

Agricultural Shocks and Social Conflict in Southeast Asia

Abstract

Conflicts are inevitable, but their occurrence and intensity vary over time and across countries. In lower-income economies where employment and income from agriculture are substantial, forms of political violence may be linked with this sector. We investigate this linkage using high-frequency conflict data covering seven Southeast Asian countries. We focus on changes in conflict during the rice harvest season, which is the most produced and consumed cereal crop in the region. We observe an increase in political violence but a decrease in social unrest in rice-producing areas during the harvest season. We investigate different plausible mechanisms that may lead to such effects, by incorporating shocks associated with rice prices and growing season rainfall, and by comparing regions with predominantly irrigated vs predominantly rainfed rice production practices. Overall, these findings point to the benefits of working with rich and disaggregated data that allow retrieving much detail that would have been camouflaged in a more aggregated setting. These findings offer important insights to policymakers as they point to possible temporal and geographic displacements of political violence, which can be linked with locations where the crop is produced and times when it is harvested.

Keywords: Agriculture, Conflict, Seasonality, Southeast Asia

1. Introduction

In lower-income economies, a small change in people's wellbeing may trigger a whole range of behavioral response, some of which may be unlawful as well as violent. Where institutions are weak, social unrest—whether it is peaceful or more violent and less contained—has been linked to changes in people's real income (e.g., Smith, 2014; Hendrix and Haggard, 2015). While protests and riots are expected in cities that not only are populous areas but also where the state administration—the key target of protesters—is located, political violence is, by no means, just an urban phenomenon. In rural areas, which often constitute the larger share of states' territories where the state capacity is limited, conflict is common. Motives and modes of conflict vary. In regions with high agricultural dependence, which is the focus of the present study, conflict can be linked with harvest-time windfalls. Indeed, empirical evidence points to a strong linkage between crop yields and conflict (Wischnath and Buhaug, 2014; Buhaug et al. 2015; Koren, 2018; Vestby, 2019), and, somewhat less unequivocally, between commodity price shocks and conflict (Dube and Vargas, 2013; Maystadt and Ecker, 2014; Raleigh et al. 2015; Berman and Couttenier, 2015; Crost and Felter, 2020).

We look into the connection between agricultural shocks and civil conflict in Southeast Asia in particular because the region's characteristics make it a good exemplar case: the region has a wide variety of economic development and agricultural dependence levels, varying rice growing seasons, and has an accompanying wide variation in civil conflict frequency and type even in middle- and low-income countries, ranging from very little conflict (in Malaysia and Vietnam) to thousands of incidents per year (in the Philippines and Myanmar).

By examining nearly 60 thousand incidents over the span of 12-year monthly data from 2010 to 2021, we find that changes in conflict in crop-producing areas during rice harvest months is a function the type of conflict (and thus the type of conflict actor) and the price of rice. Different types of conflict respond differently to harvest season: protests and riots decrease during rice harvest months, but battles and violence against civilians increase during rice harvest months. This suggests that the mechanism by which harvest-time conflict occurs in Southeast Asia varies by violence type: in the case of conflict *by* civilians, the opportunity cost of conflict increases during harvest time, while in the case of conflict *against* civilians, harvest time provides *rapacious* violent groups with an opportunity to appropriate or destroy agricultural surplus.

However, there are nuances in the findings. When rice prices are one standard deviation higher than their historical average, conflict of all types decrease during harvest season. This finding likely conflates the rapacity mechanisms of conflict with grievance and opportunity cost mechanisms of conflict. That civilians are attacked at the time of harvest, when there are spoils to be appropriated accords with the rapacity mechanism. But if this were to be the only mechanism, then such attacks would have amplified when the price of the crop increases. Instead, the opposite effect is observed, which points to the offsetting effect through the other mechanisms. Notably, the estimated effects are for the croplands vis-à-vis the parts that do not qualify as the croplands.

2. Agricultural shocks and conflict in Southeast Asia

The mechanisms by which agricultural shocks might lead to civil conflict or social unrest can be reduced to a couple of theories. One such theory is *grievance*, which suggests that people protest deterioration of their wellbeing, relative to others or to their own past. A food crisis caused by reduced availability of affordability of food items, for example, can be a factor in such conflict. Another theory is *greed*, which is associated with the predation or rapacity mechanism, which suggests that perpetrators are more likely to engage in conflict when there is more at stake. That is, an increase in farm income, e.g., after a good harvest season, or when the commodity prices are high, increases the value of spoils to be appropriated, which can amplify violence (Koren and Bagozzi, 2017; McGuirk and Burke, 2020).

Both theories, of grievance and greed, explain conflict that manifests itself not only because there are opportunities to extort wealth or incur damage and thus improve one's own relative standing, but also because the opportunity costs of engaging in such activities are not very high. The opportunity cost mechanism of conflict suggests that a person may consider the less peaceful ways of generating income, when the lawful alternatives such as farming doesn't pay enough (e.g., after a bad crop year, or a drop in commodity prices). The opportunity cost of fighting is seen as an increasing function of income—a negative income shock leading to more violence (Collier and Hoeffler, 1998; Fjelde, 2015). This alludes to a relatively long-term commitment to conflict. An example of a shorter-term or transitory commitment would be instances when

people engage in protests when their value of time is relatively low. In agricultural sector, this would be the period during the year when people are not actively farming.

At the heart of the question of the link between agricultural production and conflict is not only the mechanism, but also the form of conflict, and the type of conflict actors. The foregoing discussion primarily relates to political violence aimed at civilians, and as alluded above, such conflict can be linked to the harvest-time positive income shocks, and the relationship is expected to be positive. Studies of African data have found seasonal changes in conflict intensity. Notably, in crop-producing areas, there is an increase in attacks on civilians during harvest months (Ubilava et al. 2022). This seasonal trend is largely driven by an increase in conflict intensity by political militias. Because they are engaged in short-term violent campaigns that are designed to shift the political and economic landscape on behalf of their elite patrons within the state (either by aggrandizing the patrons or by decreasing the power or resources available to their patrons' enemies), political militias have little incentive to control territory or extract rents over the long term (unlike states and rebel groups), and instead seek to appropriate or destroy agricultural surplus of their enemies and enemies' supporters, which is maximally effective during harvest time. In this context, seasonal increases in attacks on civilians in crop-producing areas are a form of *output conflict* through a *rapacity mechanism*.

On the other hand, protests and related riots are often triggered by grievances associated with negative income shocks, and thus they are unlikely to be connected with agricultural harvest, or if they are, the relationship should be negative, for at least two reasons. First, when people—potential protesters—are busy harvesting, they are unlikely to take part in protests as the opportunity cost of this type of conflict is high. Second, if there is a short period of time, during the calendar year, when people in rural areas are relatively better off, compared to other times of the year or to people in urban areas, it is during or shortly after the harvest season, when the years' worth of income has been realized. Finally, incidents linked to larger scale conflicts, such as battles between incumbents and insurgents to take control of a territory, for example, are unlikely to be driven by or related to agricultural employment income (Ubilava et al. 2022; Mampilly and Stewart, 2021). And even if they were, the causal mechanism may very well go in the opposite direction, that is, in times of a civil war, for example, people willingly or unwillingly may be involved in the process, in expense of their usual employment, which in rural societies, often is agricultural production.

The foregoing discussion points to the benefit of a careful analysis of granular data. We do so by focusing on countries in the Southeast Asian region. This region is suitable for the present analysis for several reasons. First, most of the countries in the region fall into the lower-middle-income economies, with a considerable proportion of people living at or below the national poverty line (World Bank, 2022a, 2022b), although the region also has large across-country variation in governance and institutional capacity levels, with Singapore and Brunei at the top, and Laos, Cambodia, and Timor-Leste at the bottom. It also has institutional capacity variation within countries, as the Philippines, Myanmar, and Indonesia in particular struggle to control their geographic peripheries. Second, agriculture is a crucial sector for employment and income generation, across much of the region (World Bank, 2022c). While subsistence farming exists in Southeast Asia as in many regions with less developed economies, Southeast Asian countries are often food exporters (unlike many African countries). In fact, Thailand, Vietnam, Myanmar, and Cambodia are all in the top ten rice exporting countries globally (FAO, 2023). This means that violence associated with rice-producing areas are especially relevant to income generation for both farmers and the state. Finally, civil conflict and social unrest have been defining features of the region's politics (e.g., Crost and Felter, 2020; Crost et al., 2020; Gatti et al., 2021). The Philippines and Myanmar, for example, have seen multiple insurgencies, whether ideology- or ethnicity-based, for nearly their entire independent existences. The protests and conflicts that were sparked by the Myanmar military's coup in 2021 have evolved into a full-scale civil war, while the Philippines has high levels of civil conflict. Thailand struggled with a communist insurgency from the 1960s until the early 1980s, and spillover from Myanmar's insurgencies, while the Thai government continues to fight a low-level ethnic insurgency in southern Thailand. Since Suharto's fall in 1998, Indonesia has dealt with widespread protests, riots, and civil conflict, Islamist terrorism, as well as ethnic insurgencies in Aceh and West Papua.

We can imagine a number of different actors in Southeast Asian conflict, all of whom could instigate conflict, including civilians, armed rebel groups, state actors, and militias operating on behalf of competing elites. Civilians may instigate protests against government policies, and these protests may turn into riots. Armed rebel groups, state actors, and militias may engage in violence against civilians, either through armed attacks, battles, or explosions. The logic of conflict, agricultural shocks, and seasonality is likely to be different, and in some ways, diametrically opposed, depending on the type of actor (and thus the type of conflict).

Previous work on the connection between conflict and agricultural output in Southeast Asia has come to nuanced conclusions about the types of conflict pursued by different actors, and the potential relationship with agricultural outputs. Gatti et al. (2021) find that decreased agricultural output is associated with an increase in civil conflict in Indonesia, but that irrigation infrastructure specifically mitigates this link. They divide conflict into conflict over natural resources, issues of popular justice, conflicts triggered by government policy, those triggered by group identity, as well as separatist incidents. Their findings suggest that this effect is particularly strong for natural resource conflicts, popular justice, law enforcement actions, and less strong for conflicts driven by ethnic separatism and group identity. While their categorizations do not specifically differentiate civilian protest and rioting from state- and rebel-initiated conflict, in broad strokes, it appears that conflicts that would lead to protests against government policy and over natural resources are more amenable to mitigation through decreasing the effects of negative agricultural shocks than ethnic separatist conflicts, which are more likely to be associated with insurgent activities, particularly in Indonesia, where rebel groups generally have religious or ethnic goals.

In Southeast Asia, both the opportunity cost and rapacity mechanisms are at play, depending on the actor type (Table 1). For explosions and attacks on civilians, insurgencies may increase their attacks during the harvest season to maximize the damage they do through a number of pathways. First, they may want to expropriate farmers' income, which is realized during harvest season. Second, for farmers who do not support the insurgency or who are on the sidelines, insurgents may want to harm the farmers' earning potential in order to minimize threats to the insurgency, or to intimidate the farmers into joining them (Raleigh, 2012; Raleigh and Choi 2017). Third, the insurgents may time their attacks so as to have maximum negative effect on the state, inasmuch as the state is also likely deriving revenues during the harvest season, and state revenue is related to the ability of the state to attack the insurgents (Fearon and Laitin 2003).

By this logic, violence against civilians is likely to be focused on the destruction or appropriation of agricultural outputs. Significant numbers of attacks on civilians in Southeast Asia revolve around the theft of rice or the destruction of rice fields, rice storage units, or rice

milling facilities. In December 2013, for instance, the Myanmar military attacked civilian rice paddies in Kachin state during the harvest season.¹

State forces, political militias, and insurgent group might choose the harvest season as the time to attack because it would maximize the destruction of their enemies' resources, or allow them to appropriate that agricultural surplus. In November 2022, a Myanmar military force shot dead three villagers in a raid in Myanmar's Magway region, two of who were engaged in harvesting rice in paddy fields.² The state may also attack villages during the harvesting season that may be aided rebel groups. In November 2021, for instance, in a clash between the Myanmar military and various People Defense Forces (the armed groups associated with the anti-junta civilian government in internal exile), the military burned harvested rice fields in a village that it (obviously) suspected was loyal to the anti-state groups.³

Table 1. Actors and conflict seasonality

Type of actor	Type of conflict	Conflict seasonality	Mechanism
Civilians	Protests, riots	Decrease during harvest times	Opportunity cost
Armed actors (State, armed rebel groups, militias)	Violence against civilians, battles, explosions	Increase during harvest times	Rapacity

Insurgent groups fighting against the state also have an incentive to attack civilians who are providing agricultural outputs to the state, both to intimidate the civilians against supporting the state, and to deny the state the food. In November 2022, rebel groups ambushed a military convoy carrying rice in Myanmar in Mon state and killed a soldier.⁴ Pro-government militias can

¹ ACLED # 9785083: "On 9 December 2013, in Mung Ding Pa, Kachin state, the Myanmar army shelled civilian rice fields."

² ACLED #9679246: "On 22 November 2022, in Zar Haw village (Gangaw township, Gangaw district, Magway region), the Myanmar military IB-50 shot dead a villager in the head during the raid. The military also shot dead two other villagers who were harvesting rice in the paddy fields for unknown reasons."

³ ACLED #8807873: "On 4 November 2021, west of Pekon township (Taunggyi district, Shan-South), military troops clashed with the joint forces of Pekon PDF, Moebye PDF, Loikaw PDF, Demoso PDF, the KNDF and the Karenni Army. Military troops fired artillery and torched, looted a nearby village and burned harvested rice in paddy fields according to Pekon PDF. At least 20 military troops were killed and a resistance fighter was injured."

⁴ ACLED #9641230: "On 11 November 2022, between Aye Ka Bar and Bay La Maing villages (coded as Aye Ka Bar) (Thanbyuzayat township, Mawlamyine district, Mon state), Mon State Mount Taungnyo People Guerrilla Force

engage in similar behavior to degrade the resources available to their enemies and to appropriate resources for themselves. In June 2022, the pro-military junta militia group Pyu Saw Htee killed a rice mill owner in Sagaing and stole large amounts of money (which had been intended to buy more rice milling equipment) as well as mobile phones and a motorcycle.⁵

While riots and protests may be initiated by insurgencies or organized anti-government groups, they may also more generally be indicative of dissatisfaction by civilians, whether organized or not. A decrease in protests and riots during harvest season may come through several pathways. First, those who are directly involved in agriculture may decrease their protest activities during harvest time because they are busy harvesting. This relates to a second pathway, that of a direct opportunity cost mechanism, in which the opportunity cost of protesting increases during harvest time because there is more income to be derived from harvesting. Put another way, the infusion of income from the harvest makes protesting relatively less attractive. This may be because there are actually fewer grievances against the government when would-be protesters are realizing income. It may also be because the ‘income’ from protesting relative to other activities becomes less competitive. In Indonesia, for instance, paid protesting is a longstanding means for political parties and civil society groups to pressure the government or send a message. In many cases, protesters are provided with a packed lunch (‘nasi bungkus’ in Indonesian) and a cash payment (hence the term, the ‘nasi bungkus brigade’), and often have only a tenuous interest in the issue at the center of the protest (Andrews, 2017). Thus, protest campaigns may find fewer supporters (paid or not) during the harvest season.

Protests by farmers in Southeast Asia are often designed to pressure the government to increase (or maintain) the prices farmers receive for their products. Both Indonesia and the Philippines have seen pressure campaigns from farmers to maintain or increase the price of rice (through a guaranteed price the government pays to farmers), or to prevent rice imports (to

ambushed a convoy of three military vehicles carrying rice at about 7 am. One military soldier was killed and two others were injured.

⁵ ACLED #9411619: “On 27 June 2022, in Kyunhla town (Kyunhla township, Kanbalu district, Sagaing region), Pyu Saw Htee members detained and killed a 40-year-old rice mill owner from Pi Tauk Pin village, Kanbalu township when he traveled to the Kyunhla town with a companion to buy equipment for his rice mill. The Pyu Saw Htee members seized 1.5 million Kyats, 2 mobile phones and 1 motorcycle from them. It was reported that the rice mill owner was shot dead as he tried to run away near a quarry outside the town. His companion escaped.”

minimize competition that can undercut the domestic price).⁶ In a logic where protests increase as grievances against the state increase, or as the opportunity cost of protesting decreases relative to harvesting, we would expect higher prices or better harvests to be associated with fewer protests and riots.

We would also expect protest and riots to decrease during the harvest season relative to the non-harvest season. In the case of Thailand, for instance, there was a spate of protests against the Thai government by farmers throughout the country in 2014 because of a rice purchasing scheme in which the Thai government was supposed to have paid farmers subsidies for their rice production, but payments were either delayed or non-existent (Mohanty 2012). These protests were largely *not* during rice harvest season (which is December in Thailand), but several months later, when farmer's grievances increased, and the opportunity cost of protesting was lower relative to harvesting. Of interest here is that the Thai farmers' grievances were against both the government (for not paying the subsidies) and anti-government groups (for supposedly blocking the government from paying the subsidies).⁷ The protests were ultimately followed by a military coup against the civilian government in May 2014.

Similarly, civilians might protest during the growing season (which is also often a season of hunger as supplies from the previous harvest dwindle) as a means of extracting concessions from the government. In Thailand in July 2019, for example, hundreds of farmers blocked a road to force the government to release irrigation water for their rice paddies during a drought.⁸

⁶ ACLED # 7787765: "On 22 March 2021, dozens of students from the Agricultural Student Coalition (Komar) held a peaceful protest in front of their university in UPN Veteran, Yogyakarta city (Yogyakarta province). They opposed the government plan of importing rice. [size=dozens]"

ACLED # 9103355: "On 24 September 2018, a group of students held a peaceful protest in Medan City, North Sumatra province, demanding the government to stop importing rice. [size=no report]"

ACLED # 9225485: "On 22 January 2018, in Sukolilo, hundreds of farmers staged a rally to protest against the government's plan to import rice, stating that it will lower local rice prices."

⁷ ACLED # 7908847: "Farmers in the province of Phichit staged a protest against the anti-government movement, blasting its attempt to block the government's efforts to secure funds for the rice pledging program. Hundreds of farmers gathered at a major intersection to express their opposition to the People's Democracy Reform Committee (PDRC), who they believed have been blocking the government's attempt to pay rice farmers for rice pledged under the pledging program."

⁸ ACLED: On 19 July 2019, approximately 150 farmers gathered at a dam in Moo 13, tambon Thep Nakhon, Mueang Kamphaeng Phet of Kamphaeng Phet province, Thailand. They demanded the Irrigation Department release some water into their rice field to ease the effect of the draught. After having waited for a long time to negotiate with an officer, they blocked the road. [size=150]

3. Data

3.1. Conflict

For social unrest we use the Armed Conflict Location & Event Data (ACLED) compiled by Raleigh et al. (2010) and available at <https://acleddata.com/>. This dataset is highly granular in the sense that: (i) it features any reported conflict regardless of whether the altercation resulted in any casualty; (ii) it groups incidents into six categories, which include *battles*, *strategic developments*, and *explosions/remote violence* that feature two parties, typically the state or state-affiliated militias and the rebels, that dispute the control of a territory, it also includes *violence against civilians* perpetrated by any of the paramilitary groups, as well as *protests* and *riots* that feature different manifestations of public disorder of some sort. The main caveat of this dataset is that it covers a relatively short period of time, from 2010 onward for most Southeast Asian countries except for Indonesia (from 2015 onward), Philippines (from 2016 onward), and Malaysia (from 2018 onward). Moreover, there are very few incidents observed in Brunei, Laos, Singapore, and Timor-Leste, and we omit these countries, which leaves Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam, for the analysis.

The study period, which ranges from 2010 to 2021, covers a total of nearly 60 thousand incidents observed across seven countries. This excludes incidents with the geo-precision code 3 in the database (approximately 2.5 percent of the data), as the exact locations of such incidents are unknown and they are arbitrarily attributed to the nearest known site, typically a provincial capital. Figure 1 illustrates the geographical distribution of these incidents aggregated at the one-degree cell level. Together with the conflict incidents, the figure also features a selected set of large cities in the region. The data on cities were obtained from the World Cities Database available at <https://simplemaps.com/data/world-cities>. From this map, it becomes apparent that: (i) conflict, broadly defined, occurs across much of the Southeast Asian region; (ii) within the region, some countries are more conflict-prone than others; (iii) there is a fair bit of spatial dependence in the prevalence of conflict; and (iv) conflict, while generally more prevalent in cities, where most people reside, is not necessarily and exclusively a city phenomenon.

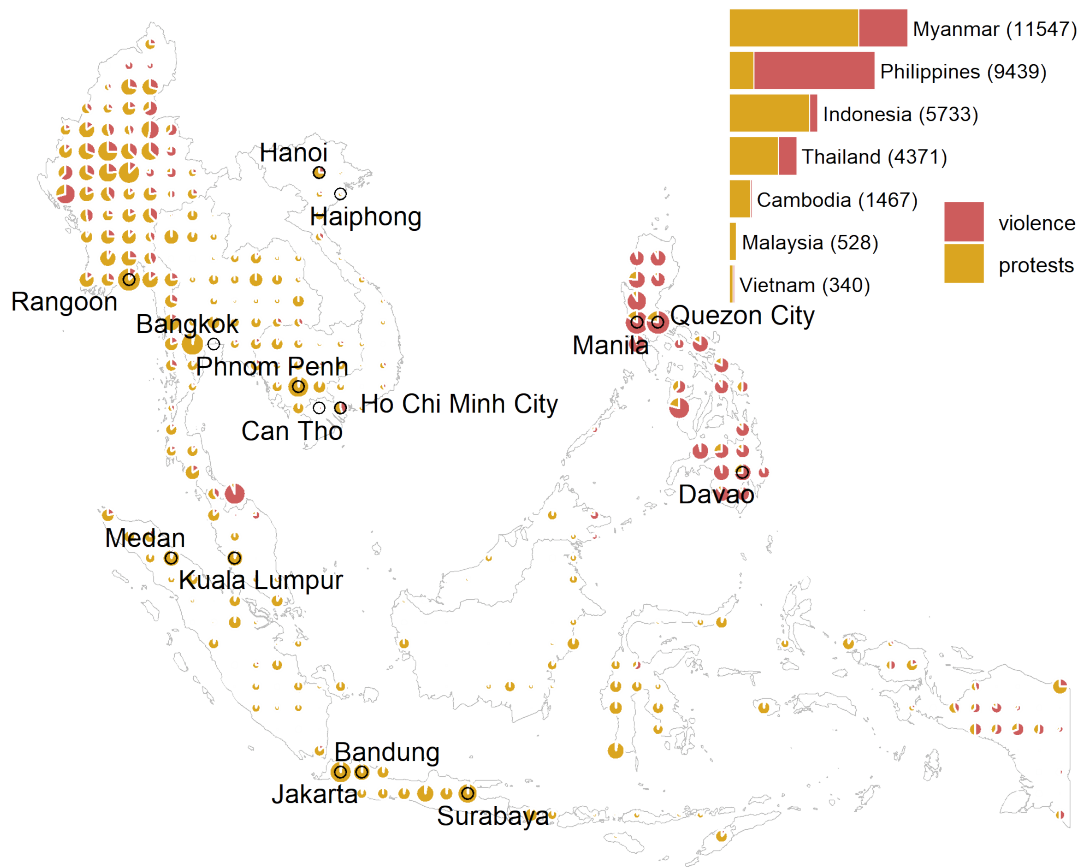


Figure 1: Geographic distribution of violence and protests (2010–2021) and the major cities

Note: The conflict data are for Cambodia, Indonesia (2015 – 2021), Malaysia (2018 – 2021), Myanmar, Philippines (2016 – 2021), Thailand, and Vietnam. The size of the dots is proportional to the incidents in a cell, ranging from 1 to 5605 (the southernmost cell of Thailand). The presented cities are the largest, in terms of population, of those with geographic centroid within a one-degree cell. When multiple cities fall within a cell, the largest of these cities is presented. Specifically, featured are the cities with population of more than 0.5 million that fall in the grid cell with aggregated city population of more than 2 million. This rule is arbitrary, and is only used for illustrative purposes, that is, to ensure that a manageable number of cities are presented on the map.

3.2. Production

We consider rice which is, by far, the most dominant cereal—both in terms of production as well as consumption— across Southeast Asia. We obtain data on the cropland harvest area from IFPRI (2019). We source the data on crop production calendar from Monfreda et al. (2008). The harvest may extend multiple months. We define the period from the month when the harvest starts to the month when the harvest ends as the *harvest season*. We define the midpoint of the

harvest season as the *harvest month*. In instances where a crop is grown over two seasons, we use the main season to identify the crop year. Within a cell, the area of cropland and the month of the harvest remain fixed over the study period.

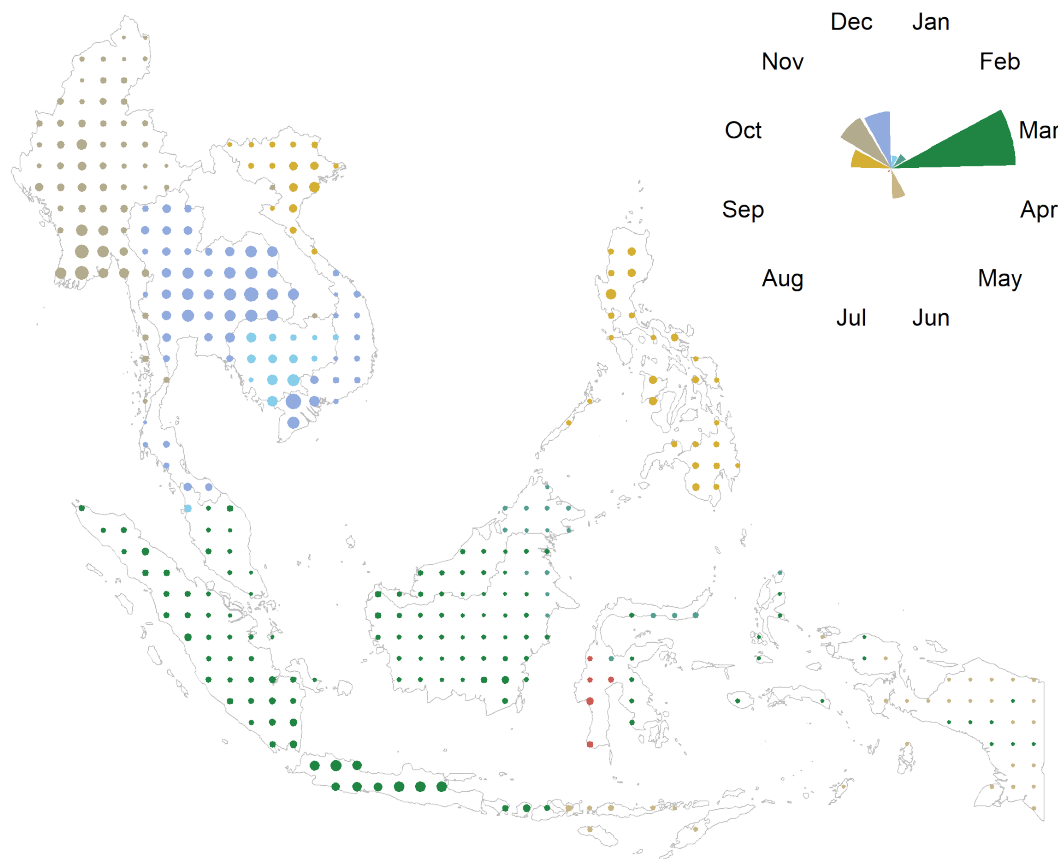


Figure 2: Geographic distribution of rice harvest months

Note: The size of the dots is proportional to the area devoted for rice production; the radial bars indicate the count of cells that fall within a given harvest month. The data on the crop area are from IFPRI (2019). The data on harvest calendar are from Monfreda et al. (2008). The countries covered are Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam.

3.3. Descriptive Statistics

In Table 2 we summarize some of the key features of the data. Violence against civilians and protests represent the two most prevalent types of violent events. Incidentally, these two types of conflict typically involve civilians who either are directly targeted (e.g., violent attacks or abduction) or become targets (e.g., intervention against protesters).

Table 2: Descriptive Statistics

	Count	Mean	S.D.	Min	Max
<i>Unit of observation: cell-year-month (2010 – 2021)</i>					
All conflict incidents	37764	1.581	7.916	0	417
Batts	37764	0.297	1.827	0	63
Explosions/Remote violence	37764	0.179	1.837	0	87
Strategic developments	37764	0.171	1.469	0	67
Violence against civilians	37764	0.344	2.880	0	164
Protests	37764	0.541	3.641	0	268
Riots	37764	0.049	0.444	0	42
<i>Unit of observation: cell</i>					
Rice harvested area (100,000 ha)	359	0.796	1.277	0	9.087

Note: the data are for Cambodia, Indonesia (2015–2021), Malaysia (2018–2021), Myanmar, Philippines (2016–2021), Thailand, and Vietnam.

4. Estimation and Identification

We denote *location*, which is a one-degree cell, with subscript i , and *period*, which is a year–month, with subscript t . The units of analysis, thus, are location-period covering 359 unique grid cells and, in most instances, 144 periods from January 2010 to December 2021. Because we apply monthly rather than yearly data, we opt for a somewhat coarse level of spatial aggregation—one-degree cells that measure approximately 110×110 km near the equator—as opposed to finer level of spatial aggregation, e.g., 0.5-degree cells, as used by other studies (e.g., McGuirk and Burke, 2020), to ensure there are enough units with conflict incidents. This level of aggregation is granular enough to not sabotage the within-country variation in conflict incidents.

Our main econometric specification is as follows:

$$y_{it} = \beta_1 s_i \text{plant}_{it} + \beta_2 s_i \text{harvest}_{it} + \mu_i + \lambda_t + \varepsilon_{it}, \quad (1)$$

where y_{it} depicts the number of incidents in cell i in period t ; s_i is the time-invariant cropland area fraction in cell i ; plant_{it} and harvest_{it} are the cell-specific plant and harvest dummy variable that take the value of one when the period of observation is the planting month and the harvesting month, respectively, and zero otherwise. μ_i is a cell fixed effect, and λ_t is a year–month fixed effect. ε_{it} is the error term.

The estimated coefficients $\hat{\beta}_1$ and $\hat{\beta}_2$ reflect the plant- and harvest-time effects on incidents of social unrest or civil conflict in a hypothetical location with 100 percent cropland. A positive value of the coefficient implies that there is more conflict during the given (plant or harvest) month, compared to other months of the crop year, and that this effect is more pronounced in cells with a higher fraction of cropland. While no cell has the cropland area fraction of 1, there are cells with nearly half or more of the area devoted to crop (namely rice) production. We scale the estimated coefficient by the expected cropland area fraction when calculating the “representative” magnitude of the impact.

5. Results and Discussion

In Table 3 we summarize the main results of the study. Overall, we observe an increase in conflict and violent attacks against civilians and a decrease in protests and riots during the harvest season, relative to the other months of the year, in the rice croplands of the Southeast Asia. We evaluate the estimated differences by evaluating the estimated parameters at the average size of the croplands (across all rice-producing locations) relative to the baseline conflict (which is the average number of incidents of each form of conflict in consideration). So, we estimate approximately ten-to-twenty-five-percent increase in conflict and violence during the harvest season, and ten-percent decrease in protests during the harvest season. These results are not sensitive to omitting years prior to 2016 (for which we do not have conflict data from Indonesia, Malaysia, and Philippines), or to omitting Indonesia, Malaysia, and Philippines from the sample (see Appendix Tables B1 and B2).

Different mechanisms are presumably at play here. The rapacity mechanism may explain the harvest-time increase in conflict and violence against civilians, which may be a direct effect of perpetrators targeting areas where there are spoils to be appropriated, as well as an indirect effect of a collateral damage associated with explosions or other battle related incidents, for example, as more people are out and about during the harvest season. The opportunity mechanism may explain the decrease in protests as people are busy harvesting, meaning that the opportunity cost of participating in protests is high.

Table 3: The Harvest-Time Conflict in the Rice Croplands of Southeast Asia

	Conflict	Battle	Explosion	Strategic	Violence	Protests	Riots
<i>Unbalanced panel: all countries, all years</i>							
Area × Harvest	0.074 (0.052)	0.027*** (0.010)	0.048** (0.019)	0.033*** (0.011)	0.037*** (0.010)	-0.066** (0.029)	-0.004 (0.003)
Obs.	37,764	37,764	37,764	37,764	37,764	37,764	37,764
R2	0.301	0.309	0.276	0.207	0.378	0.211	0.124
<i>Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):</i>							
Baseline conflict	1.59	0.30	0.18	0.17	0.34	0.54	0.05
Area harvested	0.98	0.98	0.98	0.98	0.98	0.98	0.98
<i>Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:</i>							
Harvest (%)	4.6 (3.2)	8.7*** (3.2)	26.1** (10.2)	18.6*** (6.4)	10.4*** (2.9)	-11.8** (5.3)	-8.6 (6.1)

Note: the outcome variable is a count variable that depicts the number of incidents in a cell during a year-month; the treatment variable is the cropland area (100,000 hectares) interacted with the harvest-season binary variables, which varies across locations (see Figure 2); the column headed by ‘Conflict’ combines all event types, the other six columns represent the separate event types; all regressions include cell and year-month fixed effects; the values in parentheses are standard errors adjusted to clustering at the level of a cell; ***, **, and * denote 0.01, 0.05, and 0.10 statistical significance levels. The magnitudes of the effect, presented in percentage terms, are calculated as: $100\% \times \hat{\beta} \times \bar{s}/\bar{c}$, where $\hat{\beta}$ is the parameter estimate, \bar{s} is the average cropland area harvested, and \bar{c} is the baseline conflict, which is the monthly average of incidents of a given conflict type.

To further evaluate the aforementioned theories, we examine years when the value of the harvest is higher than expected (due to the annual growth in the price of rice) or when the volume of the harvest is higher than expected (due to the rainier crop growing season). We do so by interacting the treatment variable, which is the product of the cropland area and the harvest season binary variable, with the year-on-year price inflation and the growing season rainfall, respectively. The results of these regressions are presented in Tables 4 and 5.

A common pattern that becomes evident from both these tables is that when the *value* or the *volume* of the harvest increases, incidents of civil conflict and social unrest decrease (or at least do not increase). This strongly supports the suggestive evidence that people do not protest when the opportunity cost of participating in protests are high. In addition, this additional finding supports the grievance mechanism, as people evidently protest less (or at least do not protest more) when they receive a positive income shock related to increase in price of rice or quantity of rice realized.

Table 4: The Harvest-Time Conflict in the Wake of the Rice Price Inflation

	Conflict	Battle	Explosion	Strategic	Violence	Protests	Riots
<i>Unbalanced panel: all countries, all years</i>							
Area × Harvest	0.084 (0.054)	0.028*** (0.010)	0.051** (0.020)	0.035*** (0.012)	0.038*** (0.011)	-0.064** (0.029)	-0.004 (0.003)
Area × Harvest × Price	-0.295** (0.115)	-0.034** (0.014)	-0.087*** (0.032)	-0.075*** (0.026)	-0.040** (0.018)	-0.057* (0.031)	-0.003* (0.002)
Obs.	37,764	37,764	37,764	37,764	37,764	37,764	37,764
R2	0.302	0.31	0.278	0.209	0.378	0.212	0.124
<i>Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):</i>							
Baseline conflict	1.59	0.30	0.18	0.17	0.35	0.54	0.05
Area harvested	0.98	0.98	0.98	0.98	0.98	0.98	0.98
<i>Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:</i>							
Harvest (%)	5.1 (3.3)	9.1*** (3.4)	27.6** (10.7)	19.9*** (6.7)	10.8*** (3.0)	-11.5** (5.3)	-8.4 (6.0)
Harvest × Price (%)	-13.0** (5.4)	-2.0 (2.4)	-19.6** (7.8)	-22.5** (9.4)	-0.6 (3.3)	-21.6*** (8.0)	-14.7** (7.0)

Note: the outcome variable is a count variable that depicts the number of incidents in a cell during a year-month; the treatment variable is the cropland area (100,000 hectares) interacted with the harvest-season binary variables, which varies across locations (see Figure 2); Price is the standardized measure of the year-on-year inflation of Thai Rice; the column headed by ‘Conflict’ combines all event types, the other six columns represent the separate event types; all regressions include cell and year-month fixed effects; the values in parentheses are standard errors adjusted to clustering at the level of a cell; ***, **, and * denote 0.01, 0.05, and 0.10 statistical significance levels. The magnitudes of the effect, presented in percentage terms, are calculated as: $100\% \times \hat{\beta} \times \bar{s} / \bar{c}$, where $\hat{\beta}$ is the parameter estimate, \bar{s} is the average cropland area harvested, and \bar{c} is the baseline conflict, which is the monthly average of incidents of a given conflict type.

That we observe less conflict and violence when the value or the volume of the harvest increases weakens the suggested rapacity mechanism but leaves room for a possibility of the opportunity cost and grievance mechanisms dominating the effect. People, and farmers in particular, are involved in less conflict when income from their agricultural employment is high. Moreover, the estimated impact is for cropland relative to the locations with no cropland, which likely suffer from higher prices of rice (and other food items). As a result, a decrease in conflict and violence in the cropland may be explained by less grievance in these locations (and more grievance in other locations), thus leading to the spatial displacement of conflict.

Table 5: The Harvest-Time Conflict After a Rainy Crop Growing Season

	Conflict	Battle	Explosion	Strategic	Violence	Protests	Riots
<i>Unbalanced panel: all countries, all years</i>							
Area × Harvest	0.074 (0.052)	0.027*** (0.010)	0.048** (0.019)	0.032*** (0.011)	0.037*** (0.010)	-0.065** (0.029)	-0.004 (0.003)
Area × Harvest × Rain	-0.054 (0.049)	-0.003 (0.009)	-0.019 (0.013)	-0.019* (0.011)	-0.014* (0.008)	0.003 (0.016)	-0.002 (0.003)
Obs.	37,764	37,764	37,764	37,764	37,764	37,764	37,764
R2	0.301	0.309	0.276	0.207	0.378	0.211	0.124
<i>Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):</i>							
Baseline conflict	1.59	0.30	0.18	0.17	0.35	0.54	0.05
Area harvested	0.98	0.98	0.98	0.98	0.98	0.98	0.98
<i>Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:</i>							
Harvest (%)	4.5 (3.2)	8.7*** (3.2)	26.0** (10.2)	18.4*** (6.3)	10.3*** (2.8)	-11.8** (5.2)	-8.7 (6.0)
Harvest × Rain (%)	1.2 (2.5)	7.9** (3.9)	15.7* (8.9)	7.4 (5.2)	6.4** (2.9)	-11.2** (4.8)	-12.4* (7.2)

Note: the outcome variable is a count variable that depicts the number of incidents in a cell during a year-month; the treatment variable is the cropland area (100,000 hectares) interacted with the harvest-season binary variables, which varies across locations (see Figure 2); Rain is the standardized measure of cumulative rainfall during the crop growing season preceding the harvest; the column headed by ‘Conflict’ combines all event types, the other six columns represent the separate event types; all regressions include cell and year-month fixed effects; the values in parentheses are standard errors adjusted to clustering at the level of a cell; ***, **, and * denote 0.01, 0.05, and 0.10 statistical significance levels. The magnitudes of the effect, presented in percentage terms, are calculated as: $100\% \times \hat{\beta} \times \bar{s}/\bar{c}$, where $\hat{\beta}$ is the parameter estimate, \bar{s} is the average cropland area harvested, and \bar{c} is the baseline conflict, which is the monthly average of incidents of a given conflict type.

To further investigate this suggestive evidence, we interact the treatment variable with the proportion of irrigated land in each cell (see Appendix Figure A1). The irrigated rice is the higher-yield and, often, commercially produced rice, as opposed to the rainfed rice, which is lower-yield and, typically, produced at subsistence levels. So, very different types of farmers are likely involved in these two production practices. As before, we assess harvest-time social conflict when the value or the volume of the harvest increases, by interacting the right-hand-side variables with the year-on-year rice price inflation and the growing season rainfall. Results of this exercise are presented in Tables 6 and 7.

Table 6: The Harvest-Time Conflict in Irrigated/Rainfed Lands in the Wake of Inflation

	Conflict	Battle	Explosion	Strategic	Violence	Protests	Riots
<i>Unbalanced panel: all countries, all years</i>							
Area × Harvest	0.154 (0.096)	0.051*** (0.019)	0.112*** (0.036)	0.056*** (0.020)	0.064*** (0.017)	-0.125** (0.053)	-0.004 (0.005)
Area × Harvest × Irrigated	-0.176 (0.113)	-0.057*** (0.022)	-0.145*** (0.042)	-0.052** (0.022)	-0.061*** (0.020)	0.139** (0.069)	0.001 (0.008)
Area × Harvest × Price	-0.573*** (0.214)	-0.070** (0.028)	-0.165*** (0.062)	-0.158*** (0.047)	-0.088*** (0.033)	-0.093 (0.057)	0.001 (0.005)
Area × Harvest × Price × Irrigated	0.644*** (0.247)	0.085** (0.036)	0.182** (0.078)	0.194*** (0.055)	0.111*** (0.039)	0.083 (0.068)	-0.010 (0.012)
Obs.	37,764	37,764	37,764	37,764	37,764	37,764	37,764
R2	0.303	0.310	0.276	0.211	0.379	0.212	0.124
<i>Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):</i>							
Baseline conflict	1.59	0.30	0.18	0.17	0.35	0.54	0.05
Area harvested	0.98	0.98	0.98	0.98	0.98	0.98	0.98
<i>Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:</i>							
<i>Rainfed</i>							
Harvest (%)	9.5 (5.9)	16.9*** (6.2)	60.7*** (19.4)	31.7*** (11.4)	18.0*** (4.8)	-22.4** (9.5)	-8.7 (8.9)
Harvest × Price (%)	-25.7** (10.9)	-6.1 (5.4)	-28.4 (20.5)	-58.1*** (19.4)	-6.8 (6.3)	-39.2*** (14.4)	-6.2 (12.5)
<i>Irrigated</i>							
Harvest (%)	-1.4 (2.6)	-1.8 (2.2)	-17.8** (7.5)	2.1 (3.3)	0.6 (2.4)	2.5 (5.5)	-7.6 (11.6)
Harvest × Price (%)	3.0 (4.4)	3.2 (4.8)	-8.6 (18.7)	22.5*** (8.1)	7.1** (3.2)	0.6 (6.2)	-25.5 (19.7)

Note: the outcome variable is a count variable that depicts the number of incidents in a cell during a year-month; the treatment variable is the cropland area (100,000 hectares) interacted with the harvest-season binary variables, which varies across locations (see Figure 2); Price is the standardized measure of the year-on-year inflation of Thai Rice; Irrigated denotes the proportion of irrigated land in a cell; the column headed by ‘Conflict’ combines all event types, the other six columns represent the separate event types; all regressions include cell and year-month fixed effects; the values in parentheses are standard errors adjusted to clustering at the level of a cell; ***, **, and * denote 0.01, 0.05, and 0.10 statistical significance levels. The magnitudes of the effect, presented in percentage terms, are calculated as: $100\% \times \hat{\beta} \times \bar{s}/\bar{c}$, where $\hat{\beta}$ is the parameter estimate, \bar{s} is the average cropland area harvested, and \bar{c} is the baseline conflict, which is the monthly average of incidents of a given conflict type.

Table 7: The Harvest-Time Conflict in Irrigated/Rainfed Lands After a Rainy Season

	Conflict	Battle	Explosion	Strategic	Violence	Protests	Riots
<i>Unbalanced panel: all countries, all years</i>							
Area × Harvest	0.156 (0.095)	0.052*** (0.019)	0.112*** (0.036)	0.056*** (0.020)	0.064*** (0.017)	-0.124** (0.052)	-0.005 (0.004)
Area × Harvest × Irrigated	-0.190* (0.114)	-0.058*** (0.022)	-0.149*** (0.044)	-0.055** (0.023)	-0.063*** (0.020)	0.135** (0.068)	0.000 (0.008)
Area × Harvest × Rain	-0.075 (0.097)	-0.006 (0.017)	-0.020 (0.026)	-0.011 (0.020)	-0.013 (0.016)	-0.017 (0.033)	-0.007 (0.005)
Area × Harvest × Rain × Irrigated	0.049 (0.138)	0.008 (0.020)	0.004 (0.034)	-0.018 (0.035)	-0.002 (0.021)	0.045 (0.064)	0.011 (0.013)
Obs.	37,764	37,764	37,764	37,764	37,764	37,764	37,764
R2	0.303	0.310	0.276	0.211	0.379	0.212	0.124
<i>Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):</i>							
Baseline conflict	1.59	0.30	0.18	0.17	0.35	0.54	0.05
Area harvested	0.98	0.98	0.98	0.98	0.98	0.98	0.98
<i>Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:</i>							
<i>Rainfed</i>							
Harvest (%)	9.6 (5.9)	17.0*** (6.2)	60.9*** (19.5)	32.1*** (11.5)	18.1*** (4.8)	-22.3** (9.4)	-9.1 (8.9)
Harvest × Rain (%)	5.0 (5.0)	15.0* (8.1)	49.9** (19.4)	25.8** (10.7)	14.3** (5.8)	-25.4*** (8.2)	-22.6* (11.9)
<i>Irrigated</i>							
Harvest (%)	-2.1 (2.6)	-2.2 (2.3)	-19.7** (8.0)	0.7 (3.1)	0.3 (2.4)	2.0 (5.5)	-8.3 (11.8)
Harvest × Rain (%)	-3.7 (5.1)	-1.4 (3.5)	-28.5** (13.5)	-16.0 (11.0)	-3.9 (3.3)	7.0 (10.4)	0.3 (21.6)

Note: the outcome variable is a count variable that depicts the number of incidents in a cell during a year-month; the treatment variable is the cropland area (100,000 hectares) interacted with the harvest-season binary variables, which varies across locations (see Figure 2); Rain is the standardized measure of cumulative rainfall during the crop growing season preceding the harvest; Irrigated denotes the proportion of irrigated land in the cell; the column headed by ‘Conflict’ combines all event types, the other six columns represent the separate event types; all regressions include cell and year-month fixed effects; the values in parentheses are standard errors adjusted to clustering at the level of a cell; ***, **, and * denote 0.01, 0.05, and 0.10 statistical significance levels. The magnitudes of the effect, presented in percentage terms, are calculated as: $100\% \times \hat{\beta} \times \bar{s} / \bar{c}$, where $\hat{\beta}$ is the parameter estimate, \bar{s} is the average cropland area harvested, and \bar{c} is the baseline conflict, which is the monthly average of incidents of a given conflict type.

Several additional features of interest emerge that, moreover, help clarify some of the earlier findings. In general, much of the estimated effect is due to changes in conflict and violence at the

rainfed rice locations. There are no apparent harvest-time changes in social unrest in parts of the region where irrigated rice is produced, nor any such changes emerge in the wake of price or (presumable) yield increase. A notable exception is the increase in harvest-time violence against civilians in the irrigated areas when rice prices are on the rise. This supports the predation motives of conflict. By contrast, in rainfed parts of the region, violence against civilians vanishes after the price increase, plausibly driven by reduced grievance.

6. Conclusion

We make several contributions to the literature on conflict and agricultural shocks. To better understand the pathways between harvest-time violence and conflict, we disaggregate conflict into two types of conflict which are often carried out by different groups of people for different reasons – violence against civilians, including but not limited to battles and explosions, usually carried out by the state, allied militias, or anti-state insurgent groups; and protests and riots, often against state policies, by civilians. Instead of resolving the debate over the mechanisms of resource-related conflict on one side or the other, we suggest that different types of conflict (usually instigated by different types of conflict actors) are related to seasonal agricultural output through different mechanisms: conflict *by* civilians is better understood through the opportunity cost mechanism, while conflict *against* civilians is better understood through the rapacity mechanism. The result, in Southeast Asia at least, is a situation in which protests and riots decrease during the harvest season, while violence against civilians and armed conflict increases during the harvest season.

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APPENDICES

A. FIGURES

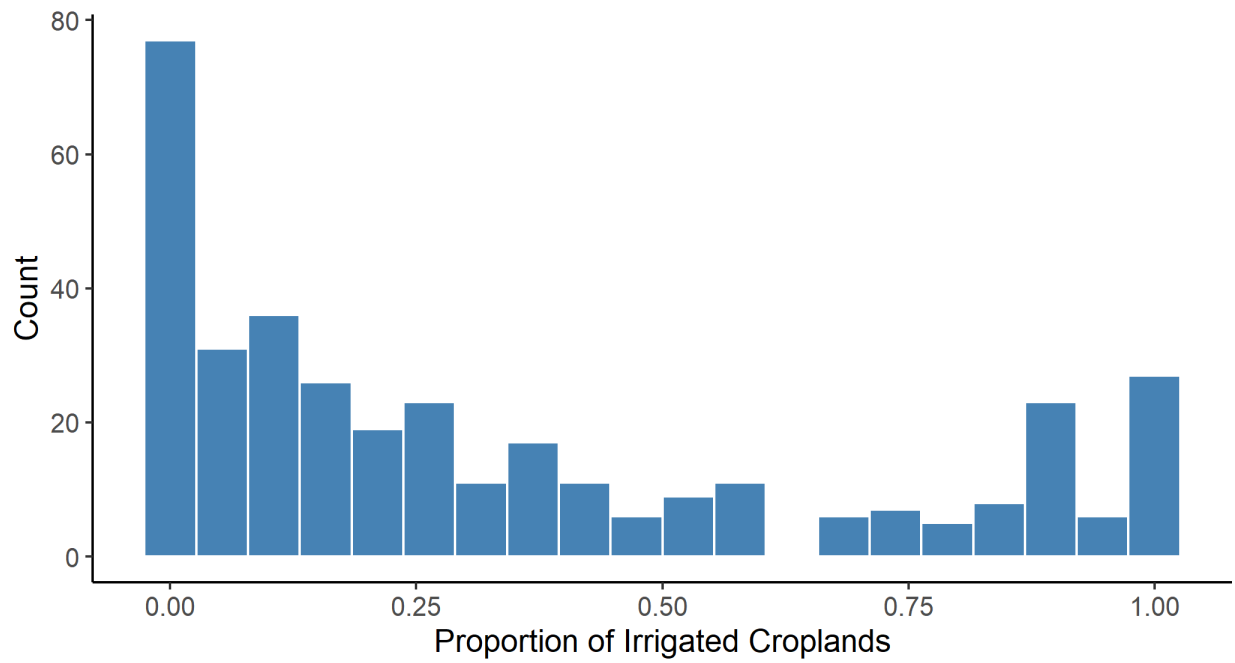


Figure A1: Distribution of the proportion of irrigated rice croplands

Note: Data are from IFRPI (2019), and cover Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam.

B. TABLES

Table B1: The Harvest-Time Conflict in the Southeast Asia (subset of years)

	Conflict	Battle	Explosion	Strategic	Violence	Protests	Riots
<i>Balanced panel: all countries excluding Malaysia, years 2016-2021</i>							
Area × Harvest	0.120 (0.089)	0.041** (0.016)	0.086*** (0.033)	0.056*** (0.019)	0.065*** (0.017)	-0.120** (0.050)	-0.007 (0.005)
Obs.	23,688	23,688	23,688	23,688	23,688	23,688	23,688
R2	0.293	0.315	0.17	0.171	0.377	0.226	0.124
<i>Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):</i>							
Baseline conflict	2.02	0.35	0.20	0.22	0.5	0.69	0.06
Area harvested	0.87	0.87	0.87	0.87	0.87	0.87	0.87
<i>Magnitude of the effect evaluated at the average cropland area fraction relative to the baseline conflict:</i>							
Harvest effect (%)	5.2 (3.8)	10.2** (4.0)	36.2*** (13.9)	22.6*** (7.8)	11.3*** (3.0)	-15.0** (6.3)	-11.2 (6.9)

Note: the outcome variable is a count variable that depicts the number of incidents in a cell during a year-month; the treatment variable is the cropland area (100,000 hectares) interacted with the harvest-season binary variables, which varies across locations (see Figure 2); the column headed by ‘Conflict’ combines all event types, the other six columns represent the separate event types; all regressions include cell and year-month fixed effects; the values in parentheses are standard errors adjusted to clustering at the level of a cell; ***, **, and * denote 0.01, 0.05, and 0.10 statistical significance levels. The magnitudes of the effect, presented in percentage terms, are calculated as: $100\% \times \hat{\beta} \times \bar{s}/\bar{c}$, where $\hat{\beta}$ is the parameter estimate, \bar{s} is the average cropland area harvested, and \bar{c} is the baseline conflict, which is the monthly average of incidents of a given conflict type.

Table B2: The Harvest-Time Conflict in the Southeast Asia (subset of countries)

	Conflict	Battle	Explosion	Strategic	Violence	Protests	Riots
<i>Balanced panel: all countries excluding Indonesia, Malaysia, and Philippines, all years</i>							
Area × Harvest	0.098* (0.052)	0.023** (0.010)	0.048*** (0.018)	0.039*** (0.012)	0.031*** (0.010)	-0.042 (0.027)	-0.001 (0.002)
Obs.	21,600	21,600	21,600	21,600	21,600	21,600	21,600
R2	0.284	0.306	0.296	0.247	0.257	0.216	0.075
<i>Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):</i>							
Baseline conflict	1.77	0.37	0.29	0.25	0.21	0.61	0.03
Area harvested	1.44	1.44	1.44	1.44	1.44	1.44	1.44
<i>Magnitude of the effect evaluated at the average cropland area fraction relative to the baseline conflict:</i>							
Harvest effect (%)	8.0* (4.3)	8.8** (4.0)	23.9*** (9.0)	22.6*** (6.8)	21.3*** (6.9)	-9.8 (6.4)	-6.0 (8.5)

Note: the outcome variable is a count variable that depicts the number of incidents in a cell during a year-month; the treatment variable is the cropland area (100,000 hectares) interacted with the harvest-season binary variables, which varies across locations (see Figure 2); the column headed by ‘Conflict’ combines all event types, the other six columns represent the separate event types; all regressions include cell and year-month fixed effects; the values in parentheses are standard errors adjusted to clustering at the level of a cell; ***, **, and * denote 0.01, 0.05, and 0.10 statistical significance levels. The magnitudes of the effect, presented in percentage terms, are calculated as: $100\% \times \hat{\beta} \times \bar{s}/\bar{c}$, where $\hat{\beta}$ is the parameter estimate, \bar{s} is the average cropland area harvested, and \bar{c} is the baseline conflict, which is the monthly average of incidents of a given conflict type.

Table B3: The Harvest-Time Conflict in the Southeast Asia (price levels)

	Conflict	Battle	Explosion	Strategic	Violence	Protests	Riots
<i>Unbalanced panel: all countries, all years</i>							
Area × Harvest	0.070 (0.049)	0.028*** (0.010)	0.046*** (0.017)	0.031*** (0.010)	0.035*** (0.009)	-0.066** (0.029)	-0.004 (0.003)
Area × Harvest × Price	-0.035 (0.042)	0.012 (0.011)	-0.019 (0.011)	-0.015* (0.009)	-0.013 (0.008)	-0.001 (0.012)	0.000 (0.001)
Obs.	37,764	37,764	37,764	37,764	37,764	37,764	37,764
R2	0.301	0.309	0.276	0.207	0.378	0.211	0.124
<i>Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):</i>							
Baseline conflict	1.59	0.30	0.18	0.17	0.35	0.54	0.05
Area harvested	0.98	0.98	0.98	0.98	0.98	0.98	0.98
<i>Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:</i>							
Harvest (%)	4.3 (3.0)	9.3*** (3.2)	24.8*** (9.4)	17.4*** (5.8)	9.9*** (2.7)	-11.8** (5.3)	-8.6 (6.0)
Harvest × Price (%)	2.1 (2.8)	13.3*** (4.5)	14.7*** (4.6)	8.6** (3.8)	6.3** (2.5)	-12.0** (6.0)	-8.1 (6.1)

Note: the outcome variable is a count variable that depicts the number of incidents in a cell during a year-month; the treatment variable is the cropland area (100,000 hectares) interacted with the harvest-season binary variables, which varies across locations (see Figure 2); the column headed by ‘Conflict’ combines all event types, the other six columns represent the separate event types; all regressions include cell and year-month fixed effects; the values in parentheses are standard errors adjusted to clustering at the level of a cell; ***, **, and * denote 0.01, 0.05, and 0.10 statistical significance levels. The magnitudes of the effect, presented in percentage terms, are calculated as: $100\% \times \hat{\beta} \times \bar{s} / \bar{c}$, where $\hat{\beta}$ is the parameter estimate, \bar{s} is the average cropland area harvested, and \bar{c} is the baseline conflict, which is the monthly average of incidents of a given conflict type.