(0.28)	(0.28)	(0.24)	(0.26)	(0.24)	(0.28)
Post-harvesting			-0.04	-0.02			-0.10	-0.10
			(0.17)	(0.16)			(0.14)	(0.16)
Observations	5,781	5,781	5,781	5,781	5,767	5,767	5,767	5,767
Number of households	2,913	2,913	2,913	2,913	2,913	2,913	2,913	2,913
R-squared	0.17	0.10	0.63	0.66	0.10	0.11	0.64	0.67
Mean of dependent variable	6,226	1,172	3,683	699	1,550	1,234	933	735

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we control time-varying household characteristics such as whether the household took credit, household received an extension, the household had irrigation access, the number of plots, and total farmland area operated (acres for any crops), household fixed effects, year fixed effects, rainfalls, and district-specific time trends. For output value and output value per acre, we additionally control for the survey month to reflect its effect on prices.

Tables 11 and 12 further explore the heterogeneous effects across production phases for the targeted conflict and non-targeted conflict, respectively. Targeted conflict during mid-season dramatically decreases agricultural outcomes by over 50 percent for the entire farm (Table 11).

Table 11. Estimated effects of targeted conflict by timing

	Entire farm				Largest plot			
	Output (log)	Yield (log)	Output value (log)	Output value per acre (log)	Output (log)	Yield (log)	Output value (log)	Output value per acre (log)
Conflicts in…								
Pre-planting + planting	-0.02	0.21	-0.77	-0.52	0.30	0.35*	-0.36	-0.28
	(0.22)	(0.20)	(0.55)	(0.51)	(0.21)	(0.20)	(0.50)	(0.45)
Mid-season	-0.92***	-0.84***	-1.25***	-1.19***	-0.91***	-0.91***	-1.33***	-1.33***
	(0.29)	(0.27)	(0.36)	(0.34)	(0.27)	(0.25)	(0.32)	(0.30)
Harvesting	0.04	0.47	0.09	0.51	-0.20	0.41	-0.16	0.45
	(0.67)	(0.65)	(0.55)	(0.53)	(0.53)	(0.57)	(0.44)	(0.49)
Post-harvesting			0.06	0.01			-0.04	-0.06
			(0.37)	(0.32)			(0.29)	(0.32)
Observations	5,781	5,781	5,781	5,781	5,767	5,767	5,767	5,767
Number of households	2,913	2,913	2,913	2,913	2,913	2,913	2,913	2,913
R-squared	0.17	0.10	0.63	0.66	0.10	0.11	0.65	0.67
Mean of dependent variable	6,226	1,172	3,683	699	1,550	1,234	933	735

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we control time-varying household characteristics such as whether the household took credit, household received an extension, the household had irrigation access, the number of plots, and total farmland area operated (acres for any crops), household fixed effects, year fixed effects, rainfalls, and district-specific time trends. For output value and output value per acre, we additionally control for the survey month to reflect its effect on prices.

Table 12. Estimated effects of non-targeted conflict by timing

	Entire farm				Largest plot			
	Output (log)	Yield (log)	Output value (log)	Output value per acre (log)	Output (log)	Yield (log)	Output value (log)	Output value per acre (log)
Conflicts in…								
Pre-planting + planting	-0.13***	-0.04	-0.24***	-0.15**	0.07	0.07	-0.05	-0.05
	(0.04)	(0.04)	(0.07)	(0.06)	(0.05)	(0.04)	(0.06)	(0.06)
Mid-season	-0.30	-0.36*	-0.20	-0.26	-0.42*	-0.46**	-0.36	-0.41*
	(0.23)	(0.20)	(0.25)	(0.23)	(0.23)	(0.19)	(0.26)	(0.22)
Harvesting	0.28	0.48	-0.12	-0.07	0.25	0.58	-0.13	0.14
	(0.43)	(0.44)	(0.48)	(0.50)	(0.35)	(0.37)	(0.42)	(0.45)
Post-harvesting			-0.22	-0.06			-0.25	-0.19
			(0.23)	(0.23)			(0.20)	(0.22)
Observations	5,781	5,781	5,781	5,781	5,767	5,767	5,767	5,767
Number of households	2,913	2,913	2,913	2,913	2,913	2,913	2,913	2,913
R-squared	0.17	0.10	0.62	0.65	0.10	0.11	0.64	0.67
Mean of dependent variable	6,226	1,172	3,683	699	1,550	1,234	933	735

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we control time-varying household characteristics such as whether the household took credit, household received an extension, the household had irrigation access, the number of plots, and total farmland area operated (acres for any crops), household fixed effects, year fixed effects, rainfalls, and district-specific time trends. For output value and output value per acre, we additionally control for the survey month to reflect its effect on prices.

In contrast, the adverse conflict effects are more significant during the pre-planting and planting seasons than the mid-season for non-targeted conflict. More specifically, the occurrence of a non-targeted conflict per 1,000 people at the township level would yield a decline of output, output value, and output value per acre, by 12 percent, 21 percent, and 14 percent, respectively. However, only yield exhibits a notable decline of 30 percent during mid-season due to non-targeted conflicts (at $p<0.1$).

Focusing on the largest plot, mid-season conflict remains the most detrimental, consistent with the findings for the entire farm. Interestingly, any conflict during pre-planting and planting positively affects output and yield, with an 8 percent and 9 percent increase, respectively (Table 10), and targeted conflicts in the same period boost yield by 30 percent at a 10 percent significant level (Table 11). We do not find any statistically significant effect of non-targeted conflict on the largest plot during the pre-planting and planting period (Table 12). Since the largest paddy plot accounts for about 25 percent of total production on average (Table 4), farmers might prioritize resources for this plot during conflict. It is also possible that the largest plots are situated nearest to the households. Given that conflict restricts farmers' mobility, they may be unable to access their farther plots and instead concentrate more resources on the larger plots that are closer. However, the actual reasons, such as the proximity of the largest plots to households, are speculative due to the lack of data. This observation is acknowledged as a limitation of our study, suggesting an area for future research.

Table 13. Estimated effects of conflict on decision variables in pre-planting & planting

	Area cultivated (log)	Area cultivated (log-for largest plot)	1=transplanting	1=broadcasting	1=used tractor	1=seeds from input retailers or government	1=seeds from farmers	1=seeds saved from the previous harvest
Any conflict	-0.08***	0.01	-0.01	0.01	-0.00	-0.06	0.07*	-0.00
	(0.02)	(0.03)	(0.03)	(0.03)	(0.01)	(0.04)	(0.04)	(0.04)
Observations	5,828	5,828	5,828	5,828	5,828	5,828	5,828	5,828
Number of households	2,914	2,914	2,914	2,914	2,914	2,914	2,914	2,914
R-squared	0.41	0.05	0.07	0.06	0.04	0.03	0.06	0.05
Targeted conflict	-0.27***	-0.06	0.09	-0.08	0.04	-0.22	0.25**	-0.02
	(0.09)	(0.10)	(0.11)	(0.12)	(0.04)	(0.19)	(0.13)	(0.21)
Observations	5,828	5,828	5,828	5,828	5,828	5,828	5,828	5,828
Number of households	2,914	2,914	2,914	2,914	2,914	2,914	2,914	2,914
R-squared	0.41	0.05	0.07	0.06	0.04	0.03	0.06	0.05
Non-targeted conflict	-0.08***	0.02	-0.03	0.02	-0.01	-0.06	0.06	-0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.01)	(0.05)	(0.04)	(0.05)
Observations	5,828	5,828	5,828	5,828	5,828	5,828	5,828	5,828
Number of households	2,914	2,914	2,914	2,914	2,914	2,914	2,914	2,914
R-squared	0.41	0.05	0.07	0.06	0.04	0.03	0.06	0.05
Mean of dependent variable	5.55	1.34	0.52	0.44	0.83	0.23	0.18	0.58

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. For all outcome variables, we control time-varying household characteristics such as whether the household took credit, household received an extension, the household had irrigation access, the number of plots, and total farmland area operated (acres for any crops), household fixed effects, year fixed effects, rainfalls, and district-specific time trends. To assess the conflict effects on the above input decisions, we aggregate conflict incidents occurring during the pre-planting and planting period.

6.4 Effects of Conflict on Decision Variables

As shown in Table 2, farmers make different farm management decisions as per planting periods. To accurately account for conflict incidents that are specific to these decisions, we tailor the conflict aggregation timeline to the input decision-making timeline. We also report the estimated impacts of conflict on decisions per planting period in Table 13, Table 14, and Table 15, respectively.

Table 13 presents the conflict impact on decisions made in pre-planting and planting. We find significant effects of conflict on the total paddy cultivated area. It shows that one additional conflict (of any type) per 1,000 people decreases the cultivated area by about 8 percent. While a similar effect is found during non-targeted conflict, the impacts of targeted conflict on the cultivated area are more severe, with a decline of approximately 24 percent for one additional conflict per 1,000 people in the township (Table 13). Conflict also prompts farmers to alter their seed sources. The likelihood of obtaining seeds from other farmers increases by around 7 percentage points due to any type of conflict at a 10 percent significant level. While we do not find statistically significant effects of non-targeted conflict, one targeted conflict leads to an increase in the likelihood of obtaining seeds from other farmers by 25 percentage points (at $p<0.05$). Even though it is not significant, the coefficients of conflict on the likelihood of using saved seeds from previous harvest are negative and similar in magnitude to the coefficients of obtaining seeds from other farmers. As reported in the media, theft, and destruction during conflict are likely to be reasons leading to altering seed sources (Frontier Myanmar, 2022). Market disruptions due to conflict might also limit farmers' ability to access seeds from formal markets such as traders and the government. The alteration in seed sourcing could be a mechanism by which conflict affects agricultural yield. Seeds saved from prior harvests are often of superior quality, being meticulously chosen by the farmers, unlike seeds bought in urgency from other farmers, whose quality may vary based on the seller's reputation (Gray, 2021; van Gastel et al., 2002).

Table 14 shows the impact of conflict on decisions made in mid-season and harvesting. We find that conflict reduces the likelihood of using compound fertilizers as well as the intensity of compound fertilizer usage. One additional conflict (of any type) per 1,000 people decreases the likelihood of using compound fertilizer by around 11 percentage points while the intensity of compound fertilizer declines by 8 kg. In terms of percentage, it shows a decrease in the intensity by 69 percent. Both conflict types similarly affect the likelihood and intensity of compound fertilizer, but more pronounced effects are found during the targeted conflict with decreases in compound fertilizer usage by 19 percentage points and the intensity by 148 percent.

Table 15 outlines the impact on decisions throughout the season, showing that conflict increases the use of exchange labor, with the 10 percentage points rise for any conflict and 17 percentage points for non-targeted conflict. However, no significant change is noted for targeted conflicts. This suggests that conflict disrupts labor mobility, pushing households towards exchange labor. For any conflict type, we do not find any statistically significant effects of conflict on the log of total farm expenditures per acre.

Table 14. Estimated effects of conflict on decision variables in mid-season & harvesting

	1=used urea	Total urea used (kg)	1=used compound	Total compound used (kg)	1=used combine harvester
Any conflict	0.02	-34.20	-0.11**	-8.25***	0.04
	(0.07)	(31.99)	(0.05)	(2.90)	(0.11)
Observations	5,828	5,828	5,828	5,828	5,828
Number of households	2,914	2,914	2,914	2,914	2,914
R-squared	0.05	0.04	0.04	0.04	0.03
Targeted conflict	0.07	-57.58	-0.19*	-17.72**	-0.13
	(0.15)	(55.68)	(0.11)	(8.04)	(0.17)
Observations	5,828	5,828	5,828	5,828	5,828
Number of households	2,914	2,914	2,914	2,914	2,914
R-squared	0.05	0.04	0.04	0.04	0.03
Non-targeted conflict	0.02	-48.95	-0.14*	-9.66***	0.25
	(0.10)	(47.52)	(0.08)	(3.49)	(0.18)
Observations	5,828	5,828	5,828	5,828	5,828
Number of households	2,914	2,914	2,914	2,914	2,914
R-squared	0.05	0.04	0.04	0.04	0.03
Mean of dependent variable	0.73	38.00	0.33	12.00	0.50

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we control time-varying household characteristics such as whether the household took credit, household received an extension, the household had irrigation access, number of plots, and total farmland area operated (acres for any crops), household fixed effects, year fixed effects, rainfalls, and district-specific time trends. To assess the input decisions related to urea and compound we aggregate conflict incidents occurring mid-season whereas the input decision related to the use of combine harvester, the timeline for conflict is the harvesting period.

Table 15. Estimated effects of conflict on decision variables in the entire season

	Total family labor used on farm/acre	1=hired labor	1=used exchanged labor	Total expenditure/acre (log)
Any conflict	0.05	-0.05	0.10**	-0.04
	(0.07)	(0.08)	(0.05)	(0.03)
Observations	5,828	5,828	5,828	5,772
Number of households	2,914	2,914	2,914	2,895
R-squared	0.13	0.58	0.18	0.44
Targeted conflict	0.18	0.24	-0.05	-0.07
	(0.12)	(0.22)	(0.15)	(0.09)
Observations	5,828	5,828	5,828	5,772
Number of households	2,914	2,914	2,914	2,895
R-squared	0.13	0.58	0.18	0.44
Non-targeted conflict	0.04	-0.13*	0.17***	-0.05
	(0.08)	(0.07)	(0.04)	(0.04)
Observations	5,828	5,828	5,828	5,772
Number of households	2,914	2,914	2,914	2,895
R-squared	0.13	0.58	0.18	0.44
Mean of dependent variable	0.80	0.47	0.20	302.00

Source: Authors' calculation.
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For all outcome variables, we control time-varying household characteristics such as whether the household took credit, household received an extension, the household had irrigation access, number of plots, and total farmland area operated (acres for any crops), household fixed effects, year fixed effects, rainfalls, and district-specific time trends. To assess the input decisions related to labor and farm expenditure, we aggregate conflict incidents occurring from pre-planting and planting to harvesting.

7. CONCLUSION

Myanmar has experienced more than thirteen-fold surge in conflict, escalating from 2.35 conflicts per township (or 0.01 per 1000 inhabitants), before the coup, to 32 per township (or 0.19 per 1000 inhabitants) after the coup in 2021. Utilizing nationally representative household data, this study evaluates the impact of these conflicts on paddy production, a critical global commodity, and the primary staple crop for local farmers in Myanmar. Our research contributes to the microeconomic analysis of conflict impact on agriculture, revealing several key insights.

First, the study documents a decline in paddy production and yield due to conflict, posing risks to food security as paddy is a major source of calories in Myanmar. The conflict-induced decrease in paddy supply suggests potential shortages, particularly in the short term when import options are limited. The impact is more acute in conflict-ridden areas, where transportation and market access are also hindered.

Second, the negative repercussions of conflict on farmgate prices and production values affect farm income, exacerbating poverty and food security. The findings show that conflicts lower paddy prices received by farmers, thereby diminishing overall production value and income. Urgent emergency assistance and social protection measures are therefore necessary to enhance food security and stabilize household incomes, particularly in conflict-affected regions. Since an increase in food insecurity and poverty can breed more conflict, these interventions and measures are critical for conflict prevention (Maystadt & Ecker, 2014).

Third, the study delineates the varying impacts of different types of conflict, highlighting that civilian-targeted conflicts like looting, property destruction, and burning villages have more severe consequences than non-targeted ones. This underscores the need for political dialogues and peace efforts to extend beyond ceasefires to prevent civilian-targeted conflicts.

Fourth, the timing of conflict is crucial, with mid-season conflicts having the most drastic effects, likely due to disruptions in labor and input availability, as well as disruptions in the timing of application.

Finally, we also find conflicts adversely affect cultivation areas, compound fertilizer usage, and changes in seed sources. This study posits them as possible channels through which conflict influences agriculture, emphasizing the need for improved seed distribution and fertilizer subsidies to counteract conflict's negative impacts and bolster resilience in vulnerable regions. Additionally, this study also identifies market disruption as a significant outcome of conflict, affecting both input (such as decreased land cultivation area and fertilizer use, increased reliance on exchange labor, leading to reduced yield and production) and output (including deceased output prices, resulting in reduced production values) aspects of agriculture.

Historically, discussions on food security and poverty reduction have focused on agricultural transformation, considering the pivotal role of agriculture in the economies of many developing countries. This study provides evidence that conflicts significantly disrupt agricultural development, with Myanmar serving as a case in point. In light of the increasing prevalence of conflict globally, this study underscores the necessity to reassess intervention strategies and development policies in contexts characterized by conflict and fragility.

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APPENDIX

Table A.1 Types of conflict and related sub-events

Event	Sub-events
Battles	Armed clashes, government regains territory, and a non-state actor overtakes territory
Explosions/remote violence	Chemical weapons, air/drone strikes, suicide bombs, shelling/artillery/missile attacks, remote explosives/landmines/IEDs, and grenades
Violence against civilians	Sexual violence, attack, abduction/forced disappearance
Demonstration events	Peaceful protest, protest with intervention, excessive force against protesters, violent demonstration, and mob violence
Strategic developments	Agreement, arrests, change to group/activity, disrupted weapons use, headquarters or base established, non-violent transfer of territory, other

Source: ACLED (2021).

Table A.2 Information on variety grown and rainfall by state/regions

No	State/region	Start	End	Flooding & heavy rain?	Early rain?	Variety	Location
1	Kachin	Jun	Nov	No	No	Medium duration	Upper
2	Chin	Jun	Nov	No	No	Medium duration	Upper
3	Sagaing	Jun	Oct	No	No	Short duration	Upper
4	Mandalay	Jun	Oct	No	No	Short duration	Upper
5	Magway	Jun	Oct	No	No	Short duration	Upper
6	Shan	Jun	Oct	No	No	Short duration	Upper
7	Nay Pyi Taw	May	Sept	No	Yes	Short duration	Upper
8	Kayah	May	Oct	No	Yes	Short duration	Lower
9	Kayin	May	Nov	Yes	Yes	Long duration	Lower
10	Tanintharyi	May	Nov	Yes	Yes	Long duration	Lower
11	Bago	May	Oct	Yes, in some parts	Yes	Medium duration	Lower
12	Mon	May	Nov	Yes	Yes	Long duration	Lower
13	Rakhine	Jun	Dec	Yes	No	Long duration	Lower
14	Yangon	May	Nov	Yes	Yes	Long duration	Lower
15	Ayeyarwady	May	Nov	Yes	Yes	Long duration	Lower

Source: Authors' discussion with Agronomists.

Table A.3 Total conflict events by year

	2021 (N=243)				2022 (N=243)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Any conflicts up to survey month	46.11	65.80	0.00	439.00	48.87	74.25	0.00	441.00
Any conflicts up to harvesting	32.43	44.23	0.00	238.00	35.63	53.67	0.00	366.00
Any conflicts in pre-planting and planting	15.52	23.54	0.00	165.00	15.68	27.75	0.00	212.00
Any conflicts in mid-season	11.99	18.06	0.00	108.00	16.41	23.66	0.00	138.00
Any conflicts in harvesting	4.93	7.88	0.00	49.00	3.54	6.83	0.00	54.00
Any conflicts in post-harvesting	13.68	26.30	0.00	201.00	13.24	23.93	0.00	136.00
Targeted conflicts up to survey month	18.21	22.77	0.00	153.00	20.26	28.39	0.00	156.00
Targeted conflicts up to harvesting	12.74	15.76	0.00	91.00	14.77	19.95	0.00	107.00
Targeted conflicts in planting	5.09	7.26	0.00	50.00	6.47	10.61	0.00	68.00
Targeted conflicts in mid-season	5.54	7.83	0.00	53.00	6.87	9.31	0.00	48.00
Targeted conflicts in harvesting	2.11	3.20	0.00	23.00	1.43	2.85	0.00	21.00
Targeted conflicts in post-harvesting	5.47	8.84	0.00	62.00	5.49	10.67	0.00	81.00
Non-targeted conflicts up to survey month	27.90	47.72	0.00	346.00	28.61	51.24	0.00	343.00
Non-targeted conflicts up to harvesting	19.69	31.95	0.00	203.00	20.86	37.88	0.00	259.00
Non-targeted conflicts in planting	10.43	18.20	0.00	155.00	9.20	18.95	0.00	144.00
Non-targeted conflicts in mid-season	6.44	12.01	0.00	78.00	9.55	16.58	0.00	102.00
Non-targeted conflicts in harvesting	2.82	5.93	0.00	44.00	2.11	4.99	0.00	43.00
Non-targeted conflicts in post-harvesting	8.21	19.51	0.00	168.00	7.75	15.33	0.00	107.00
				2017 (N=243)				
Township population ('000)	169.47	83.897	6.319	491.43				

Source: Authors' calculation.
Note: The entire season here includes all months from pre-planting up to survey month.

Figure A.1. Survey timeline and recall periods

<table>
<tr><td colspan="8" rowspan="2">Monsoon Season</td><td colspan="3">Round 1: Survey Implementation (2021)</td></tr>
<tr><td colspan="3">Round 3: Survey Implementation (2022)</td></tr>
<tr><td>May</td><td>Jun</td><td>Jul</td><td>Aug</td><td>Sept</td><td>Oct</td><td>Nov</td><td>Dec</td><td>Jan</td><td>Feb</td><td>Mar</td></tr>
<tr><td colspan="8">Recall period (2021/2022) for agricultural values</td><td colspan="3">Recall period of paddy prices</td></tr>
</table>

Source: MAPS (2022).

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