**Agricultural Shocks and Social Conflict in Southeast Asia[[1]](#footnote-1)**

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**Abstract**

Conflicts are inevitable, but their occurrence and intensity vary greatly over time and across countries. In lower-income economies where employment and income from agriculture is 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 benefits of working with rich and disaggregated data that allow to retrieve much detail that would have been camouflaged in a more aggregated setting. These findings offer important insights to policy makers as they point to possible temporal and geographic displacement 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 & 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 & Ecker, 2014; Raleigh, Choi, & Kniveton, 2015; Berman and Couttenier, 2015; Crost and Felter, 2020).

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 lends to 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. 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. On the other hand, protests and related riots are often triggered by grievance 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. 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). Second, agriculture is a crucial sector for employment and income generation, across much of the region (World Bank, 2022c). 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) **[perhaps some anecdotes here, e.g., insurgency in the Southern Thailand, Myanmar Civil War 2021--, etc.]**.

By examining nearly 60 thousand incidents over the span of 12-year monthly data from 2010 to 2021, we find that protests and riots decrease during the rice harvest months, and this effects nearly doubles when the prices of rice are one standard deviation higher than their historical average. This finding accords with the opportunity cost mechanism of conflict insofar as people tend to participate in protests less when there is more at stake, which in rural areas would be around the time of harvest when the years’ worth of surplus is to be collected. We also find that violence against civilians increases during the rice harvest months, but this effect reverses when the prices of rice are one standard deviation higher than their historical average. 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. Data**

*2.1. 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.

*2.2. Production*

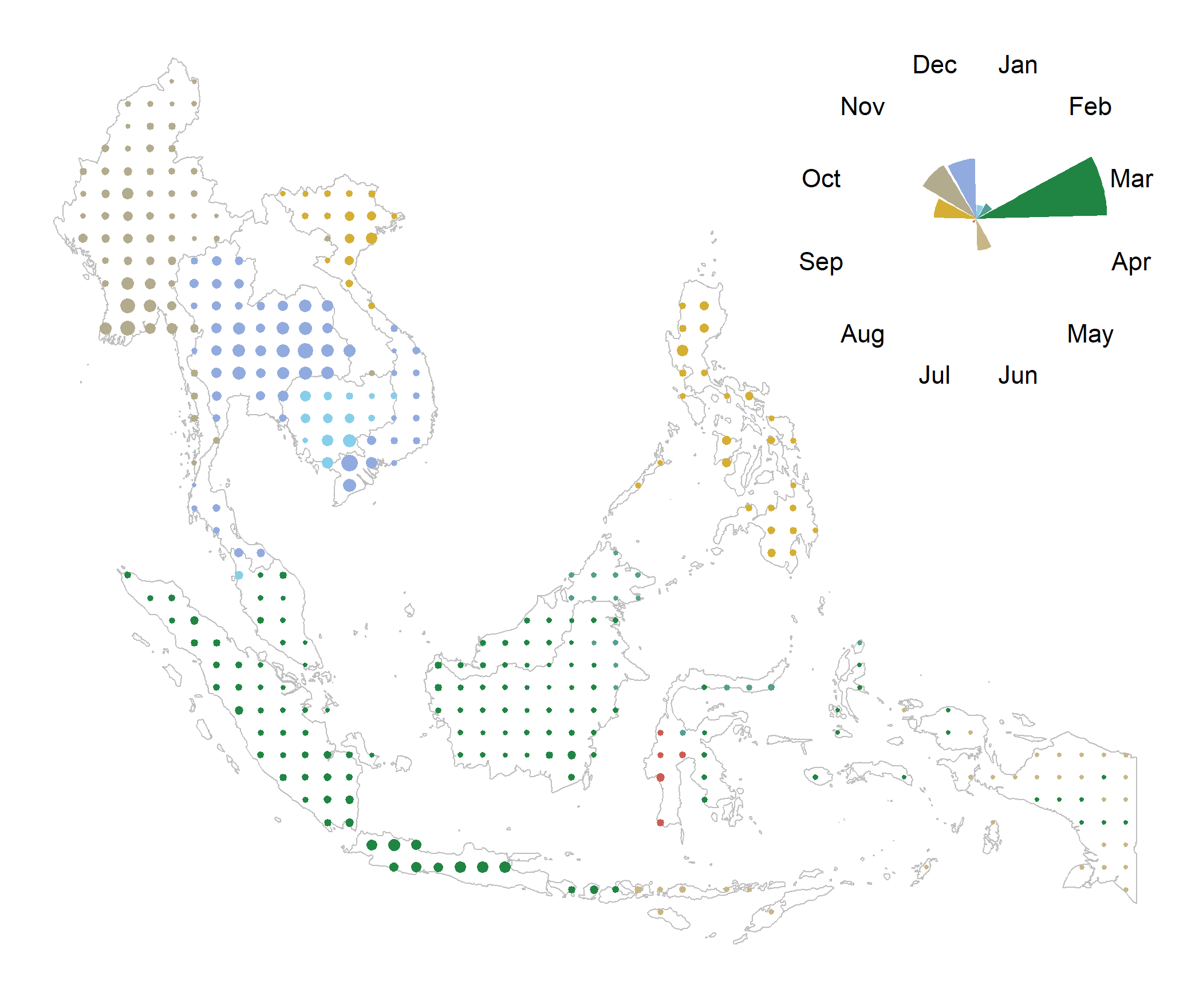
We consider rice which is, by far, the most dominant cereal—both in terms of production as well as consumption— across Southeast Asia. We obtain data on the cropland harvest area from IFPRI (2019). We source the data on crop production calendar from Monfreda et al. (2008). The harvest may extend multiple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

Map

Description automatically generated with medium confidence

**Figure 1: Geographic distribution of incidents (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.



**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.

*2.3. Descriptive Statistics*

In Table 1 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 1: Descriptive Statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Count | Mean | S.D. | Min | Max |
|  | *Unit of observation: cell-year-month (2010 – 2021)* | | | | |
| All conflict incidents | 37764 | 1.581 | 7.916 | 0 | 417 |
| Battles | 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 |
|  | *Unit of observation: cell* | | | | |
| 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.

**3. 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:

, (1)

where depicts the number of incidents in cell *i* in period *t*; is the time-invariant cropland area fraction in cell *i*; and 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. is a cell fixed effect, and is a year–month fixed effect. is the error term.

The estimated coefficients  and   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.

**4. Results and Discussion**

In Table 2 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, 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 2: The Harvest-Time Conflict in the Rice Croplands of Southeast Asia**

|  | **Conflict** | **Battle** | **Explosion** | **Strategic** | **Violence** | **Protests** | **Riots** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Unbalanced panel: all countries, all years*** | | | | | | | |
| Area × Harvest | 0.074 | 0.027\*\*\* | 0.048\*\* | 0.033\*\*\* | 0.037\*\*\* | -0.066\*\* | -0.004 |
|  | (0.052) | (0.010) | (0.019) | (0.011) | (0.010) | (0.029) | (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 |
| *Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):* | | | | | | | |
| 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 |
| *Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:* | | | | | | | |
| Harvest (%) | 4.6 | 8.7\*\*\* | 26.1\*\* | 18.6\*\*\* | 10.4\*\*\* | -11.8\*\* | -8.6 |
|  | (3.2) | (3.2) | (10.2) | (6.4) | (2.9) | (5.3) | (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:  , where is the parameter estimate, is the average cropland area harvested, and 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 3 and 4.

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 3: The Harvest-Time Conflict in the Wake of the Rice Price Inflation**

|  | **Conflict** | **Battle** | **Explosion** | **Strategic** | **Violence** | **Protests** | **Riots** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Unbalanced panel: all countries, all years*** | | | | | | | |
| Area × Harvest | 0.084 | 0.028\*\*\* | 0.051\*\* | 0.035\*\*\* | 0.038\*\*\* | -0.064\*\* | -0.004 |
|  | (0.054) | (0.010) | (0.020) | (0.012) | (0.011) | (0.029) | (0.003) |
| Area × Harvest × Price | -0.295\*\* | -0.034\*\* | -0.087\*\*\* | -0.075\*\*\* | -0.040\*\* | -0.057\* | -0.003\* |
|  | (0.115) | (0.014) | (0.032) | (0.026) | (0.018) | (0.031) | (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 |
| *Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):* | | | | | | | |
| 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 |
| *Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:* | | | | | | | |
| Harvest (%) | 5.1 | 9.1\*\*\* | 27.6\*\* | 19.9\*\*\* | 10.8\*\*\* | -11.5\*\* | -8.4 |
|  | (3.3) | (3.4) | (10.7) | (6.7) | (3.0) | (5.3) | (6.0) |
| Harvest × Price (%) | -13.0\*\* | -2.0 | -19.6\*\* | -22.5\*\* | -0.6 | -21.6\*\*\* | -14.7\*\* |
|  | (5.4) | (2.4) | (7.8) | (9.4) | (3.3) | (8.0) | (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:  , where is the parameter estimate, is the average cropland area harvested, and 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 famers in particular, involve 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). So, 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 4: The Harvest-Time Conflict After a Rainy Crop Growing Season**

|  | **Conflict** | **Battle** | **Explosion** | **Strategic** | **Violence** | **Protests** | **Riots** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Unbalanced panel: all countries, all years*** | | | | | | | |
| Area × Harvest | 0.074 | 0.027\*\*\* | 0.048\*\* | 0.032\*\*\* | 0.037\*\*\* | -0.065\*\* | -0.004 |
|  | (0.052) | (0.010) | (0.019) | (0.011) | (0.010) | (0.029) | (0.003) |
| Area × Harvest × Rain | -0.054 | -0.003 | -0.019 | -0.019\* | -0.014\* | 0.003 | -0.002 |
|  | (0.049) | (0.009) | (0.013) | (0.011) | (0.008) | (0.016) | (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 |
| *Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):* | | | | | | | |
| 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 |
| *Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:* | | | | | | | |
| Harvest (%) | 4.5 | 8.7\*\*\* | 26.0\*\* | 18.4\*\*\* | 10.3\*\*\* | -11.8\*\* | -8.7 |
|  | (3.2) | (3.2) | (10.2) | (6.3) | (2.8) | (5.2) | (6.0) |
| Harvest × Rain (%) | 1.2 | 7.9\*\* | 15.7\* | 7.4 | 6.4\*\* | -11.2\*\* | -12.4\* |
|  | (2.5) | (3.9) | (8.9) | (5.2) | (2.9) | (4.8) | (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:  , where is the parameter estimate, is the average cropland area harvested, and 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 a given 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 5 and 6.

**Table 5: The Harvest-Time Conflict in Irrigated/Rainfed Lands in the Wake of Inflation**

|  | **Conflict** | **Battle** | **Explosion** | **Strategic** | **Violence** | **Protests** | **Riots** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Unbalanced panel: all countries, all years*** | | | | | | | |
| Area × Harvest | 0.154 | 0.051\*\*\* | 0.112\*\*\* | 0.056\*\*\* | 0.064\*\*\* | -0.125\*\* | -0.004 |
|  | (0.096) | (0.019) | (0.036) | (0.020) | (0.017) | (0.053) | (0.005) |
| Area × Harvest | -0.176 | -0.057\*\*\* | -0.145\*\*\* | -0.052\*\* | -0.061\*\*\* | 0.139\*\* | 0.001 |
| × Irrigated | (0.113) | (0.022) | (0.042) | (0.022) | (0.020) | (0.069) | (0.008) |
| Area × Harvest × Price | -0.573\*\*\* | -0.070\*\* | -0.165\*\*\* | -0.158\*\*\* | -0.088\*\*\* | -0.093 | 0.001 |
|  | (0.214) | (0.028) | (0.062) | (0.047) | (0.033) | (0.057) | (0.005) |
| Area × Harvest × Price | 0.644\*\*\* | 0.085\*\* | 0.182\*\* | 0.194\*\*\* | 0.111\*\*\* | 0.083 | -0.010 |
| × Irrigated | (0.247) | (0.036) | (0.078) | (0.055) | (0.039) | (0.068) | (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 |
| *Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):* | | | | | | | |
| 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 |
| *Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:* | | | | | | | |
| *Rainfed* | | | | | | | |
| Harvest (%) | 9.5 | 16.9\*\*\* | 60.7\*\*\* | 31.7\*\*\* | 18.0\*\*\* | -22.4\*\* | -8.7 |
|  | (5.9) | (6.2) | (19.4) | (11.4) | (4.8) | (9.5) | (8.9) |
| Harvest × Price (%) | -25.7\*\* | -6.1 | -28.4 | -58.1\*\*\* | -6.8 | -39.2\*\*\* | -6.2 |
|  | (10.9) | (5.4) | (20.5) | (19.4) | (6.3) | (14.4) | (12.5) |
| *Irrigated* | | | | | | | |
| Harvest (%) | -1.4 | -1.8 | -17.8\*\* | 2.1 | 0.6 | 2.5 | -7.6 |
|  | (2.6) | (2.2) | (7.5) | (3.3) | (2.4) | (5.5) | (11.6) |
| Harvest × Price (%) | 3.0 | 3.2 | -8.6 | 22.5\*\*\* | 7.1\*\* | 0.6 | -25.5 |
|  | (4.4) | (4.8) | (18.7) | (8.1) | (3.2) | (6.2) | (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:  , where is the parameter estimate, is the average cropland area harvested, and is the baseline conflict, which is the monthly average of incidents of a given conflict type.

**Table 6: The Harvest-Time Conflict in Irrigated/Rainfed Lands After a Rainy Season**

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

**5. Conclusion**

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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** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Balanced panel: all countries excluding Malaysia, years 2016-2021*** | | | | | | | |
| Area × Harvest | 0.120 | 0.041\*\* | 0.086\*\*\* | 0.056\*\*\* | 0.065\*\*\* | -0.120\*\* | -0.007 |
|  | (0.089) | (0.016) | (0.033) | (0.019) | (0.017) | (0.050) | (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 |
| *Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):* | | | | | | | |
| 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 |
| *Magnitude of the effect evaluated at the average cropland area fraction relative to the baseline conflict:* | | | | | | | |
| Harvest effect (%) | 5.2 | 10.2\*\* | 36.2\*\*\* | 22.6\*\*\* | 11.3\*\*\* | -15.0\*\* | -11.2 |
|  | (3.8) | (4.0) | (13.9) | (7.8) | (3.0) | (6.3) | (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:  , where is the parameter estimate, is the average cropland area harvested, and 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** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Balanced panel: all countries excluding Indonesia, Malaysia, and Philippines, all years*** | | | | | | | |
| Area × Harvest | 0.098\* | 0.023\*\* | 0.048\*\*\* | 0.039\*\*\* | 0.031\*\*\* | -0.042 | -0.001 |
|  | (0.052) | (0.010) | (0.018) | (0.012) | (0.010) | (0.027) | (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 |
| *Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):* | | | | | | | |
| 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 |
| *Magnitude of the effect evaluated at the average cropland area fraction relative to the baseline conflict:* | | | | | | | |
| Harvest effect (%) | 8.0\* | 8.8\*\* | 23.9\*\*\* | 22.6\*\*\* | 21.3\*\*\* | -9.8 | -6.0 |
|  | (4.3) | (4.0) | (9.0) | (6.8) | (6.9) | (6.4) | (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:  , where is the parameter estimate, is the average cropland area harvested, and 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** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Unbalanced panel: all countries, all years*** | | | | | | | |
| Area × Harvest | 0.070 | 0.028\*\*\* | 0.046\*\*\* | 0.031\*\*\* | 0.035\*\*\* | -0.066\*\* | -0.004 |
|  | (0.049) | (0.010) | (0.017) | (0.010) | (0.009) | (0.029) | (0.003) |
| Area × Harvest × Price | -0.035 | 0.012 | -0.019 | -0.015\* | -0.013 | -0.001 | 0.000 |
|  | (0.042) | (0.011) | (0.011) | (0.009) | (0.008) | (0.012) | (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 |
| *Average cropland area harvested (100,000 hectares) and the number of incidents (baseline conflict):* | | | | | | | |
| 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 |
| *Magnitude of the effect evaluated at the average cropland area relative to the baseline conflict:* | | | | | | | |
| Harvest (%) | 4.3 | 9.3\*\*\* | 24.8\*\*\* | 17.4\*\*\* | 9.9\*\*\* | -11.8\*\* | -8.6 |
|  | (3.0) | (3.2) | (9.4) | (5.8) | (2.7) | (5.3) | (6.0) |
| Harvest × Price (%) | 2.1 | 13.3\*\*\* | 14.7\*\*\* | 8.6\*\* | 6.3\*\* | -12.0\*\* | -8.1 |
|  | (2.8) | (4.5) | (4.6) | (3.8) | (2.5) | (6.0) | (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:  , where is the parameter estimate, is the average cropland area harvested, and is the baseline conflict, which is the monthly average of incidents of a given conflict type.

1. Preliminary and incomplete. [↑](#footnote-ref-1)
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