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Irrigation and Conflict: Evidence from Kurdish Separatism in Turkey

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Abstract

This paper leverages a large-scale dam construction project in Southeastern Turkey to test the hypothesis that climactic shocks play a causal role in civil conflict. I use original 5km and 10km gridded datasets on irrigation and Kurdish separatism for the period 1985-2019. Exploiting exogenous topographical variation in the distribution of irrigation schemes, I find that conflict incidence and insurgent recruitment decline significantly in grid cells following the introduction of irrigation. Yields for all major crops except irrigated cotton are highly sensitive to rainfall, and clashes are more frequent following a poor harvest. However, the effect of irrigation on conflict is strongly mitigated by land inequality.

Keywords: Irrigation, Conflict, Agriculture, Turkey, Insurgent, PKK

JEL Codes: C21, C23, C26, D74, O13, Q15

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I Introduction

The impact of climate shocks on civil conflict has been the subject of particular focus and debate in recent years (Hsiang et. al., 2011; Uexkull, 2014; Couttenier and Sobeyran, 2013; Maystadt and Ecker, 2014; Miguel et. al. 2004; Miguel and Satyanath, 2011). Though many cross-country studies find a link between rainfall and civil conflict, the mechanisms underlying this relationship remain poorly understood. As a result, many of these findings have been disputed by qualitative studies that situate agricultural production within the broader context of political and social factors contributing to conflict. This is particularly true in the Middle East, where the popular thesis that a severe drought contributed to the Syrian uprising (Kelly et. al., 2015; Gleick 2014) has come under increasing scrutiny (Selby et. al., 2017; Ide, 2018). In this paper, I conduct a detailed quantitative investigation of the relationship between rainfall, irrigation, and the political economy of Kurdish separatism in Turkey.

Turkey’s Southeastern Anatolia region provides an optimal setting to test both mechanisms linking agricultural income and civil conflict, as well as potential mitigating policy interventions. The region’s nine provinces are characterized by an arid climate, a high degree of economic dependence on agriculture, and the highest levels of poverty in Turkey (Fikret, 2016). Situated on the border with Syria, this region experienced the same climactic shocks that have been implicated in the uprising against Bashar al-Assad, and has been the site of a Kurdish insurgency for over 40 years.

In the 1980s, the Turkish government broke ground on the Southeastern Anatolia Project (*Güneydoğu Anadolu Projesi*, henceforth GAP), a regional development program aiming to bring 1.8 million hectares of land under irrigation (GAP, 2016). Irrigation has both increased farmers’ incomes by allowing them to grow higher value crops and has shielded them from ever-more frequent droughts. This, in turn, seems to strongly affect rural Kurds’ views of the government; in the words of one farmer: “We did not trust the state before, but it brought electricity, water, phone, etc. to us and now we trust the state a lot” (Harris, 2009: 11).

I leverage an original, highly disaggregated dataset to investigate the relationship between irrigation and Kurdish separatism in Southeastern Turkey between 1985 and 2019. Analysis is conducted at the level of 5km-by-5km and 10km-by-10km grid cells. The primary explanatory variables include a remote-sensing based measure of irrigation, multiple drought indices, and crop production statistics. The dependent variables consist of two different measures of conflict incidence and a measure of PKK recruitment derived from online obituaries. Detailed political and economic covariates include ballot-box level election data, topographical variables, a measure of Kurdish tribal control, and nightlights. I seek to answer the following question: has irrigation reduced Kurdish separatism in Southeastern Turkey?

I first assess the cross-sectional impact of irrigation on conflict likelihood. The distribution of canal-fed irrigation schemes is largely determined by exogenous topographical constraints, as they must be below the altitude of their distributary dams and must be on nearly completely level ground. I exploit this exogenous topographical variation in the placement of irrigation schemes at the level of 5km-by-5km grid cells, during the resurgence of hostilities following the breakdown of a truce in 2015. Using a spatially autoregressive instrumental variables approach and ACLED conflict incidence data, I find that a fully irrigated 25 km² grid-cell is 58% less likely than the average cell to experience a conflict event involving Kurdish rebels during the 2016-2019 period. The effect is strengthened when the dependent variable is restricted to isolate military raids targeting villages that are perceived to be materially supporting the PKK. This effect is robust to the inclusion of a comprehensive array of control variables, aggressive geographic restrictions, and the inclusion of contiguous and inverse-distance spatial spillover effects.

To assess whether conflict decreases following the introduction of irrigation, I employ dynamic spatial panel models using UCDP conflict incidence data spanning over the period 1985-2018, at the level of 10km-by-10km grid-cells. Because irrigation schemes may be deliberately placed in areas that are expected to have higher potential agricultural production or less potential for conflict, the benchmark specification excludes all grid-cells that never

receive irrigation during the study period. Despite the fact that the panel models and instrumental variables models use different conflict datasets and are estimated at different spatial levels, the treatment effect of irrigation is similar: a 27 km² increase in a cell's irrigated area leads to a 49% decrease in conflict likelihood for a given cell-year. Results remain consistent despite the use of three alternative measures of irrigation, and the use of PKK recruitment as the dependent variable rather than conflict incidence.

I present evidence on the mechanism underpinning the relationship between irrigation and conflict. Broadly, this mechanism holds that an individual's decision to join a rebellion is a function of “whether economic opportunities are so poor that the life of a rebel is attractive to 500 or 2,000 young men” (Fearon and Laitin, 2003: 88). Irrigation likely increases the opportunity cost of rebellion by generating two positive income effects: allowing farmers to grow higher value crops and insulating farmers from rainfall shocks. Yields for four major crops—which together account for over 90% of cultivated land in the region—are shown to be highly sensitive to rainfall. Wheat, which accounts for nearly 50% of the sown area in Southeastern Anatolia, is particularly sensitive. District level panel models suggests that the precarity of agricultural income plays a role in Kurdish separatism: clashes are more frequent following a poor harvest of wheat, the dominant crop in the region. Irrigation induces a shift towards the cultivation of cotton, which is both more lucrative and the only crop in the sample for which yields were uncorrelated with rainfall. I complement this quantitative analysis with a qualitative case study in Appendix B involving fieldwork interviews in an irrigation scheme during a period of drought and anti-government protest. The case study indicates that farmers who receive irrigation adopt a significantly more positive view of the government than farmers who do not.

As a further test of this mechanism, treatment heterogeneity related to land inequality is explored, showing that irrigation fails to mitigate conflict in areas with high land inequality. The prevalence of tribal social structures characterized by “feudal” land tenure means that the degree to which farmers benefit economically from irrigation is likely to be uneven across

the region. Interacting the irrigation variable with various indicators of tribal control suggests that the introduction of irrigation in tribal areas actually increases the likelihood of conflict by generating violent local competition over this new source of rents. This effect is strongest in areas with a high proportion of government-aligned tribes, many of whom function as state-sponsored paramilitaries through the “Village Guard” program. Local news reports confirm that historical competition between tribes—known as *kan davalari* or “blood feuds”—are increasingly being fought over scarce irrigation water and often involve paramilitaries. This aligns closely with recent literature on rent-seeking and lootability in civil wars (Berman et. al., 2017). I further explore this phenomenon in a second qualitative case study in Appendix B. Fieldwork interviews and local news reports trace the process through which the introduction of a scarce resource in an area with a history of inter-tribal conflict led to the militarization of blood feuds and the intensification of conflict as a result of irrigation.

This paper makes three main contributions to the literature. First, I fill a critical gap in the growing literature on climate and conflict by exploiting exogenous variation in the relationship between rainfall and agricultural income to provide detailed evidence on the mechanisms linking the two. Second, I address the lack of social, historical, and political context in this literature by situating agricultural income within the broader political economy of the conflict using a detailed array of bespoke covariates. Third, I provide evidence that public infrastructure programs can partially mitigate the growing effects of climactic shocks on conflict incidence and insurgent recruitment.

The paper proceeds as follows. Section II conducts an overview of the existing scholarship on relationship between agricultural income and civil conflict. Section III provides background on the Southeastern Anatolia Project, the dynamics of PKK recruitment, and their interconnections. Section IV describes the data, and sections V and VI contain the empirical analysis. The spatially autoregressive instrumental variables approach is conducted in section V, focusing on a cross-section of conflict events spanning 2016-2019. Section VI examines longitudinal trends through the use of dynamic spatial panel models during the

1985-2018 period. Section VII tests the “opportunity cost of rebellion” mechanism in two parts: first, by exploring the relationship between irrigation, agricultural production, and conflict; second, by examining treatment heterogeneity related to extreme land inequality in tribal areas. Section VIII concludes.

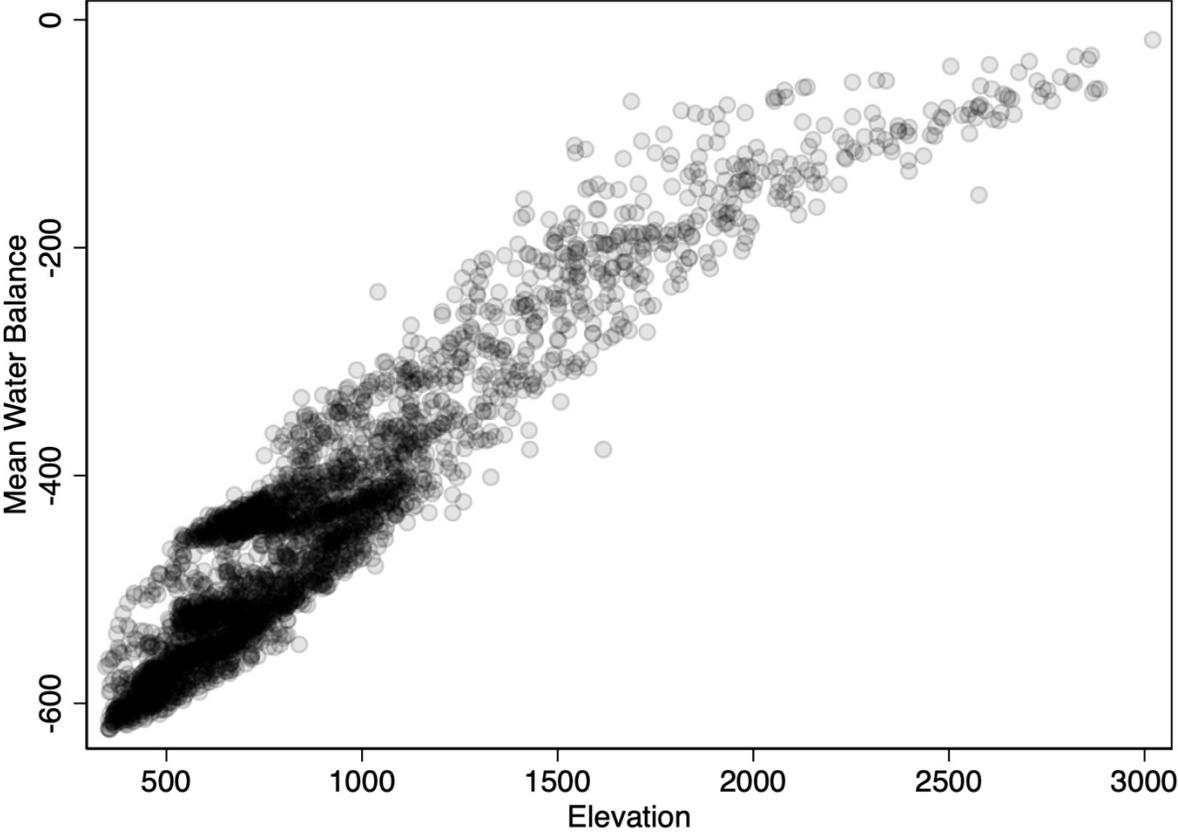
II Related Literature: Development, Drought, and Rebellion.

Droughts have been argued to have a uniquely strong effect in motivating civil conflict due to their negative effect on the availability of essentials such as food and water, and because they disproportionately affect low-income rural communities engaged in labor-intensive agricultural work (Hsiang et. al., 2011; Uexkull, 2014; Couttenier and Sobeyran, 2013; Maystadt and Ecker, 2014). The most well-established mechanism through which economic development affects violent conflict is through the former’s effect on the opportunity cost of rebellion (Collier and Hoeffler, 1998). As incomes rise relative to the economic returns to participating in an insurgency, the incentive to join a rebel group diminishes (Grossman, 1991). Dal Bó and Dal Bó (2004) suggest that in a two-sector model of the economy, negative shocks to the labor-intensive (rather than the capital-intensive) sector significantly increase relative returns to joining a rebellion.

The provision of irrigation to farmers interacts with both of the mechanisms outlined above by simultaneously increasing rural incomes through crop substitution and by insulating farmers from climactic shocks. Indeed, in studies that use rainfall as an instrument for the effect of agricultural income on civil conflict, irrigation is often cited as a threat to identification, a potential policy solution, and an avenue for further research (Blattman and Miguel, 2010; Miguel et al. 2004; Bohlken and Sergenti, 2010; Harari and LaFerrara, 2018). Despite abundant empirical evidence on the relationship between agricultural income shocks and civil conflict, the role of irrigation as a potential mitigating factor has been largely

neglected. Sarsons (2015) finds that in India, income in districts downstream from dams is much less sensitive to rainfall shocks, but that this has no effect on the incidence of Hindu-Muslim riots. This is largely irrelevant to the mechanisms discussed above, however, as participation in a riot offers no economic benefits. Gatti, Baylis, and Crost (2020) provide the first evidence that irrigation attenuates the link between climate shocks and conflict in Indonesia, but acknowledge a number of identification concerns. As such, mechanisms involving the opportunity cost of rebellion and agricultural income shocks merits further investigation.

Figure 1: Relationship Between Water Balance and Elevation



This figure displays the relationship between a 10km grid cell’s mean water balance (precipitation minus evapotranspiration) and elevation in Southeastern Anatolia.

Furthermore, many of the empirical findings linking drought and civil conflict have been either weak or contested. Rainfall is frequently used as an instrument for agricultural income,

and the impacts of the former on conflict are consequently treated as causal (Miguel et. al. 2004; Harrari and LaFerrara, 2018). However, rainfall variables likely violate the exclusion restriction, not least through the well-established positive relationship between rainfall and elevation (Song et al., 2019). Figure 1 shows that in Southeastern Anatolia, 88% of the variation in a 5km cell’s mean water balance is explained solely by elevation. High levels of spatial aggregation and resulting bias from within-country heterogeneity in cropping patterns and the spatial distribution of conflict also hamper identification (Cicccone, 2011). Blattman and Miguel (2010: 8) contend that “the most promising avenue for new empirical research is on the subnational scale, analyzing conflict causes, conduct, and consequences at the level of armed groups, communities, and individuals.” As a result, empirical analyses are increasingly being conducted using grid-cells, remote sensing data, and geospatial techniques (Harari and LaFerrara, 2018; Verwimp et. al., 2019).

The present study addresses these theoretical and empirical gaps in the literature on the microeconomics of violent conflict. Empirical analysis is conducted at the level of 10×10 km and 5×5 km grid-cells, using two distinct measures of conflict incidence and a measure of PKK recruitment, an irrigation variable derived from remote sensing, and a rich array of georeferenced political, climactic, and economic covariates. By examining insurgent recruitment in the context of irrigation in Turkey’s arid Kurdish region at such a high level of detail, fine-grained tests of the opportunity cost mechanisms of insurgent become possible. This paper makes empirical and theoretical contributions to the expanding literature on the microeconomics of violent conflict, the impact of infrastructural investments on development, and spatial econometrics.

III Background

III.a Kurdish Separatism

Following the establishment of the Turkish Republic in 1923, the government undertook an effort to create a nation-state modeled after European powers such as France (Park, 2013). This involved the writing of a constitution, a strong emphasis on secularism, and most importantly a policy of “Turkification”, whereby “Turkish ethnic identity has been strictly imposed as a hegemonic identity in every sphere of social life” (Aktar in Ülker, 2005: 29). Later that year, a group of Kurdish tribes led by Sheikh Said rebelled against the Republican government with the goal of establishing an “independent Kurdistan” (Olson, 2000: 69). The rebellion lasted nearly four months, involved the siege of the region’s largest city, Diyarbakir, and led to 8,000 casualties before Sheikh Said was defeated (Ibid).

For much of the 20th century, Southeastern Anatolia saw sporadic bouts of armed insurrection by the Kurds, followed by devastating military campaigns by the government. The development of a unified Kurdish resistance movement came in 1974, with the establishment of the Kurdistan Worker’s Party (Patiya Karkerên Kurdistanê, henceforth PKK) by Abdullah Öcalan (Özcan, 2013). Thereafter, the cycles of revolt and repression were replaced with a low-intensity conflict beginning in 1984, peaking in the 1990s, and continuing to this day. Following the breakdown of a 2013-2015 truce, hostilities between the PKK and the Turkish government have intensified almost to the level of the conflict’s peak in 1994. Olson (2013: 32) notes that “more Turkish military actions have been carried out in Kurdistan than in any other area of Turkish concern, foreign or domestic”.

The economic destitution of Turkey’s Kurdish region is an explicit feature in the writings of the PKK’s founder, Abdullah Öcalan (2007; 2015). The Marxist ideological character of nearly all 20th-century Kurdish rebel movements is often attributed to the fact that “the Kurdish identity question was expressed in terms of regional economic inequalities and suggested a socialist solution” (Yavuz, 2001: 10). In a study of PKK recruitment, Tezcür

(2016) finds an inverse correlation between recruitment and district-level GDP, though he makes no claims to causality. As a “peasant movement”, the PKK’s main base of support is among the rural farming villages in Southeastern Anatolia and nearby mountainous regions (Yarkin, 2015: 31).

III.b The Southeastern Anatolia Project

The Southeastern Anatolia Project (*Güneydoğu Anadolu Projesi*, henceforth GAP), is a regional development program consisting of 22 dams and 19 hydroelectric power plants on the Tigris and Euphrates rivers, as well as 1.8 million hectares of irrigated land (GAP, 2016). The rate of extreme poverty in the nine provinces encompassed by the project is more than five times the national average, with 44% of the population living below the national poverty line of US\$1.1/day in 2007 (Fikret, 2016; Saatci and Akpınar, 2007: 632). Nearly two thirds of all economic activity in the region is derived from agriculture, and income gains associated with the transition from rain-fed subsistence agriculture to irrigated cotton cultivation are estimated to range from three- to sevenfold (Bilgen, 2016; Tokdemir et. al., 2016: 2). Exports from Southeastern Anatolia more than quadrupled between 2005 and 2015 (GAP, 2018). There is evidence, however, that the developmental impact of the project has been highly uneven, with income gains tightly confined to irrigated areas, leaving non-irrigated areas virtually unchanged by GAP (Bakirci, 2001). Even within irrigated areas, inequality related to land tenure is significant (Fikret, 2016). Furthermore, flooding caused by the dams has displaced up to 355,000 people and destroyed cultural heritage sites such as Hasankeyf (Varsamidis, 2010).

Ethnographic studies conducted in newly irrigated areas in Southeastern Anatolia found a “heightened sense of state legitimacy as a function of irrigation access”; in the words of one farmer, “our view of the state changed positively... we had hatred before, but now they started investing in the Southeast” (Harris, 2016: 9). Another farmer stated, “We did not trust the state before, but it brought electricity, water, phone, etc. to us and now we trust

the state a lot” (Harris, 2009: 11). Conversely, one farmer—frustrated that his village had not received irrigation—asked, “Why should I not support Öcalan?” (Harris, 2006: 193).

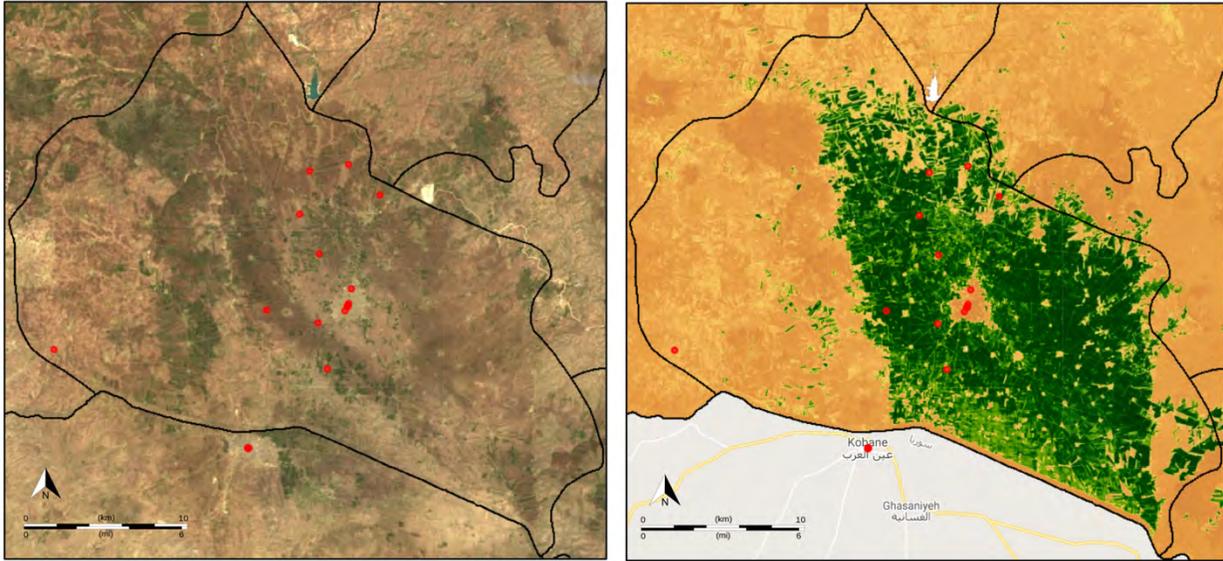
There was an explicit expectation among Turkish policymakers that “GAP will help to decrease, if not eliminate, the appeal of the PKK” (Jongerden, 2010: 137; Olson, 1996: 96). A leaked U.S. intelligence cable paraphrases then-President Abdullah Gül as saying “If Kurds are gainfully employed, have better educational opportunities, and see increased levels of infrastructure development throughout their region, their affinity for the terrorist PKK will wane further. A top priority is ensuring completion of the massive Southeastern Anatolia Project (GAP) within five years.” (Wikileaks, 2008b). In a region where few farmers have enough savings to insulate themselves from income shocks, government-provided irrigation appears to have a substantial impact on their perception of the Turkish state.

IV Data

I constructed a dataset spanning a comprehensive array of political, economic, and climactic variables for Southeastern Anatolia. All variables are georeferenced, enabling analysis at multiple spatial scales and the use of highly disaggregated geographic units. Variables are derived from remote sensing, web scraping, and existing datasets used widely in the literature.

The primary explanatory variable in this analysis is the expansion of irrigated agricultural land, which is gauged using remote sensing. Because of overlapping growth schedules, the crop cycle in Southeastern Anatolia only supports the planting of one crop per year in a given field (Ozdogan et. al, 2002). Cotton, which accounts for 96% of irrigated crops in the region, is grown in the mid-to-late summer and harvested in early October (Unlu, 2007). Thus, if green vegetation is observed in July or August, it is almost certainly irrigated agriculture, and as such “there is overwhelming consensus on the efficiency of vegetation indices such as the NDVI in identifying irrigated fields” in Southeastern Anatolia (Ozdogan 2006). 32-day composite NDVI images were sourced for July and August from NASA’s LANDSAT

Figure 2: Isolating Irrigation using Summertime NDVI

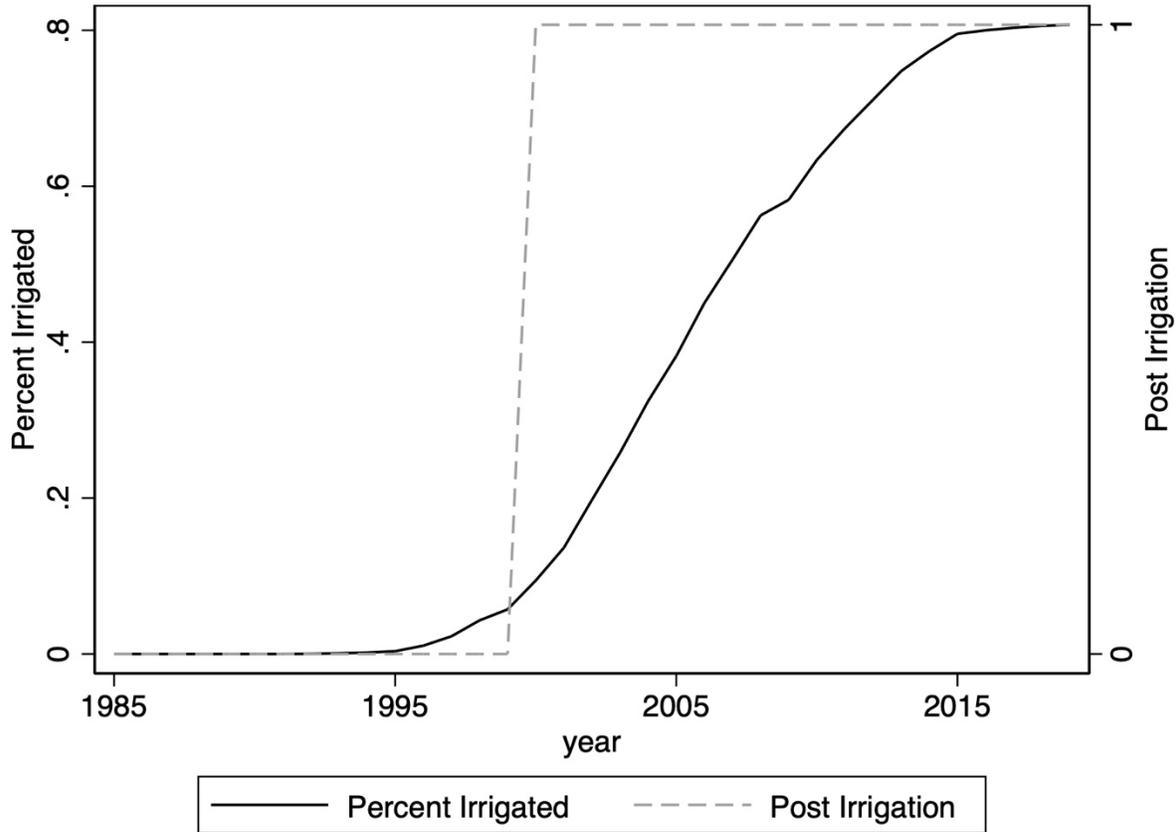


The panel on the left displays an optical satellite image of the district of Suruç, with red dots indicating the geolocated birthplaces of PKK recruits from Tezcür (2016). The panel on the right displays the Normalized Difference Vegetation Index (NDVI), calculated using Landsat 8 imagery taken during August 2020. This process clearly highlights the Suruç irrigation scheme.

satellites, from 1985 to 2019. A minimum NDVI cutoff filters out wild vegetation. Figure 2 compares an unprocessed satellite image of the district of Suruç to a processed image, highlighting the extent of irrigation. Three distinct measures of irrigation are derived from the NDVI data. The first measure denotes the percent of a grid-cell that is under irrigation in a given year. The second is a binary variable indicating the onset of irrigation, moving from 0 to 1 when a grid-cell is more than 20% irrigated. The third denotes the number of years since irrigation was first introduced. A comparison of these three measures for a sample district is shown in Figure 3.

Conflict variables are derived from two main sources. Panel data on conflict were compiled from the Uppsala Conflict Data Program, one of the most widely used conflict datasets. The main conflict variable used herein is a binary measure of whether fighting occurred involving the PKK in a cell in a given year, spanning from 1989 to 2019. The frequency of clashes over time is shown in Figure B1. This includes PKK attacks on Turkish Armed Forces (TSK) and civilians, as well as TSK raids on PKK positions. For added robustness, conflict data

Figure 3: Irrigated Area and Irrigation Onset variables



The solid line shows the percent of a 10km grid cell located in Kiziltepe that is under irrigation in a given year, derived from the remote sensing procedure carried out in Figure 2. The dashed line shows a binary variable indicating irrigation onset for the same cell.

were also compiled from the Armed Conflict Location and Event Data project (ACLED). ACLED data contain more detail than the UCDP data, but only go as far back as 2016 for Turkey. As such, the ACLED data were pooled across three years (2016-2019) to create a cross-sectional variable denoting the spatial distribution of conflict events in the recent flare-up of fighting between the PKK and the government. Figure 4 shows the geographic distribution of conflict events from both datasets at the 10 km grid-cell level, showing a high density of clashes in the Eastern portion of the study area.

In addition to looking at conflict incidence from two different sources, data on PKK recruitment are also used to provide an even more detailed investigation of conflict channels.

Figure 4: Geographic Distribution of Violent Clashes



The figure above displays the spatial distribution of violent clashes between the PKK and the Turkish Government in Southeastern Anatolia using geolocated conflict data from the UCDP and Armed Conflict Location & Event Data (ACLED). Darker cells contain more total clashes across the entire study period.

Data on PKK recruitment was obtained from Tezcür (2016). Each observation includes the year and location of an individual's recruitment to the PKK. The dataset was compiled from PKK obituaries listed in two online magazines (Serxwebûn and Berxwedan) published by the PKK since 1982. Each obituary contains biographical information on the recruit including name, gender, as well as locations and dates of birth, death, and recruitment. Many even include a recruit's previous occupation, their parents' occupation, and whether they had relatives who had joined previously. There are data on 8,266 recruits in total—though the present analysis uses a subsample of 2,678 who were born and recruited in the study area—between 1985 and 2012. The dataset as a whole comprises roughly 41% of known militants based on numbers reported by both the PKK and a Turkish Parliamentary commission (Tezcür, 2016). In contrast to the vast majority of empirical analyses on conflict and development that utilize conflict incidence as a proxy for recruitment, these data contain the actual dates and geographic coordinates of recruitment, allowing for an unusually detailed investigation of individual motivations for joining a rebellion.

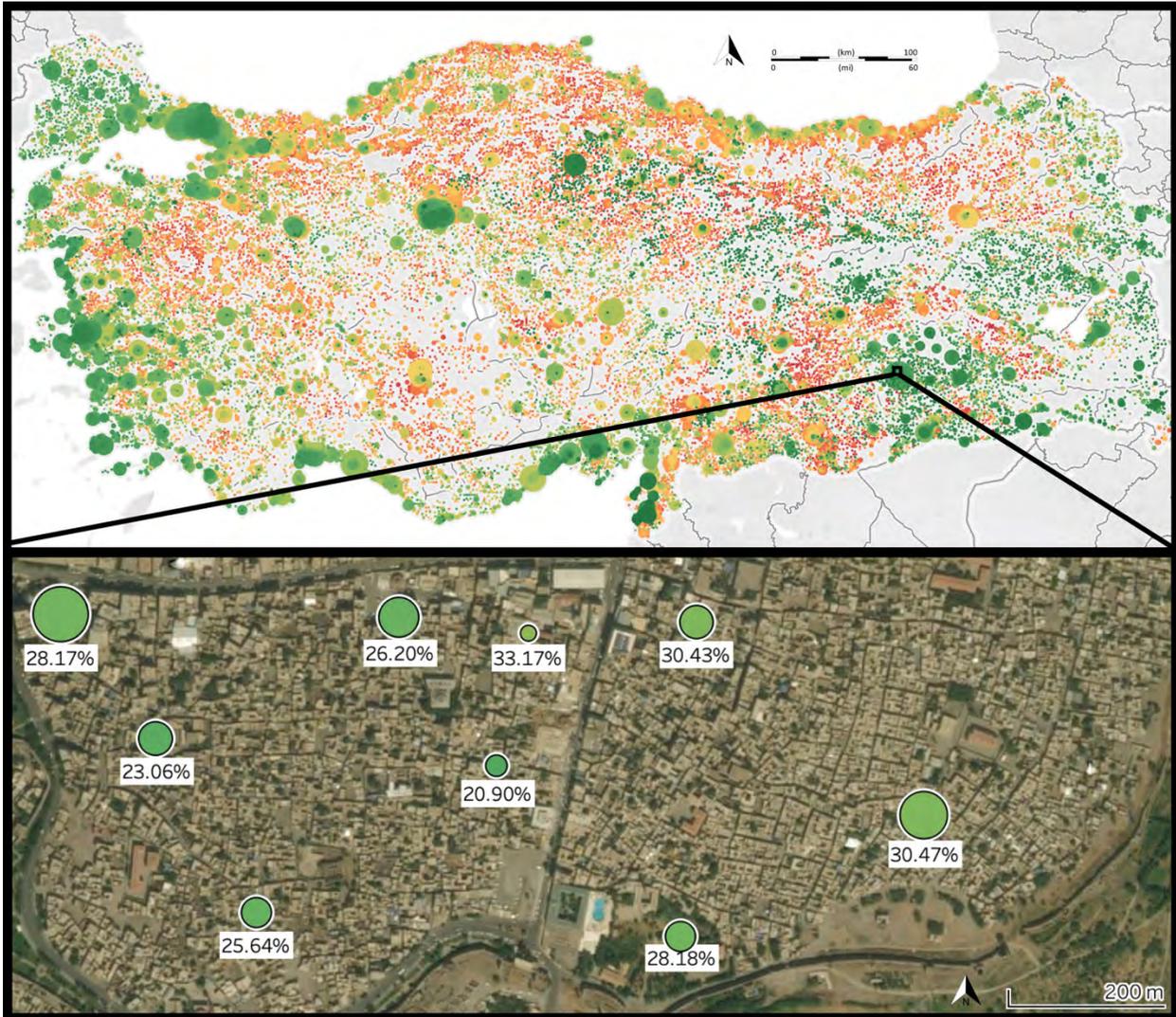
A key feature of the political economy of rural Southeasten Anatolia is the prevalence of Kurdish tribes (*aşiretler*). A subgroup of these tribes—mainly those that practice Sunni Islam, speak Kurmancî, and have become involved in right-wing politics—were armed by

the Turkish state to form paramilitary “village guards” (köy koruculuğu) to fight the PKK (Guida, 2014). On the other hand, a significant number of tribes—mainly those that practiced Alevi Islam, spoke Zazaki, and had become involved in socialist politics during the 20th century— have historically been at the helm of the Kurdish struggle for autonomy (Yavuz, 2001). Furthermore, accounting for aşiret control is important because land tenure is often characterized as “feudal” in tribal areas, which could temper the positive income effect of irrigation wrought by the Southeastern Anatolia Project (Öktem, 2014: 180).

The quantitative identification of tribal regions of Turkey relies on their practice of “combined voting” (birleşik oy), whereby “many villages vote en masse—usually without making a single deviance—for the party chosen by the chieftain” (Guida, 2014: 176). Scans of individual ballot box receipts are available on the Turkish Supreme Elections Board (YSK) website for all elections since 2009. Web scraping was used to access data from a total of 2.9 million ballot boxes spanning 20 elections at various levels (municipal, provincial, presidential, and parliamentary). The spatial distribution of ballot box-level election results for the whole of Turkey is shown in Figure 5, with a pane magnifying central Diyarbakir. Ballot boxes in which one party or candidate received over 95% of the vote were reclassified into separate dummy variables with 1 denoting bloc voting for a given party. The number of instances of bloc voting in each district or grid-cell was divided by the total number of ballot boxes therein, yielding a measure of the proportion of likely tribally administered villages in each area. 3,840 instances of birleşik oy were encountered (1564 for the HDP, 2276 for the AKP), constituting 5.36% of the total sample. This is consistent with survey findings by Akşit and Akçay (1997), who found that 4.3% of the 187 villages in their survey sample were under aşiret control.

In addition to the variables on tribal control, several additional variables were derived from ballot-box data. The respective vote shares of the AKP or HDP across all elections are measured to provide a sense of the overall political leanings of a given area. Finally, the log number of voters registered at each ballot box is used as a highly detailed proxy for

Figure 5: Ballot Box-Level Election Results



The results from 2.9 million ballot box-level election results between 2009 and 2019 are displayed above. Red indicates a high proportion of votes for the Justice and Development Party (AKP). Point size reflects the number of registered voters at a ballot box. The top panel shows results for all of Turkey, while the bottom panel shows results for several neighborhoods in Diyarbakir.

population density.

Climactic variables were constructed using monthly rainfall and temperature values from the University of Idaho's TerraClimate dataset. These values are used to compute the Standardized Precipitation-Evapotranspiration Index (SPEI), which unlike conventionally- used drought indices, such as the Standardized Precipitation Index (SPI) or the Palmer Drought Severity Index (PDSI), integrates not only rainfall but temperature into its calculation. Har-

rari and La Ferrara (2018) note that while the conflict literature tends to consider the effects of either temperature or rainfall, SPEI allows for their joint effect to be estimated. The calculation of SPEI begins with the computation of the water balance, or the difference between rainfall and potential evapotranspiration. These values are standardized by cell such that the resulting value is expressed in terms of standard deviations from the cell’s historical average. The main climactic variables used herein are an annual measure of SPEI, and the water balance.

To avoid neglecting the urban dimension of the conflict, nighttime lights data are used to capture cell-level information on urbanization and economic development. Nighttime lights data were collected from the Defense Meteorological Satellite Program (DMSP), and reflect the average radiance displayed by a cell in a given year. The difference in nighttime lights between 1992 and 2014 is used as a rough proxy for development at the cell level. As cities expand, highways are built, and villages receive electricity for the first time, their nighttime lights signature increases (Bruederle and Hodler, 2018). The maximum observed nightlights value in a given cell is also used to distinguish between urban, sub-urban, and rural areas.

Further time invariant cell-level covariates include elevation, slope, a binary indicator of whether a cell is on the southern border, and kilometers of roads. Finally, two longitudinal dummy variables control for different phases in the conflict; the first indicates whether or not a given year was in a period of ceasefire, and the other indicates the onset of the Syrian civil war. The former accounts for low levels of conflict resulting from armistice agreements, while the latter controls for possible cross-border spillovers from the Syrian civil war owing to the relationship between the PKK and Syrian Kurdish rebel groups such as the YPG. Summary statistics for all variables at the 5km and 10km level are reported in Table 1. The raw, unaggregated geospatial data for several key variables defined above are visualized in the interactive online tool.

Table 1: Summary Statistics

Variable	5km Grid Cells			10km Grid Cells		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Irrigated Area	85400	0.911	3.086	27230	3.048	10.481
Post Irrigation	85400	0.154	0.361	27230	0.159	0.365
Clashes (UCDP)	73200	0.009	0.096	23340	0.033	0.179
Clashes (ACLED)	85400	0.084	0.278	27230	0.225	0.418
Population	85400	5.326	0.966	27230	5.508	0.855
AKP voteshare	85400	0.595	0.191	27230	0.588	0.164
HDP voteshare	85400	0.136	0.12	27230	0.144	0.111
Tribal	85400	0.108	0.098	27230	0.108	0.08
Nightlights Change	85400	4.658	5.072	27230	4.159	3.721
Nightlights	85400	7.88	7.301	27230	7.329	5.87
Roads	85400	9.727	1.212	27230	11.015	1.114
SPEI	82960	-0.046	0.69	26452	-0.045	0.688
Slope	85400	7.822	6.149	27230	8.536	6.595
Elevation	85400	803.996	305.47	27230	851.096	359.956
Ceasefire	85400	0.229	0.42	27230	0.229	0.42
Syrian War	85400	0.257	0.437	27230	0.257	0.437
Area	85400	24.583	2.224	27230	94.013	17.527
Border	85400	0.028	0.165	27230	0.075	0.263

This table provides summary statistics for all variables at both the 10km and 5km grid cell level.

V Empirical Analysis

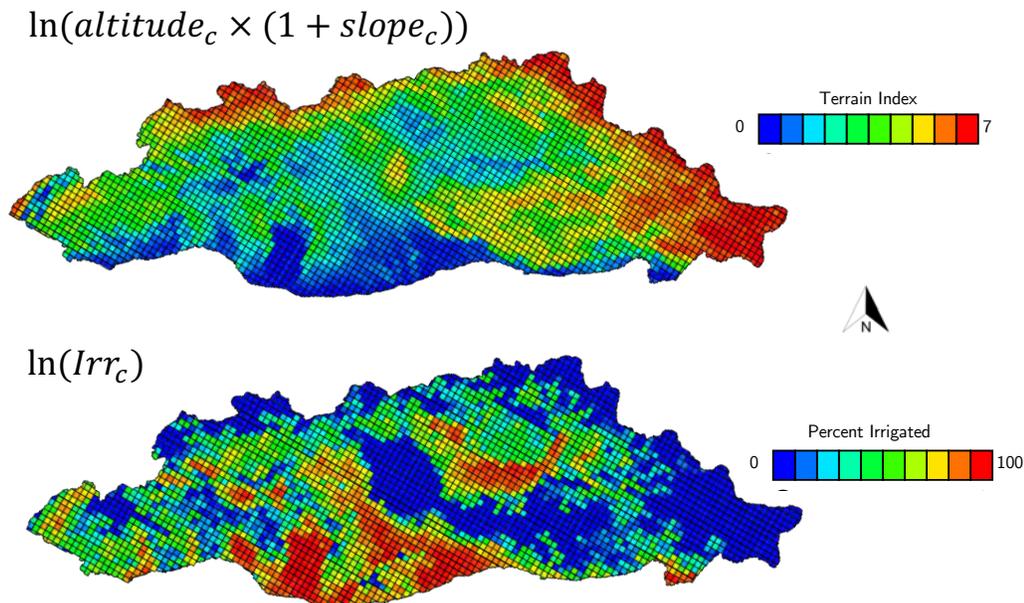
V.a Cross-Sectional Instrumental Variables Approach

Exploiting exogenous topographic variation in the placement of irrigation schemes, this section examines the cross-sectional relationship between irrigation and conflict in Southeastern Anatolia. Employing a spatially autoregressive instrumental variables approach conducted at the level of 5km grid-cells, I show a persistent negative relationship between a cell’s irrigated area and the likelihood of conflict incidence.

Using conflict incidence data from the Armed Conflict Location and Event Dataset spanning from 2016 to 2019, I first estimate a cross-sectional instrumental variables model at the level of 5km by 5km grid-cells. Similar to Duflo and Pande (2007), who use river gradients as an instrument to assess the impact of dam construction on poverty in India, I exploit

exogenous geographic variation in the placement of irrigation schemes.

Figure 6: Topography and Irrigation



The top panel shows topographical variation in the study area using 5km grid cells. Low values in this Terrain Index denote areas that are relatively low and flat, while high values indicate areas that are high and steep. The bottom panel shows the distribution of irrigated cropland, which closely matches the distribution of low, flat terrain.

Identification relies on two geographic constraints faced by gravity-fed irrigation schemes: land must be relatively low—below the altitude of distributary dams— and relatively flat to avoid runoff. Identifying irrigation schemes purely on the basis of elevation is complicated by the fact that dams in the region are built at different elevations. Similarly, the presence of flat high pastures prevents the precise identification of irrigation using only slope data. As such, the instrument used herein is defined as the log product of elevation and slope. The interaction of these terms highlights areas that are both relatively low and flat. Figure 6 compares the spatial distribution of the terrain instrument and the irrigation variable at the level of 5km grid-cells, showing a high degree of similarity. Equation (1) below specifies the general two stage instrumental variables strategy:

$$\begin{aligned}
Irr_i &= \gamma_0 + \gamma_1 Z_i + \gamma_2 X_i + \epsilon \\
Y_i &= \beta_0 + \pi_1 \overline{Irr}_i + \beta_1 X_i + u
\end{aligned}
\tag{1}$$

Where Irr_i is an endogenous variable denoting the log area under irrigation in grid cell i , Z_i is the terrain instrument, X_i is a matrix of covariates, and Y_i is the dependent variable denoting conflict incidence.

The exclusion restriction assumes that topography only affects conflict by determining geographic eligibility for irrigation. This is likely violated in the full sample: many PKK training camps and bases are located in mountainous regions that are inaccessible to Turkish ground forces (Olson, 1997). As such, there is likely to be a positive relationship between topography and conflict incidence for reasons unrelated to irrigation. However, this is only true for extremely rugged areas, as the strategic benefit of placing bases in the mountains is only incurred if the terrain effectively precludes vehicular access meaning that the exclusion restriction plausibly holds for non-mountainous areas. Mountains are clearly identifiable in right tail of the elevation histogram of Southeastern Anatolia presented in Figure B2. The solid line represents an altitude cutoff at 1200 meters that excludes mountainous grid-cells. The dotted line shows a more aggressive altitude cutoff at 1000 meters that even begins to exclude agricultural land.

Equation (1) is estimated as a two-stage probit model in columns 1-3 of Table 2, and as a linear probability model via 2SLS in columns 4-6. Columns 1 and 4 use the full sample, columns 2 and 5 restrict the sample to observations below 1200 meters, and columns 3 and 6 further restrict the elevation cutoff to 1000 meters. Table 2 indicates a consistent negative relationship between irrigation and conflict incidence in the 2016-2019 period. This effect persists across model specifications and geographic restrictions. The magnitude, direction, and significance of the coefficients is not substantively different between the probit model and the linear probability model. The Kleibergen-Paap F statistic is 1697 for the full sample

Table 2: Irrigation and Conflict Incidence, Cross-Sectional IV Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Probit	Probit	Probit	2SLS	2SLS	2SLS
Log Irrigated Area	-0.335*** (0.0410)	-0.293*** (0.0447)	-0.268*** (0.0500)	-0.0511*** (0.00720)	-0.0410*** (0.00696)	-0.0373*** (0.00769)
Population	0.136*** (0.0477)	0.153*** (0.0526)	0.209*** (0.0578)	0.0256*** (0.00775)	0.0257*** (0.00777)	0.0322*** (0.00799)
AKP voteshare	-1.271*** (0.306)	-1.526*** (0.331)	-1.092*** (0.384)	-0.185*** (0.0477)	-0.207*** (0.0506)	-0.132*** (0.0484)
HDP voteshare	0.490 (0.465)	0.278 (0.498)	0.902 (0.562)	0.0516 (0.0697)	0.00934 (0.0721)	0.0960 (0.0699)
Tribal	-0.0266 (0.576)	0.175 (0.634)	-0.231 (0.735)	0.122** (0.0580)	0.137** (0.0603)	0.0898 (0.0618)
Nightlights Change	-0.0617*** (0.0233)	-0.0632*** (0.0243)	-0.0573** (0.0231)	-0.0174*** (0.00437)	-0.0183*** (0.00431)	-0.0179*** (0.00424)
Nightlights	0.0697*** (0.0176)	0.0665*** (0.0185)	0.0592*** (0.0174)	0.0203*** (0.00321)	0.0202*** (0.00318)	0.0195*** (0.00311)
Roads	0.157*** (0.0463)	0.217*** (0.0669)	0.202*** (0.0694)	0.0132*** (0.00320)	0.0196*** (0.00542)	0.0189*** (0.00581)
SPEI	2.698 (4.834)	-1.222 (5.402)	-5.205 (6.239)	0.396 (0.653)	-0.0959 (0.720)	-0.481 (0.802)
Area	0.0465** (0.0227)	0.0328 (0.0257)	0.0313 (0.0277)	0.00481** (0.00195)	0.00489* (0.00275)	0.00508 (0.00321)
Previous Clashes	0.00375** (0.00184)	0.00337* (0.00179)	0.00234 (0.00163)	0.00155* (0.000839)	0.00131 (0.000818)	0.000911 (0.000783)
Border	0.707** (0.280)	0.709** (0.294)	0.694** (0.311)	0.0690 (0.0441)	0.0782 (0.0502)	0.0805 (0.0537)
Observations	2,440	2,223	1,965	2,440	2,223	1,965
Geographic restriction	Re- None	<1200	<1000	None	<1200	<1000

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

This table reports IV estimates of the effect of irrigation on PKK recruitment at the level of 5km by 5km grid cells, with robust standard errors displayed in parentheses. Equation (1) is estimated as a two-stage probit model in columns 1-3 of Table 2, and as a linear probability model via 2SLS in columns 4-6. Columns 1 and 4 use the full sample, columns 2 and 5 restrict the sample to observations below 1200 meters, and columns 3 and 6 further restrict the elevation cutoff to 1000 meters. The Kleibergen-Paap F statistic is 1697 for the full sample and 1743 for the maximum geographic restriction.

and 1743 for the maximum geographic restriction, suggesting that the instrument is not weak.

However, due to the 5km resolution of the grid, spatial autocorrelation must be accounted for. The structure of spatial dependence is modeled using a spatial weighting matrix W . The benchmark W is a binary contiguity matrix which assigns a value of 1 to the eight cells directly bordering the cell of interest, and 0 to all others. The spatial lag of a variable X

for cell c is denoted as $X_c \times W$ and is equal to the average value of X in the eight cells neighbouring c . For robustness, a spatial weighting matrix denoting the inverse distance from cell c is also used. Figure B3 shows the effect of spatially lagging the irrigation variable using contiguity and inverse-distance weighting matrices. The contiguity matrix models spillovers in the direct vicinity of irrigation schemes, while the inverse distance matrix allows for gradually attenuating spatial dependence across the entire study region. Equation (2) augments the instrumental variables model by adding three spatially autoregressive terms:

$$\begin{aligned}
 Y_i &= \beta_0 + \pi_1 \overline{Irr}_i + \beta_1 X_i + \theta_1 W X_i + \lambda_1 W Y_i + u \\
 u &= \rho W u + \epsilon
 \end{aligned}
 \tag{2}$$

$W Y_i$ is a spatial lag of the dependent variable, $W X_i$ is a spatial lag of the independent variables, and u is a spatially autoregressive error term. The result is a Spatially Autoregressive Instrumental Variables (SAR-IV) model.

Columns 1-4 in Table 3 report the results of equation (2) where W is a binary contiguity spatial weights matrix, while columns 5-8 use an inverse distance matrix. All columns employ the most extreme geographic restriction (<1000 meters). The dependent variable in columns 1 and 5 is general conflict incidence. Subsequent columns disaggregate conflict into its components: the incidence of PKK attacks (columns 2 and 6), military raids (columns 3 and 7), and protest incidence (columns 4 and 8). The same set of time invariant cell-level control variables used in the panel models is included but values are calculated at the 5km level. Two additional control variables are specified: historical water stress is measured as the cell-level mean of the rainfall variable, and temporal persistence of conflict is accounted for by taking the sum of pre-2000 clashes using the UCDP conflict data.

Table 3: Irrigation and Conflict Incidence by Type, Spatially Autoregressive IV Estimates

	W= Binary Contiguity Matrix				W= Inverse Distance Matrix			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Conflict	PKK Attacks	Military Raids	Protests	All Conflict	PKK Attacks	Military Raids	Protests
Log Irrigated Area	-0.0134** (0.00549)	-0.00646* (0.00362)	-0.0132*** (0.00452)	-0.00349 (0.00352)	-0.0192** (0.00774)	-0.0180*** (0.00601)	-0.0199*** (0.00612)	-0.00563 (0.00391)
Y x W	0.497*** (0.162)	0.372** (0.157)	0.466** (0.195)	0.145 (0.177)	1.605 (1.178)	-3.066 (2.085)	0.976 (1.162)	3.480*** (1.316)
Population	0.0453*** (0.00898)	0.0306*** (0.00681)	0.0349*** (0.00791)	0.0216*** (0.00590)	0.0400*** (0.00818)	0.0298*** (0.00629)	0.0312*** (0.00709)	0.0207*** (0.00556)
AKP voteshare	-0.0514 (0.0588)	0.0350 (0.0371)	-0.0823 (0.0526)	0.0336 (0.0248)	-0.0872 (0.0542)	0.0195 (0.0353)	-0.113** (0.0471)	0.0120 (0.0237)
HDP voteshare	0.121 (0.116)	0.121* (0.0660)	0.0908 (0.110)	0.0840* (0.0510)	0.0717 (0.110)	0.0539 (0.0636)	0.0367 (0.0993)	0.0255 (0.0483)
Tribal	0.0186 (0.0691)	-0.0525 (0.0418)	0.0724 (0.0568)	-0.0303 (0.0401)	0.0328 (0.0729)	-0.0571 (0.0451)	0.0869 (0.0606)	-0.0489 (0.0425)
Nightlights Change	-0.0247*** (0.00382)	-0.0256*** (0.00363)	-0.0263*** (0.00364)	-0.0268*** (0.00290)	-0.0198*** (0.00380)	-0.0221*** (0.00346)	-0.0224*** (0.00360)	-0.0240*** (0.00304)
Nightlights	0.0307*** (0.00297)	0.0289*** (0.00290)	0.0279*** (0.00299)	0.0300*** (0.00260)	0.0241*** (0.00268)	0.0240*** (0.00249)	0.0234*** (0.00268)	0.0250*** (0.00238)
Roads	0.0224*** (0.00613)	0.0152*** (0.00458)	0.0134*** (0.00495)	0.0134*** (0.00388)	0.0218*** (0.00644)	0.0128*** (0.00463)	0.0127** (0.00503)	0.00894*** (0.00336)
SPEI	6.753*** (2.195)	5.313*** (1.678)	5.849*** (1.827)	2.135 (1.344)	6.605*** (2.186)	6.853*** (1.913)	4.463*** (1.418)	2.344** (1.191)
Area	0.00851** (0.00356)	0.00529* (0.00274)	0.00527* (0.00317)	0.00347 (0.00251)	0.00573* (0.00330)	0.00311 (0.00257)	0.00334 (0.00298)	0.000598 (0.00236)
Previous Clashes	0.000663 (0.000561)	0.00101 (0.000752)	0.000851 (0.000671)	0.000906 (0.000697)	0.000808 (0.000602)	0.00103 (0.000777)	0.000970 (0.000699)	0.00105 (0.000766)
Border	0.0284 (0.0577)	0.00257 (0.0424)	0.0220 (0.0473)	-0.000650 (0.0379)	0.0527 (0.0552)	0.0261 (0.0399)	0.0213 (0.0433)	0.0125 (0.0345)
Observations	1,965	1,965	1,965	1,965	1,965	1,965	1,965	1,965
Geographic Restriction	<1000m	<1000m	<1000m	<1000m	<1000m	<1000m	<1000m	<1000m

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

This table reports spatially autoregressive IV estimates of the effect of irrigation on PKK recruitment at the level of 5km by 5km grid cells, with robust standard errors displayed in parentheses. Columns 1-4 report the results of equation (2) where W is a binary contiguity spatial weighting matrix. Columns 5-8 use an inverse distance matrix. All columns employ the most extreme geographic restriction (<1000 meters). The dependent variable is general conflict incidence in columns 1 and 5, PKK attacks in columns 2 and 6, military raids in columns 3 and 7, and protest incidence in columns 4 and 8. The same set of time invariant cell-level control variables used in the panel models is included but values are calculated at the 5km level.

The results are instructive. Table 3 displays a consistent negative relationship between irrigation and conflict incidence regardless of whether spatial dependence is assumed to be confined to neighbouring cells, or to decrease linearly with distance. Though the overall effect of irrigation across all types of violent conflict is negative, there is heterogeneity in the strength and significance thereof.

Columns 1 and 4 indicate that irrigation strongly decreases the likelihood of experiencing a conflict event. Column 1 indicates that a fully irrigated 25 km² grid-cell is 58% less likely than the average cell to experience a conflict event involving Kurdish rebels during the 2016-2019 period. Disaggregating conflict shows that this effect is primarily driven by a negative relationship between irrigation and military raids. These “counter-terror operations” are typically carried out in villages that are believed to be materially supporting the PKK by harboring militants, serving as weapons caches, or producing improvised explosive devices. Columns 2 and 5 suggest that the relationship between irrigation and the likelihood of experiencing a PKK attack is much weaker.

The locations of military raids are a better proxy for popular support of the Kurdish insurgency than the locations of PKK attacks; the safehouses and weapons caches targeted by these raids are unlikely to be placed in villages where guerillas do not feel they have the trust of the local population. The link between popular support for the PKK and the latter’s choice of targets is less clear. On the one hand, opportunistic attacks against local security forces or police officers would likely be higher in areas with more militants. On the other hand, rebels probably do not carry out offensive attacks against the villages that support them—if anything, the opposite is likely to be true. Indeed, column 7 shows that military raids are less likely to occur in areas that consistently vote for the ruling AKP, while column 8 shows an insignificant but positive relationship between AKP vote share and the likelihood of experiencing a PKK attack. Thus, if irrigation erodes popular support for the PKK, this would be most visible through the former’s effect on military raids. To illustrate this point, Table B1 contrasts the qualitative descriptions of sample PKK attacks and military raids

drawn from the ACLED dataset.

The coefficients of the control variables further contextualize these results. There are strong indications that the resurgence of conflict in the lowlands of Southeastern Anatolia is largely taking place in inhabited areas rather than isolated hideouts and bases. Population, nighttime luminosity, and road cover are positively correlated with all types of conflict across all models. However, despite the strong positive relationship between overall luminosity and conflict, areas that experienced the greatest growth in nightlights are significantly less likely to experience conflict of any kind. Nightlights growth is strongest in rural villages that have received electricity for the first time (much of which is derived from hydropower), peri-urban areas on the outskirts of growing cities, and areas that have received substantial infrastructural investments such as roads and highways. This trend provides further contextual evidence that areas that have benefitted most from state-led development policies display lower levels of anti-government militancy. The fact that irrigation remains significant despite controlling for general economic development suggests that the latter's influence on conflict is not purely economic. It also further rules out omitted variable bias related to the potential endogeneity of infrastructural investments by accounting for uneven development across the region.

Conflict continues to display spatial and temporal dependence. The number of violent clashes experienced by a grid cell before the first ceasefire in 2000 is a consistently strong predictor of conflict in the current period. The spatially lagged dependent variable provides an insight into the nature of conflict spillovers in the region. Columns 1-3 indicate that the likelihood of experiencing conflict in a given cell is substantially increased if any of the neighbouring cells have experienced a conflict event. This is true for all types of conflict. When an inverse distance matrix is employed *WY* becomes insignificant, suggesting that conflict spillovers are highly localized.

To summarize, exploiting exogenous geographic variation in the placement of irrigation schemes, this section finds that the resurgence of violence in Southeastern Anatolia between

2016 and 2019 is systematically lower in irrigated areas. This effect is robust to the inclusion of a wide array of control variables, aggressive geographic restrictions, and the inclusion of contiguous and inverse distance spatial spillover effects. Irrigation most strongly affects the likelihood of experiencing a military raid, which, in turn, acts as a proxy for popular support of the PKK; this is because raids are typically carried out against villages that are believed to be materially supporting the rebels.

V.b Dynamic Spatial Panel Models

I next examine the longitudinal relationship between irrigation and Kurdish separatist conflict in Southeastern Turkey, using two sets of panel models. The first is estimated via OLS with standard errors corrected for spatial and serial correlation (Hsiang, 2010), and the second is a spatial Durbin model. The guiding question in this instance is whether separatism decreases in a given area following the introduction of irrigation. Analysis is conducted at the level of 10km by 10km grid cells. At higher resolutions, conflict events become too rare to be estimated consistently in the panel models. Conversely, decreasing the resolution of the cells hampers the precise delineation between irrigated and non-irrigated areas. The main dependent variable is a binary indicator of PKK-involved conflict incidence derived from the UCDP dataset. The primary explanatory variable is a binary measure indicating the onset of irrigation.

For a panel of N cells and t years, Irr denotes the irrigation variable, X a vector of time-invariant controls, and L a vector of time-varying controls. Fixed effects for year and district are represented by γ and μ , respectively, and a linear time trend is denoted by τ :

$$Y_{c,i,t} = \beta_0 + \beta_1 Irr_{c,t} + \beta_2 X_c + \beta_3 L_t + \gamma_t + \mu_i \tau_c + \epsilon_{c,i,t} \quad (3)$$

A linear probability model is estimated via OLS, using panel-adjusted Conley (1999) standard errors developed by Hsiang (2010), thereby accounting for both spatial and serial

correlation.

Duflo and Pande (2007: 3) outline several concerns related to the endogeneity of infrastructural investments, specifically related to dam construction and irrigation. Key among these is the fact that the provinces that are chosen for dam construction projects are often targeted for political and economic reasons including potential agricultural productivity or the political clout of local governments.

As such, all analysis is restricted to observations within the nine provinces that were selected for the Southeastern Anatolia Project. While the selection of these provinces was very likely endogenous, the first stage IV results from the previous section suggest that the distribution of gravity-fed irrigation schemes within this area was largely determined by topographical factors. The use of a 10km grid further allays these concerns; though it is plausible that even the districts within these nine provinces were also endogenously selected for treatment, the feasibility of such targeting (both administratively and practically) at the level of 10km grid cells is low. Nevertheless, the benchmark specification excludes all grid-cells that never receive irrigation. As such, only cells that eventually become irrigated but have yet to receive irrigation are treated as counterfactuals for irrigated cells.

Several complexities in the dynamics of conflict remain to be accounted for. Harari and La Ferrara (2019) note that the spatial dependence of conflict can be disaggregated into two main categories: autocorrelation in conflict determinants, and direct spillovers from fighting into neighbouring areas. Furthermore, they expect conflict to exhibit strong serial correlation.

To model spatial and temporal dependence, a dynamic, spatially autoregressive Durbin model (SDM) is estimated using maximum likelihood.

$$\begin{aligned}
 Y_{c,i,t} = & \beta_0 + \beta_1 Irr_{c,t} + \beta_2 X_c + \beta_3 L_t + Y_{c,i,t-1} \\
 & + \rho W + \theta_1 Irr_{c,t} \times W + \theta_2 X_c \times w + \beta_3 L_t + \gamma_t + \mu_i \tau_c + \epsilon_{c,i,t}
 \end{aligned}
 \tag{4}$$

The temporal persistence of conflict is integrated into the model with the addition of a one-year lag of the dependent variable. The addition of spatially lagged independent variables accounts for autocorrelation in conflict determinants, while the spatial lag of the dependent variable captures variation in conflict incidence owing to direct contagion.

The selection of fixed effects is informed by the inclusion of a comprehensive array of time-invariant cell-level characteristics including elevation, slope, distance to the border, population, nighttime lights, historical party vote shares, tribal control, and road cover. Combined with the already narrow geographic focus of the study area, these variables either directly or indirectly control for many of the innate political, economic, ethnic, and geographic differences between cells. As such, the main threat posed by omitted variables relates to time-varying trends in the political and economic history of the region. These include elections at all levels, which likely affected the intensity of the government's approach to both infrastructural investment and Kurdish separatism. Year fixed effects control for national-level shocks. Year and district-year fixed effects control for national- and local-level shocks, respectively. Another is forced displacement: many areas experienced long-term outmigration as a result of climate shocks, conflict, or poverty. District- and cell-level linear time trends control for these unobserved phenomena.

Table 4 reports the results from equations 3 and 4. Columns 1 and 2 employ the full sample of observations, while columns 3 and 4 restrict the sample to only include areas that receive irrigation at some point during the study period. Columns 1 and 3 are estimated using a panel OLS model with standard errors corrected for serial and spatial autocorrelation (Hsiang, 2010). Results in columns 2 and 4 correspond to spatial Durbin Models estimated via Maximum Likelihood, using a binary contiguity spatial weighting matrix.

As the results show, there is a strong negative relationship between the onset of irrigation and the likelihood of experiencing conflict in a given cell-year across all models. Results derived from the full sample of observations suggest that the introduction of irrigation reduces conflict likelihood by between 1.2% and 1.9%. Though this effect may appear small, it

Table 4: Irrigation and Conflict Incidence, Spatial Panel Models

	(1)	(2)	(3)	(4)
	OLS HAC I	Durbin I	OLS HAC II	Durbin II
Post Irrigation	-0.0193*** (0.00675)	-0.0124*** (0.00445)	-0.0189*** (0.00666)	-0.0224*** (0.00428)
Treatment Group	-0.00144 (0.00955)	0.00150 (0.00487)		
Y_{t-1}		0.407*** (0.0199)		0.249*** (0.0461)
Population	0.0376*** (0.00814)	0.0133*** (0.00274)	0.00359 (0.0105)	0.000133 (0.00330)
AKP voteshare	0.0148 (0.0425)	-0.0278** (0.0137)	-0.0299 (0.0435)	-0.00312 (0.0155)
HDP voteshare	0.289*** (0.0553)	0.0167 (0.0255)	-0.0558 (0.0689)	0.0746* (0.0395)
Tribal	-0.0456 (0.0547)	-0.0398** (0.0198)	0.0860 (0.0595)	0.0973*** (0.0337)
Nightlights Change	0.00125 (0.00546)	0.00178 (0.00136)	0.00412 (0.0127)	0.00166 (0.00600)
Nightlights	0.00332 (0.00338)	0.00157* (0.000827)	0.0115 (0.00799)	0.00696* (0.00399)
Roads	0.0144*** (0.00454)	0.0102*** (0.00143)	-0.00694 (0.00636)	-0.00495 (0.00320)
SPEI	0.00699 (0.00648)	-0.00664 (0.0156)	0.00419 (0.00999)	0.0208* (0.0117)
Slope	0.00535*** (0.00123)	-0.00151** (0.000593)	0.00328 (0.00402)	0.00154 (0.00169)
Elevation	1.32e-05 (2.52e-05)	3.05e-05*** (1.16e-05)	0.000100** (4.50e-05)	4.33e-05 (3.95e-05)
Cell Area	0.000486* (0.000254)	-5.59e-05 (7.46e-05)	-0.000216 (0.000355)	-0.000110 (9.10e-05)
Ceasefire	-0.212*** (0.0308)	-0.0740*** (0.0197)	0.00154 (0.0154)	-0.0128 (0.0120)
Syrian War	0.270*** (0.0418)	0.0472 (0.0306)	0.00482 (0.0123)	0.0244 (0.0177)
Border	0.00409 (0.0192)	-0.0172** (0.00686)	-0.0231 (0.0206)	-0.0167*** (0.00618)
Observations	23,340	22,562	6,510	6,293
Year FE	X	X	X	X
Cell Specific Time Trend	X		X	
District Specific Time Trend		X		X
Only Treated Cells			X	X

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

This table reports estimates of the effect of irrigation on PKK recruitment from spatial panel models at the level of 10km by 10km grid cells, with robust standard errors displayed in parentheses. Columns 1 and 2 employ the full sample of observations, while columns 3 and 4 restrict the sample to only include areas that receive irrigation at some point during the study period. Columns 1 and 3 are estimated using a panel OLS model with standard errors corrected for serial and spatial autocorrelation (Hsiang, 2010). Columns 2 and 4 are spatial Durbin Models estimated via Maximum Likelihood, using a binary contiguity spatial weighting matrix. All specifications include year fixed effects. Columns 1 and 3 include a cell fixed effect interacted with a linear time trend. Columns 2 and 4 include a district fixed effect interacted with a linear time trend.

corresponds to between 37% and 58% of the unconditional mean of the dependent variable. However, results derived from the full sample are potentially driven by endogeneity in the selection of irrigation schemes. This is partially mitigated through the inclusion of a fixed effect for the “treatment” group which denotes that a cell received irrigation at some point during the study period, accounting for innate differences between areas that were selected for irrigation and areas that were not. For added robustness, columns 3 and 4 omit all cells that never receive irrigation. The negative effect of irrigation on conflict incidence not only survives the sample restriction, it is slightly strengthened.

Results are also robust to the inclusion of a detailed array of control variables, fixed effects, and model specifications. The dynamic spatial Durbin models include a one year lag of the dependent variable, which shows that conflict in the previous year significantly increases the likelihood of experiencing conflict in the following year. Restricting the sample to only include irrigated areas does not substantially affect the association between irrigation and conflict, the coefficients of several control variables are affected. Covariates associated with urban land cover are particularly affected; in the full sample, there is a strong positive association between conflict and both population and road cover. When the sample is restricted to irrigated cells, both of these relationships become insignificant. This likely results from the omission of most large cities in columns 3 and 4. Interestingly, the ceasefire variable follows the same pattern, suggesting that the 2001-2013 truce saw a decrease in urban clashes, but not in rural fighting. Finally, restricting the sample to irrigated areas has a strong effect on the association between conflict and tribal voting behaviour. In the full sample Durbin model (column 2) there is a significant negative relationship between the two, while in the restricted sample Durbin model (column 4), a strong positive relationship emerges. This result is explored in detail in section VII.

Results from the panel models are robust to a number of alternative specifications of both the dependent and independent variables. This section explores various modifications of the benchmark model presented in column 4 of Table 4 above. This baseline specification is a

spatial Durbin model restricted to irrigated areas, employing a binary contiguity weighting matrix, year fixed effects and a district-level linear time trend, a full set of covariates, and a one-year lag of the dependent variable. Table B3 reports the results of these alternative specifications.

Alternative measure of conflict. The dependent variable in columns 1 and 2 is the UCDP conflict incidence measure. However, it is substituted in columns 3 and 4 for an obituary-derived measure of PKK recruitment developed by Tezcür (2016). This measure is also binary and denotes the year and location of an individual’s recruitment to the PKK. As previously explored, clashes (and particularly military raids) primarily take place in villages that are perceived to be materially supporting the PKK. Measuring recruitment is a more direct way of assessing an area’s support for the PKK, though there are potential biases posed by the fact that the measure is derived from PKK-reported obituaries.

Alternative measures of irrigation. Instead of the binary irrigation onset variable, two additional measures of irrigation are employed. Columns 2 and 4 use irrigated area as the treatment variable, which represents the number of square kilometers of the grid cell under irrigation in a given year. Figure 3 shows that irrigated area varies both cross-sectionally, as some grid cells become more irrigated than others, and longitudinally as irrigation is phased in over time. Both of these sources of variation allow for an examination of whether treatment intensity affects conflict.

The effect of irrigated area on conflict incidence is reported in column 2. In 2019, the average irrigated grid cell contained 27 km² of irrigated cropland, representing roughly a quarter of its total area. Though the marginal effect of each additional square kilometer of irrigated cropland on the likelihood of conflict incidence is small, the cumulative effect is considerable. A 27 km² increase in irrigated area leads to a 0.91% decrease in the likelihood of conflict incidence. Given that the average likelihood of experiencing a conflict event in a given cell-year is 1.8%, this effect is equivalent to nearly 50% of the unconditional mean of the dependent variable. In other words, receiving the average quantity of irrigation over the

whole study period decreases the likelihood of experiencing a conflict event by roughly half.

Column 4 reports the effect of irrigated area on PKK recruitment, which yields similar results. A 27 km² increase in irrigated area leads to a 0.62% decrease in the likelihood of PKK recruitment, equivalent to 39% of the latter's unconditional mean. A cell in the top quartile of irrigated area (receiving 38 km² of irrigation over the whole period) would experience a 56% decrease in the relative likelihood of experiencing a recruitment event, and a 69% decrease in the likelihood of conflict incidence. These results suggest that greater treatment intensity leads to greater reductions in the likelihood of experiencing conflict and recruitment events.

The treatment variable in columns 1 and 3 is a measure of the number of years that have elapsed since the introduction of irrigation. Unlike irrigated area, this variable does not vary cross-sectionally and isolates longitudinal treatment intensity. Though there is a significant effect on both conflict incidence and recruitment, the effect on the latter is smaller. This might reflect the different time periods covered by each model; the recruitment data spans from 1985-2012, while the UCDP data covers 1989-2018.

These alternative specifications also shed light on the relationship between conflict and some of the covariates. There is a strong negative relationship between historical electoral support for the AKP and PKK recruitment, and a consistent positive relationship between HDP support and conflict incidence. Tribal voting behaviour is strongly correlated to both conflict incidence and PKK recruitment.

These results indicate a consistent negative relationship between irrigation and Kurdish separatism in Southeastern Turkey which is robust to the inclusion of a highly detailed array of control variables, fixed effects, time trends, and spatial and temporal dependence structures add further validity. This relationship persists whether irrigation is measured as a binary phenomenon with a before and after period, as the number of square kilometers under irrigation in a cell-year, or as the number of years since its onset. It also persists whether Kurdish separatism is measured as conflict incidence or PKK recruitment.

VI Mechanisms

Both cross-sectional and panel models indicate a persistent negative relationship between irrigation and conflict incidence in Southeastern Anatolia. This section examines the possible mechanisms underlying this relationship using mixed methods.

I first explore the relationship between irrigation, agricultural production, and conflict via district-level fixed-effect panel models. I find that irrigation allows crop yields to be independent from rainfall, and that there is a positive relationship between conflict and the cultivation of rainfall-sensitive wheat.

Next, I examine heterogeneity in the treatment effect related to tribalism. I find that irrigation actually increases the likelihood of conflict incidence in tribal areas due to violent competition between tribes over scarce irrigation water. The negative effect of irrigation on conflict not only persists, but is strengthened when accounting for heterogenous effects in tribal areas.

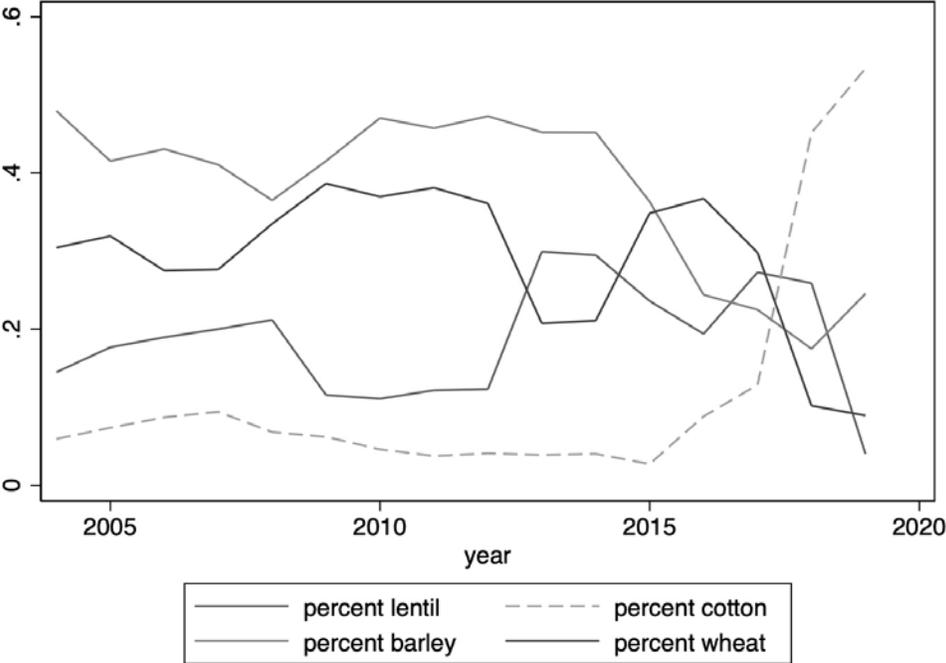
Finally, to generate a more detailed understanding of these mechanisms, I conduct two qualitative case studies that draw on original fieldwork, ethnographic evidence, and local news reports to examine two outliers in the relationship between irrigation and conflict, at the irrigation schemes in Batman and Suruç. These case studies are presented in the appendix to this chapter. The first finds that despite very strong anti-government sentiment in the urban center of Suruç, interviews with farmers in the surrounding area suggest a heightened sense of state legitimacy as a function of access to irrigation. The second explores the mechanics of violent competition over resources in a tribal area with high levels of irrigation.

VI.a Agricultural Income

The dominant mechanism linking agricultural income and conflict in the literature is the opportunity cost of rebellion (Collier and Hoeffler, 1998). Low agricultural income levels and negative income shocks decrease the opportunity cost of joining an insurgency (Blattman and

Miguel, 2010). Writing before the onset of large-scale irrigation, White (1998: 148) notes that “most of the economically active Kurds in the Kurdish region’s agricultural sector are very poor—often destitute—sharecroppers. In virtually none of these cases do these Kurds have adequate savings to insulate them from further adversity during harder economic times”. As such, the opportunity cost of joining the PKK is likely to be very low for rainfall-dependent farmers, and perhaps even negative in times of severe drought. Irrigation likely increases the opportunity cost of rebellion by generating two positive income effects: allowing farmers to grow higher value crops and insulating farmers from rainfall shocks. This section examines the relationship between irrigation, cropping patterns, and conflict in greater detail using district-level crop production data.

Figure 7: The Effect of Irrigation on the Crop Mix in Suruç

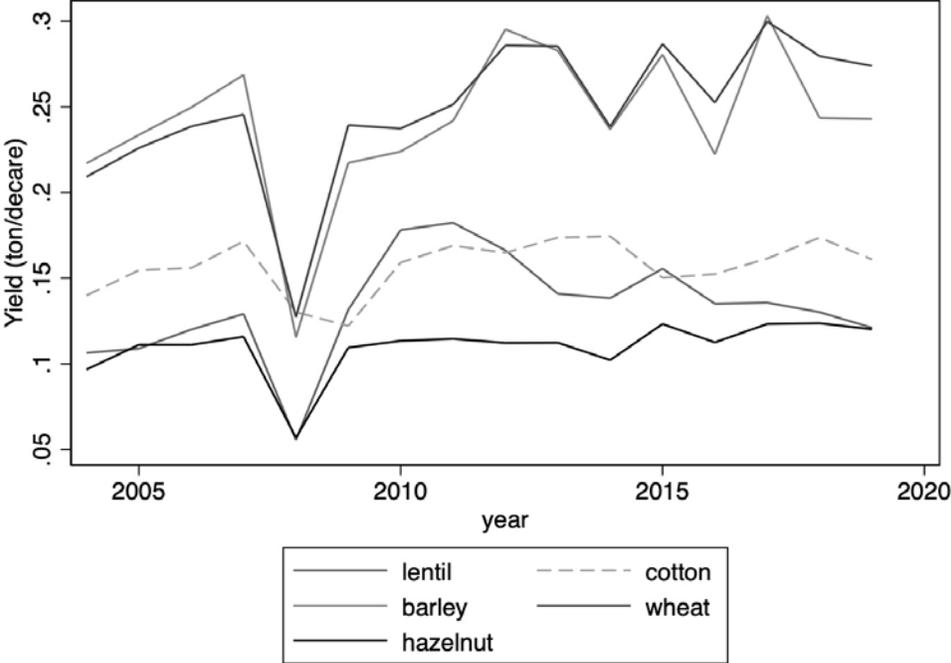


Prior to the introduction of irrigation in 2016, the dominant crop in Suruç was barley. Lentils and wheat were also grown interchangeably. Following the introduction of irrigation, the production for all three of these crops declines sharply, while production of cotton surges.

Figure 7 shows the composition of the crop mix of Southeastern Anatolia between 2004 and 2019. Five crops—wheat, barley, cotton, lentils, and hazelnuts—account for over 95% of

the cultivated land in the region. Wheat is by far the dominant crop, making up over half of the total sown area in most years. The introduction of irrigation is often followed by a drastic shift in the crop mix in favor of higher-value cotton. Figure 7 plots the relative proportions of crops grown in the district of Suruç over time. The primary crops were barley and wheat until the onset of irrigation in 2015, which led to a dramatic shift towards cotton production. In 2019, the price per kilogram of cotton (3.2 TL) was nearly triple that of barley and wheat (1.2 TL), despite relatively similar yields (TUIK, 2020). Thus, the transition to irrigated agriculture likely generates significant income gains through crop substitution.

Figure 8: Crop Yield Sensitivity to Rainfall Shocks



The yields for five major crops over time are shown above. In 2008, Southeastern Anatolia experienced a severe drought. Yields for all non-irrigated crops decline sharply. Cotton, which is almost exclusively irrigated, suffered a much smaller decline in yields.

Irrigation in Southeastern Anatolia also effectively insulates farmers from income shocks associated with rainfall deficits. In 2008, Southeastern Anatolia suffered a severe drought, with the average water balance 24% below the mean. The impact thereof on crop yields is visible in Figure 8. The yields for all crops other than cotton were between 54% and 61%

lower than average. Yet despite having the highest water requirement out of the main crops grown in the region, cotton saw the smallest decline in yields.

Table 5: Irrigation and Crop Yields at the District Level

	(1)	(4)	(2)	(3)	(5)
	Cotton Yield	Wheat Yield	Barley Yield	Lentil Yield	Hazelnut Yield
Irrigated Area	0.331*** (0.0665)	0.651*** (0.0972)	0.305** (0.143)	0.0775 (0.123)	0.0231 (0.160)
Water Balance	0.000878 (0.00598)	0.0637*** (0.0180)	0.0730*** (0.0259)	0.0236** (0.0115)	0.0299*** (0.0108)
Observations	926	974	974	955	946
Year FE	X	X	X	X	X
District FE	X	X	X	X	X

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

This table reports the results of district-level fixed effect panel models estimating the effect of rainfall and irrigation on crop yields in Southeastern Anatolia between 2004 and 2018. All specifications include district and year fixed effects.

To investigate this formally, I estimate district-level fixed effect panel models estimating the effect of rainfall and irrigation on crop yields in Southeastern Anatolia between 2004 and 2018. The results are reported in Table 5. There is a strong positive relationship between rainfall and yields for all crops except cotton, confirming the trend observable in Figure 8. Yields for barley, lentils, and hazelnuts are unaffected by the proportion of a district under irrigation. However, a 10% increase in district-level irrigation is associated with a 64kg/decare increase in wheat production and a 31kg/decare increase in cotton production. The fact that wheat is both highly sensitive to rainfall but also more productive in districts with irrigation suggests that the majority of wheat is rain-fed, but a small proportion thereof is irrigated. If the proportion of irrigated wheat were high, we would expect yields to be largely independent of rainfall, as is the case for cotton.

In Table 6 I examine the relationship between crop production statistics and conflict at the district level. The production statistics consist of a one-year lag of the yield and sown area of a given crop in a given district.

Table 6: Conflict Incidence and Lagged Crop Production

	(1) Clashes
Ceasefire	-0.284*** (0.0474)
Syrian War	0.122*** (0.0288)
Cotton Yield _{t-1}	0.236 (0.245)
Barley Yield _{t-1}	0.0171 (0.180)
Hazelnut Yield _{t-1}	0.449 (0.399)
Wheat Yield _{t-1}	-0.496** (0.235)
Lentil Yield _{t-1}	0.170 (0.289)
Cotton Sown Area _{t-1}	-0.000145 (0.000142)
Barley Sown Area _{t-1}	-6.82e-05 (9.39e-05)
Hazelnut Sown Area _{t-1}	-0.000112 (0.000472)
Wheat Sown Area _{t-1}	3.56e-05 (2.87e-05)
Lentil Sown Area _{t-1}	-0.000341** (0.000163)
Observations	10,745
R-squared	0.122
Year FE	X
District FE	X

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

This table reports the results of a district-level fixed effect panel model estimating the relationship between crop yields and conflict incidence in Southeastern Anatolia between 2004 and 2018. All specifications include district and year fixed effects.

There is a significant negative relationship between wheat yields and conflict incidence, suggesting that the risk of conflict is higher following a poor wheat harvest. There is also a significant positive relationship between the sown area of wheat and conflict incidence, suggesting that districts that are highly reliant on this rainfall-sensitive crop are also more conflict-prone. Both of these results are highly consistent with the mechanism that agricultural income shocks decrease the opportunity cost of rebellion. Though we might expect a negative relationship between yields and conflict for all rain-fed crops, the effect is only observable for wheat because it accounts for over 50% of the cultivated land in the region.

As previously mentioned, an important secondary effect of increasing agricultural incomes through a state-led development program involves reshaping rural populations' conception of the state, which has deep implications for insurgency. A qualitative case study in Appendix B provides a more extreme test of the capacity of irrigation to change individuals' perception of the government's legitimacy in the context of an active insurgency. In the villages across the Suruç Plain, 69 individuals joined the PKK before the introduction of irrigation. Only six joined after. Even though State Hydraulics Administration (DSİ) was largely responsible for a wave of crop failures in the summer of 2018, farmers promised to create a "monument" to the state if it resolved the water shortage. A PKK guerrilla visiting one of these villages to recruit new cadres might find their speech falling on deaf ears. However, these farmers who now effusively praise the state live and work on the outskirts of an urban center which has cultivated record numbers of PKK recruits, and where the mere presence of an AKP Member of Parliament led to deadly riots. When asked about the impact of the DSİ-induced crop failures, farmers mostly acknowledged temporary hardships, but largely dismissed them in reference to the memories of drought and famine in the time before the canals were dug. Keeping in mind the positive association between crop failures and violent conflict, it appears as though the material security afforded by this state project insulates farmers from the hardships and grievances that drive individuals to join the PKK.

In the context of extreme poverty, low savings rates, and widespread subsistence agri-

culture, the opportunity cost of joining the PKK is likely to be very low particularly during times of economic hardship. The relationship between conflict and agricultural production suggests that economic precarity plays a role in Kurdish separatism: clashes are more frequent in districts reliant on rain-sensitive wheat, particularly following a poor wheat harvest. The introduction of irrigation is often accompanied by a shift in production to higher value crops such as cotton, and the decoupling of crop yields from rainfall. In conjunction, these dynamics suggest that the effect of irrigation on agricultural production and income is an important mediating factor in the relationship between irrigation and Kurdish separatism.

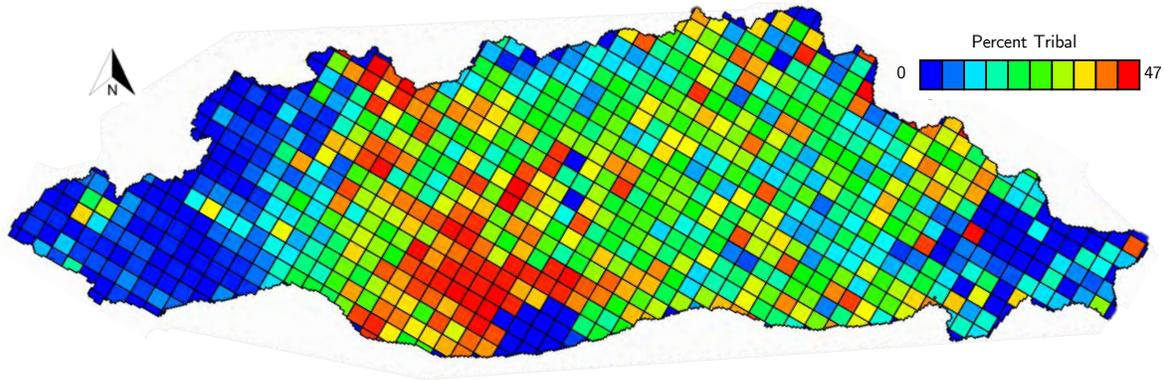
VI.b Tribal Treatment Heterogeneity

The previous section has identified the incomes generated by irrigation as one of the likely mechanisms linking irrigation and conflict. However, the distribution of these incomes is unlikely to be homogenous across the study area, particularly given the prevalence of tribal social structures which have been described as “feudal” (Aksit and Akcay, 1997). This section explores heterogeneity in the treatment effect related to tribal social structures.

The Turkish (and before it, Ottoman) government has relied on tribal chieftains to rule Southeastern Anatolia; these local elites were allowed to maintain power and collect rents from their territory on the condition that they align themselves with the government (Guida, 2014: 178). The most significant recent iteration of this phenomenon was the formation of the “Village Guard” [koy koruculugu] system in 1985, through which the government selectively armed loyalist tribes as a paramilitary force to fight the PKK (ibid). At the height of the conflict there were 95,000 village guards, equivalent to nearly half the number of total active military personnel in the entire Turkish Armed Forces (Oktem, 2014; TSK, 2014). The spatial distribution of ballot boxes displaying tribal bloc voting is shown in Figure 9.

Thus, an alternative explanation for the reduction in Kurdish separatism following the introduction of irrigation could be the government’s use of irrigation to co-opt tribal chieftains. A stronger treatment effect in tribal areas would support this mechanism. On the

Figure 9: The Spatial Distribution of Tribes in Southeastern Anatolia



The choropleth map above indicates the proportion of ballot boxes in a 10km cell displaying tribal bloc-voting behaviour.

other hand, a diminished treatment effect in tribal areas would strengthen the opportunity cost of rebellion mechanism; because the distribution of land in tribal areas is highly unequal, income gains associated with irrigation are unlikely to directly benefit farmers.

To explore treatment heterogeneity related to tribalism, the benchmark spatial Durbin Model (Table 4, column 4) is estimated with the addition of interactions between the irrigation variable and indicators of tribal voting behaviour. This allows the effect of irrigation on conflict to vary depending on whether it is introduced to land controlled by tribes AKP- or HDP-affiliated tribes. The results of these specifications are reported in Table 7. Column 1 adds an interaction between the treatment variable and the total proportion of ballot boxes displaying tribal bloc voting in a given grid-cell to the benchmark SDM. The coefficient on this interaction is both highly significant and positive, suggesting that conflict likelihood actually increases when irrigation is introduced into tribal areas. Columns 2 and 3 disaggregate the tribal indicator, isolating bloc voting for the AKP and HDP, thereby accounting

for the political alignment of tribes.

In columns 3 and 4, the total effect of irrigation on conflict incidence becomes positive. The irrigation variable remains negative and significant across all specifications, but the interaction term is positive and significant when AKP-aligned tribes are isolated in column 3. This trend persists in column 4 when both disaggregated interaction terms are included. In column 3, the onset of irrigation reduces the likelihood of conflict incidence by 4.4% in non-tribal areas. However, in areas where AKP-affiliated tribal control exceeds 46%, the effect of introducing irrigation becomes positive. This level of tribal control is rare—only 7% of cells in the sample are above this threshold. These counter-intuitive results highlight an important facet of the political economy of violence in Southeastern Anatolia: tribal competition over scarce resources.

The effect of selective government support and co-optation of Kurdish tribes, especially during the civil war, was the militarization of “blood feuds” [kan davalari] between tribes. Ozcan (2006: 5) notes that “the tribal phenomenon helps to explain the sense of disunity among Kurds, the absence of accord, and the pitilessness of internal clashes”. Akpolat (2009: 423) conducted fieldwork on one such feud which left 44 men, women, and children dead in (heavily irrigated) Mardin province, and found that the cause of these feuds is “the struggle over ownership of the primary means of production in this area: land, livestock, and water”. This struggle over the means of production occurs in what has been described as an “anarchic” environment, where the citizenry—particularly the paramilitary Village Guards—is more heavily armed than the Jandarma and the local police (Criss, 1995). Because irrigation schemes sometimes cover hundreds of thousands of hectares, they often encompass the territories of several tribes. Thus, when irrigation water is rotated from villages in one tribe’s territory to another, this too can become a potential site of conflict.

Local news reports have covered “blood feuds” over access to irrigation in Silvan, Sirnak, Sanliurfa, Kisehir and beyond (Hurriyet, 2007; Karar, 2019). Mahmut Tezcan (1981: 64), an anthropologist studying these feuds at Ankara University, provides a detailed account

Table 7: Tribal Treatment Heterogeneity

	(1)	(2)	(3)	(4)
	All Tribes	HDP Tribes	AKP Tribes	AKP and HDP Tribes
Post Irrigation	-0.0498*** (0.00920)	-0.0253*** (0.00533)	-0.0441*** (0.00792)	-0.0508*** (0.00977)
Post x Tribal	0.217*** (0.0500)			
Post x HDP Tribal		0.101 (0.0847)		0.161* (0.0896)
Post x AKP Tribal			0.0978*** (0.0222)	0.106*** (0.0241)
Y x W	0.245*** (0.0462)	0.249*** (0.0461)	0.245*** (0.0461)	0.245*** (0.0462)
Population	0.00167 (0.00336)	0.000321 (0.00325)	0.00129 (0.00336)	0.00170 (0.00333)
AKP voteshare	-0.0158 (0.0162)	0.00111 (0.0156)	-0.0188 (0.0164)	-0.0135 (0.0161)
HDP voteshare	0.0699* (0.0400)	0.0660 (0.0431)	0.0803** (0.0400)	0.0671 (0.0433)
Tribal	-0.0157 (0.0455)	0.0888** (0.0346)	0.00386 (0.0425)	-0.0178 (0.0463)
Nightlights Change	0.000868 (0.00598)	0.00188 (0.00600)	0.000776 (0.00599)	0.00104 (0.00598)
Nightlights	0.00739* (0.00398)	0.00685* (0.00398)	0.00744* (0.00398)	0.00731* (0.00397)
Roads	-0.00548* (0.00313)	-0.00503 (0.00322)	-0.00530* (0.00317)	-0.00546* (0.00315)
SPEI	0.0204* (0.0117)	0.0205* (0.0117)	0.0207* (0.0117)	0.0201* (0.0118)
Slope	0.00124 (0.00169)	0.00157 (0.00170)	0.00127 (0.00169)	0.00129 (0.00171)
Elevation	6.52e-05 (4.10e-05)	4.36e-05 (3.98e-05)	6.23e-05 (4.07e-05)	6.46e-05 (4.11e-05)
Ceasefire	-0.0117 (0.0119)	-0.0124 (0.0120)	-0.0120 (0.0119)	-0.0114 (0.0119)
Syrian War	0.0262 (0.0177)	0.0245 (0.0177)	0.0258 (0.0178)	0.0261 (0.0177)
Cell Area	-4.99e-05 (9.19e-05)	-0.000123 (9.47e-05)	-4.28e-05 (9.48e-05)	-5.78e-05 (9.53e-05)
Border	-0.0141** (0.00621)	-0.0169*** (0.00622)	-0.0141** (0.00623)	-0.0143** (0.00627)
Observations	6,293	6,293	6,293	6,293
Year FE	X	X	X	X
District Time Trend	X	X	X	X

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Results in this table represent modifications of the specification found in column 4 of Table 4. The dependent variable in all cases in the UCDDP-derived conflict incidence measure. Column 1 adds an interaction between the treatment variable and the total proportion of ballot boxes displaying tribal bloc voting in a given grid-cell. Columns 2 and 3 interact the treatment variable with a disaggregated tribal indicator, isolating bloc voting for the AKP and HDP respectively. Column 4 includes both interaction terms.

of an irrigation-induced blood feud in Kirsehir that decimated several generations from two clans:

“Cuhadar Gedik’s father used to fight with Necip Aslan about water. ‘You are going to irrigate now? No, I am going to irrigate now!’ and so on. They fight, and Cuhadar’s father shoots four of Necip’s relatives and a bystander. Then one of their fathers shoots back and injures him. He shoots the brother of the man whose father attacked him. Then his father shoots back. Cuhadar’s grandmother is hit in the crossfire and dies. [...] Cuhadar goes to some relatives who he saw shooting guns at a wedding in 1966 and borrows a gun. Then he goes to get coffee. Necip’s brother is also there. They fight and pull guns on each other. Mehmet Aslan gets shot in the arm. He dies a while afterwards. Cuhadar is 14 years old. He goes to jail for 19 years. While he is in jail, Cuhadar’s aunt is killed.”

This type of local cleavage between tribes resulting from competition over irrigation water was exploited by the government and turned into a new front in the battle against the PKK. One article in a national newspaper reads:

“In the village of Otlubayir in Agri province, Muhtar [village head] Vehbi Aksoy and his relatives began a feud with Nihat Aslan, a Village Guard, over the issue of irrigation water. Village Guard Aslan fired on the Muhtar and his relatives with an automatic Kalashnikov rifle. Muhtar Aksoy and his nephews Serkan, Sinan, Hakan, and Vahit were killed, and three others were injured”. (Hurriyet, 2010)

The Kalashnikov in question was given to Aslan by the government to aid in the fight against the PKK but it was used in a feud over irrigation water. The guerrillas also frequently get involved in these feuds, as they did in Şirnak, when a bus carrying 12 Village Guards to the construction site of an irrigation scheme was ambushed by the PKK, killing all passengers (CNN Turk, 2018).

A parliamentary inquiry into the Village Guard system found this to be a systematic phenomenon: “Several Village Guards have killed villagers with whom they have blood feuds based on the pretext that the latter are PKK supporters” (Belge, 2011: 107). Between 1985 and 1997, 17 village guards were prosecuted for participating in blood feuds (ibid). The militarization of these feuds was also perpetuated by the PKK itself—McDowall (2003: 421) notes that “Rather than assaulting the agha class as a whole, the PKK operated with fine calculation, exploiting blood feuds where these existed, helping to create them where they did not”.

The evidence above suggests that competition over access to irrigation can spark or intensify blood feuds that have abounded in the Southeast. Kalyvas (2003: 487) contends that “framing civil wars in binary terms is misleading” and that “local cleavages and intracommunity dynamics must be incorporated in theories of civil war”. The divisions between tribes that often lead to these feuds have been fostered by governments since the Ottoman era, with the most recent iteration of this policy involving the selective armament of pro-government tribes to fight the PKK through the Village Guard system. The result, as demonstrated, is that irrigation can actually intensify conflict where competition over resources overlaps with these historically reinforced divisions.

A qualitative case study in Appendix B focuses on conflict dynamics in the Batman-Silvan Irrigation Scheme, an area containing the two grid-cells in the sample that contain the highest levels of both irrigation and tribal presence. A combination of fieldwork interviews, prior ethnographic work, and local news reports details the processes through which the introduction of a lucrative economic resource in an area with pre-existing social and political cleavages can lead to violence. In this case, many of the economic benefits that were shown in the previous subsection to have a negative effect on conflict are siphoned off by tribal landlords. Furthermore, historical blood feuds between tribes intensified following the introduction of a scarce and valuable irrigation water, and these gradually became militarized as the government selectively armed tribes loyal to the government to act as a

vanguard against the PKK.

An increase in conflict resulting from the introduction of a new high-value resource aligns closely with the literature on rent-seeking and lootability in civil wars. Recently, Berman et. al. (2017) found that roughly a quarter of violence in Africa involved control over mining facilities, and that clashes increased when mineral prices were high. They motivate their study by analyzing a feud between two tribes in Darfur over control of a gold mine that left 800 dead. In the context of Southeastern Anatolia, tribal control mitigates the negative effect of irrigation on conflict. In areas with exceptionally high levels of AKP-affiliated tribal control, the introduction of irrigation appears to generate violent local competition over this new source of rents. This result further strengthens the opportunity cost mechanism discussed in the previous section as tribal areas tend to exhibit extreme land inequality, negating the positive income effect of irrigation for farmers.

VII Conclusion

This paper provides a highly detailed test of the dominant mechanism linking agricultural income and civil conflict. This has direct bearing on the large and ever-growing body of literature examining the relationship between rainfall, income, and civil war. A fully irrigated 25 km² grid-cell was found to be 58% less likely than the average cell to experience a conflict event involving Kurdish rebels during the 2016-2019 period. Between 1985 and 2019, a 27 km² increase in irrigated area decreased the likelihood of experiencing a conflict event in a 100 km² grid-cell in a given year decreased by 49% relative to the mean. Agricultural income is likely the mediating factor: conflict incidence is higher in districts reliant on rain-sensitive wheat, particularly following a bad harvest. Irrigation triggers a shift from rain-sensitive crops to cotton, which is both more lucrative and resistant to rainfall shortages. Accounting for heterogeneity in the relationship between irrigation and conflict related to unequal land tenure in tribal areas strengthens the negative effect of irrigation on Kurdish

separatism, providing further evidence for the opportunity cost mechanism. However, the onset of irrigation in tribal areas is associated with an increase in conflict due to militarized competition between tribes over irrigation-derived rents.

These findings have policy relevance both within and beyond Turkey. Strong serial dependence in conflict incidence, as well as the negative association between recruitment and irrigation, suggest that a military approach to the Kurdish insurgency is counterproductive. Instead, insulating farmers from climactic shocks and enhancing their livelihoods through irrigation appears to be more effective in quelling separatism. The extent to which this is true in other contexts is subject to several caveats. The PKK was established as a “peasant movement”, which recruited heavily in agricultural communities. There was direct ethnographic evidence that irrigation mediated Kurdish farmers’ affinity for either the Turkish state or the PKK (Harris, 2006; 2009; 2016). There was also evidence that the Turkish state explicitly expected GAP to reduce the appeal of the PKK (Wikileaks, 2008a; 2008b). Thus, climactic vulnerability, irrigation, and insurgent recruitment were directly linked in the political economy of Southeastern Anatolia, in ways that may not be true in other cases.

Further research is needed to establish the validity of the conclusions drawn herein in other contexts at a comparable level of spatial and temporal disaggregation. A more detailed empirical inquest into the concrete mechanics of the “opportunity cost of rebellion” mechanism would also be beneficial. For example, given that Dal Bó and Dal Bó (2004) propose that negative income shocks would have opposite effects in capital-intensive versus labor-intensive sectors, more work is needed to account for the fact that agriculture tends to become significantly more capital-intensive over time.

Appendix

Table B1: Qualitative Examples of Military Raids and PKK Attacks

	Military Raid	PKK Attack
Description	Weapons Seizure: In Lice town the Turkish military seized more than 10 tons of explosives during an anti-PKK operation. As reported on the 27th of June.	PKK killed a village chief outside the village of Bahcebasi on the night of the 26th May. The militants also burnt the car belonging to the victim.
Side A	Military Forces of Turkey (2002-2016)	PKK: Kurdistan Workers Party
Side B	PKK: Kurdistan Workers Party	Civilians (Turkey)
ACLED ID	3398	3196
Description	On August 11 one PKK militant was killed in Yumurcak village of Kiziltepe district Mardin when clashes occurred during a police operation on his home.	A car bomb exploded at around 7.30pm on May 25th at a gendarmerie miliary checkpoint in Anitli village in Midyat district of Mardin. The explosion killed one soldier and two village guards as well as the two PKK militants who detonated the bomb from inside the car.
Side A	Police Forces of Turkey (2016-)	PKK: Kurdistan Workers Party
Side B	PKK: Kurdistan Workers Party	Military Forces of Turkey (2002-2016), Gendarmerie
ACLED ID	5145	3180
	Property destruction: Between February 28 and March 2, Gendarmerie Forces destroyed 19 shelters belonging to PKK during the operations in the rural areas of Kursunlu village, Dicle district, Diyarbakir	PKK militants raided Baglica village in Artuklu district of Mardin on the 20th May and killed a village guard. Following the attack, military vehicles and ambulances rushed to the scene and eight soldiers were injured when PKK detonated explosives at the convoy. No medical personnel were reported to have been injured.
Side A	Military Forces of Turkey (2002-2016), Gendarmerie	PKK: Kurdistan Workers Party
Side B	PKK: Kurdistan Workers Party	Village Guards
ACLED ID	5515	3138

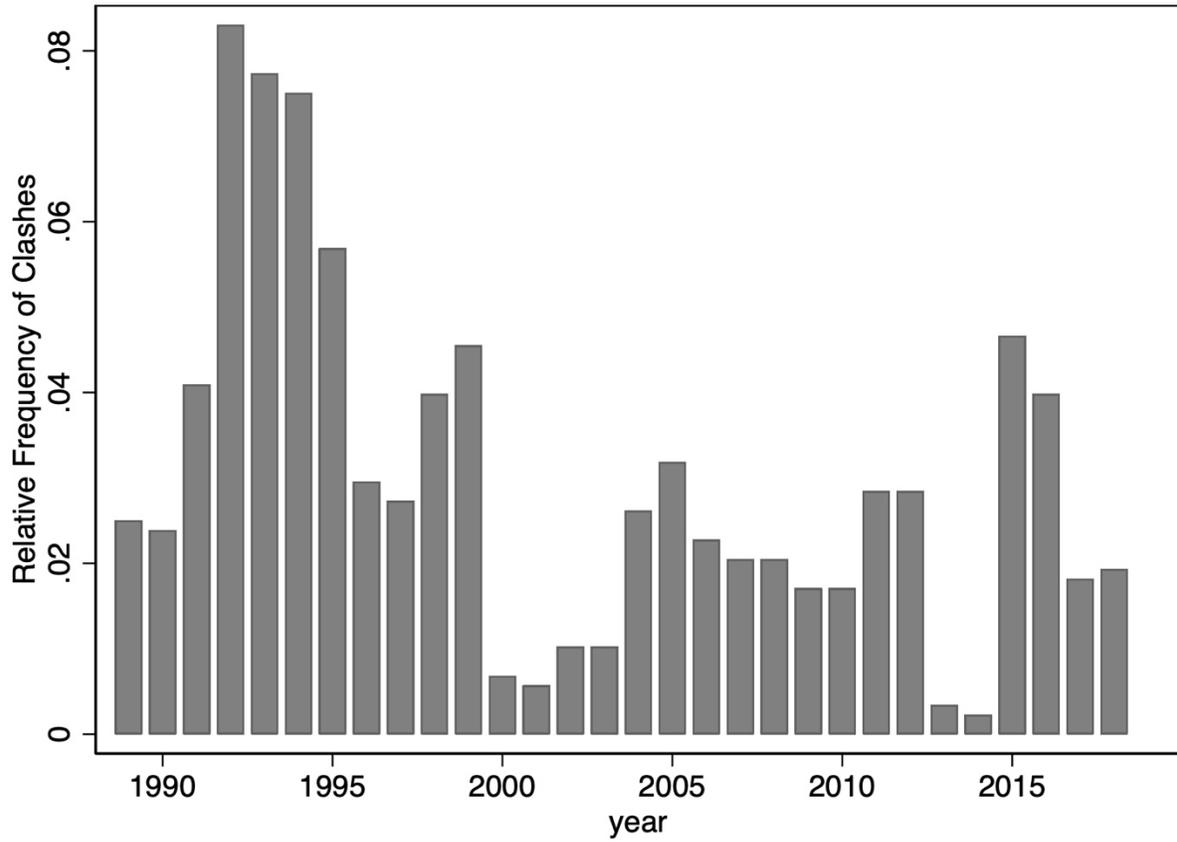
Table B2: Spatial Panel Models with Alternate Measures of Irrigation and Conflict

	(1) Clashes	(2) Clashes	(3) Recruitment	(4) Recruitment
Irrigated Area		-0.000339** (0.000172)		-0.000232** (0.000116)
Years Since Irrigation	-0.00222*** (0.000388)		-0.000644*** (0.000236)	
Y_{t-1}	0.247*** (0.0460)	0.253*** (0.0459)	0.125*** (0.0374)	0.126*** (0.0373)
Population	0.000210 (0.00332)	-0.000524 (0.00336)	0.00607 (0.00395)	0.00595 (0.00396)
AKP voteshare	-0.00497 (0.0156)	0.000336 (0.0167)	-0.0457** (0.0180)	-0.0477*** (0.0180)
HDP voteshare	0.0760* (0.0393)	0.0843** (0.0398)	0.00225 (0.0529)	0.00545 (0.0527)
Tribal	0.104*** (0.0333)	0.0979*** (0.0332)	0.0658** (0.0314)	0.0679** (0.0314)
Nightlights Change	0.00100 (0.00601)	0.00191 (0.00600)	-0.00623 (0.00477)	-0.00578 (0.00469)
Nightlights	0.00736* (0.00399)	0.00681* (0.00397)	0.00604* (0.00320)	0.00576* (0.00314)
Roads	-0.00316 (0.00316)	-0.00548 (0.00338)	-0.000634 (0.00327)	-0.000784 (0.00331)
SPEI	0.0191 (0.0117)	0.0238** (0.0115)	0.0168 (0.0132)	0.0172 (0.0131)
Slope	0.00196 (0.00171)	0.000638 (0.00169)	-0.000350 (0.00207)	-0.000718 (0.00210)
Elevation	4.36e-05 (4.01e-05)	3.99e-05 (4.04e-05)	2.71e-05 (4.15e-05)	2.34e-05 (4.17e-05)
Cell Area	-9.18e-05 (9.15e-05)	-5.74e-05 (9.76e-05)	9.21e-05 (0.000123)	0.000118 (0.000124)
Ceasefire	-0.0149 (0.0117)	-0.0120 (0.0120)	0.0164 (0.0107)	0.0113 (0.00974)
Syrian War	0.0329* (0.0177)	0.0198 (0.0177)	0.00992 (0.0152)	0.00675 (0.0146)
Border	-0.0156** (0.00611)	-0.0155** (0.00630)	-0.0118 (0.00817)	-0.0112 (0.00820)
Observations	6,293	6,293	5,859	5,859

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

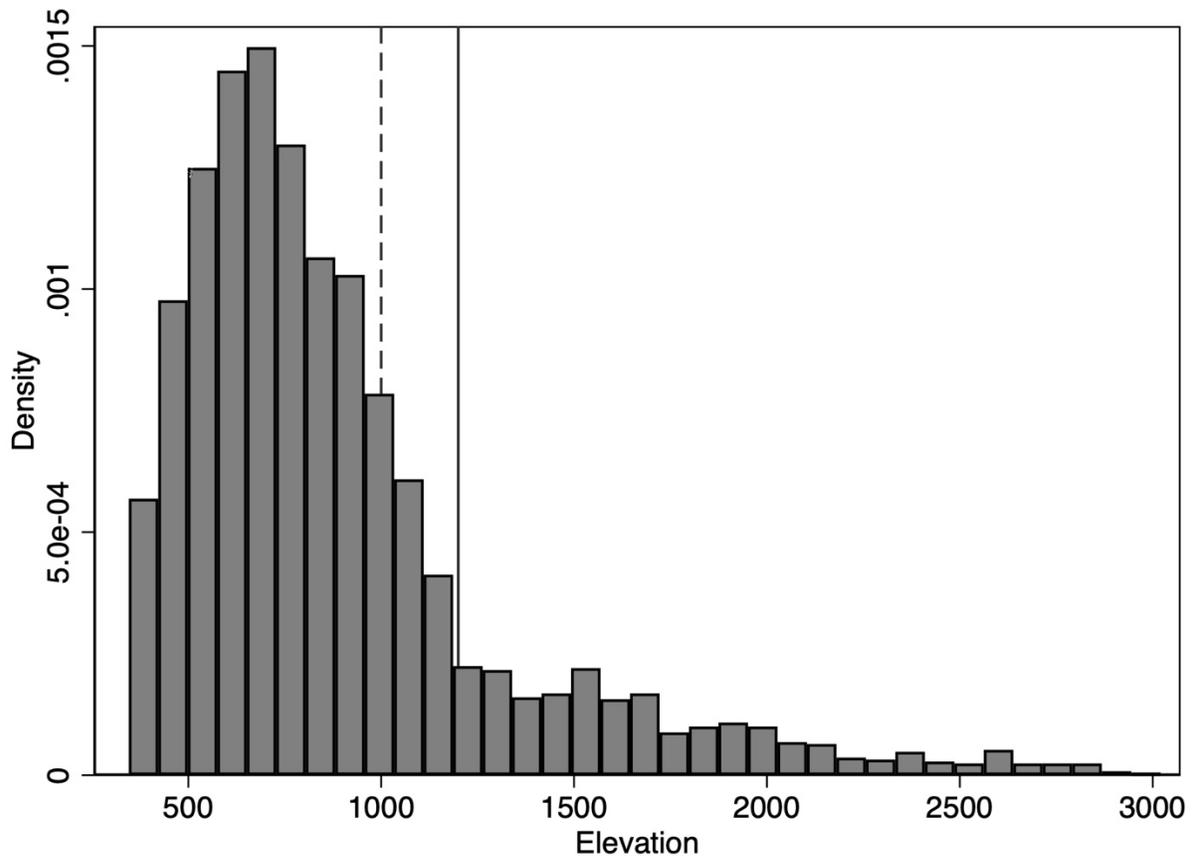
Results in this table represent modifications of the specification found in column 4 of Table 4. The dependent variable in columns 1 and 2 is the UCDP-derived conflict incidence measure. The dependent variable in columns 3 and 4 is an obituary-derived measure of PKK recruitment developed by Tezcür (2016). Columns 2 and 4 use irrigated area as the treatment variable, which represents the number of square kilometers of the grid cell under irrigation in a given year. Robust standard errors are reported in parentheses.

Figure B1: Frequency of Violent Clashes Over Time



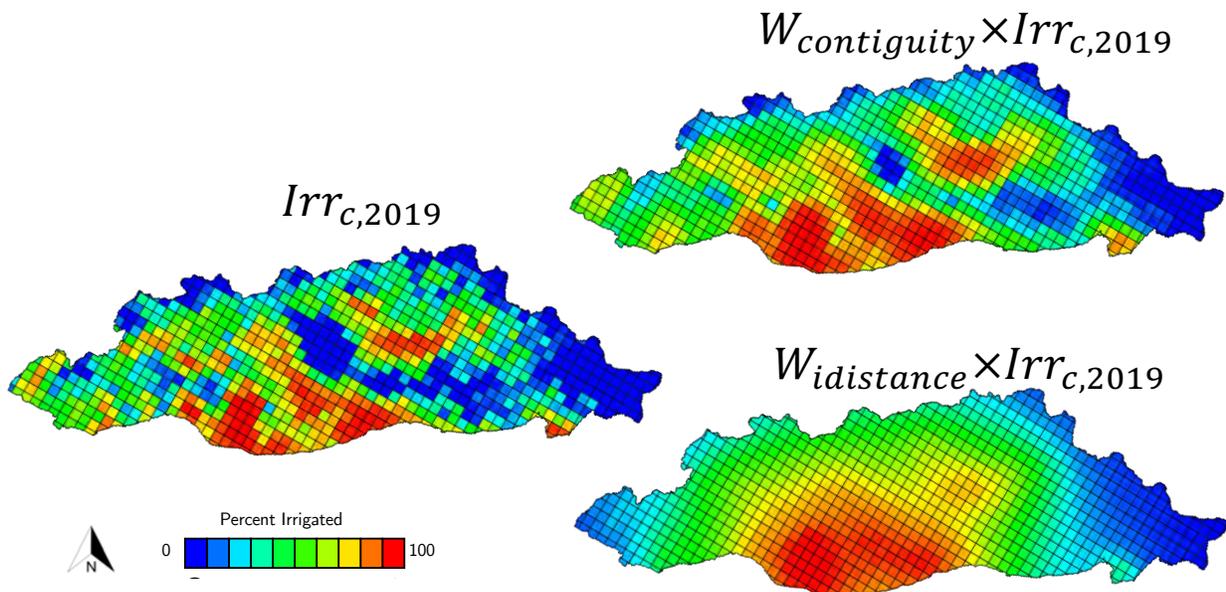
This figure shows the relative frequency of clashes between the PKK and the Turkish Government recorded in the Uppsala Conflict Data Program (UCDP) dataset. The large volume of clashes prior to the year 2000 indicates the conflict's active phase, which was followed by a ceasefire lasting until 2015.

Figure B2: Elevation Histogram of Southeastern Anatolia



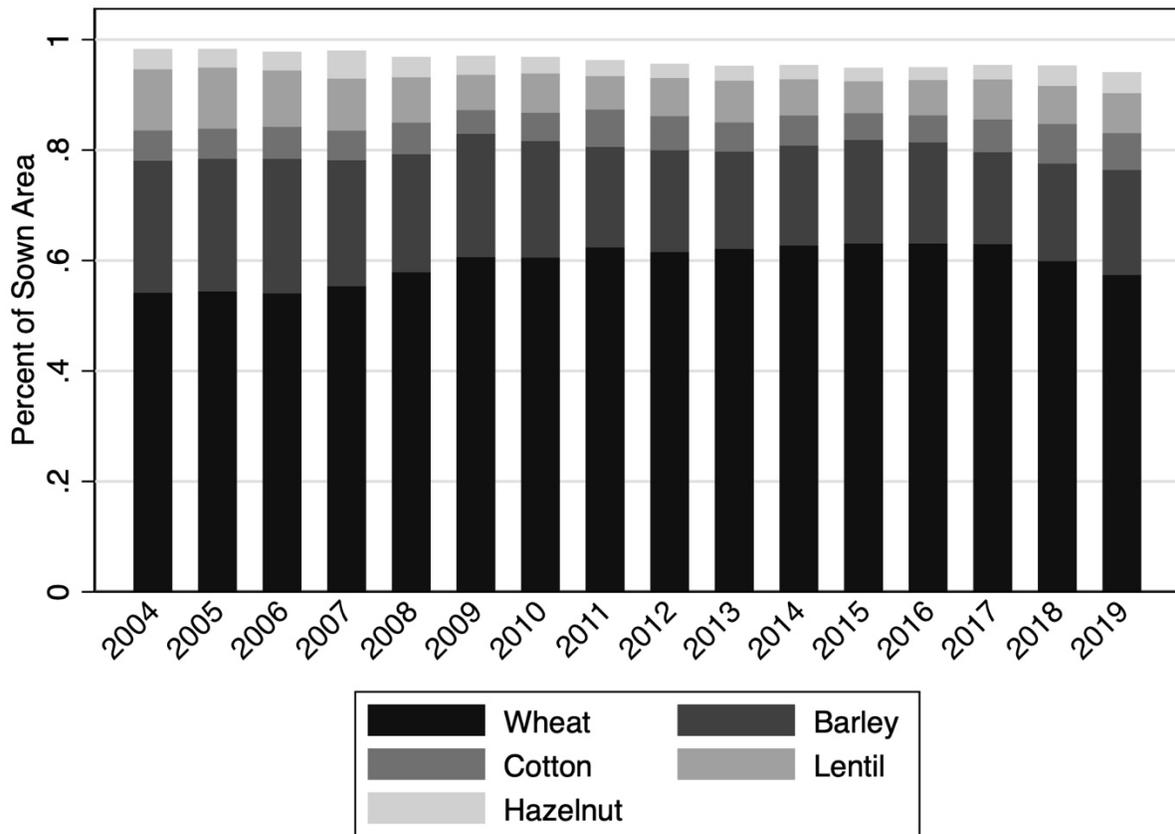
The histogram above shows the elevation profile of the study area. Mountainous areas are clearly identifiable as a long right tail in the distribution. The solid line denotes an altitude cutoff used to eliminate mountainous areas from the sample, and the dashed line shows a more aggressive geographic restriction used for robustness.

Figure B3: Effect of Spatial Weights on the Irrigation Variable



The map on the left shows the spatial distribution of the irrigation variable in 2019. The map on the top-right demonstrates the effect of an interaction between the irrigation variable and a binary contiguity spatial weighting matrix. The map on the bottom-right demonstrates the effect of using an inverse distance weighting matrix.

Figure B4: Southeastern Anatolia Crop Production Statistics



The chart above shows the relative shares of five major crops in terms of sown area. Wheat is by far the dominant crop, making up roughly 60% of sown area.

Figure B5: Central University Research Ethics Committee Approval Letter

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Head of Department: Professor Christopher Adam



5 June 2018

–
Ollie Ballinger
St Antony's College
Oxford

Dear Ollie

Research Ethics Approval - Ref No: CUREC 1A/ODID C1a 18-037

Project Title: The Political Economy of Agricultural Land Use Change in Southeastern Anatolia

The above application has been considered on behalf of the Oxford Department of International Development's Departmental Research Ethics Committee (DREC) in accordance with the procedures laid down by the University for ethics approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to the DREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly approval has been granted.

Should there be any subsequent changes to the project, which raise ethical issues not covered in the original application, you should submit details to the DREC for consideration.

Yours sincerely

Prof Laura Rival
Chair of ODID DREC

Field Research Design

Interviews were conducted with a variety of stakeholders affected by the Southeastern Anatolia Project (GAP), largely fitting into three main categories: government officials, Irrigation Union officials, and farmers. Interviews with government officials were conducted in person in Ankara, while Interviews with Irrigation Union councilors in Suruç and Batman were conducted via telephone, following a deterioration in the political situation in Turkey during fieldwork which made travel to these areas untenable. The impact of this development will be discussed further alongside the interview responses themselves. A first round of purposive sampling was carried out in interviews with farmers in order to adequately represent major stakeholder groups such as smallholder farmers, and to ensure that diverse parts of the study area are covered (Cakmak, 2000).

For case studies, two areas in particular were chosen. The first was Suruç, because a spontaneous protest began during fieldwork in response to a shortage of water; the second was Batman, because interviews with government officials suggested that the process of renationalization was being violently contested in this area. Furthermore, the quantitative analysis suggested that both of these areas were strong outliers in the overall relationship between irrigation and recruitment. Once an initial purposive sample covering these areas and representing different stakeholder groups was established, a second round of snowball sampling was used in order to provide multiple perspectives within the same communities. The overarching purpose of these interviews was to gather information about irrigation-dependent farmers' relationship with the state in the context of an insurgency, as well as the social, political, and economic factors that mediate this relationship.

Interviews were conducted between August and September 2018, during which time the Turkish government was in the process of renationalizing irrigation infrastructure. As DSİ began retaking control of irrigation schemes, many of the problems that had plagued the early DSİ-controlled irrigation projects began resurfacing: improper timing and dispensation of irrigation water led to significant crop failures, with the Suruç irrigation scheme running

out of water less than midway through the summer growing season, leading to protests (Urfanatik, 2018). In Batman, a DSI engineer was severely beaten while carrying out re-nationalization (Interview III). This contentious political climate allowed for an extreme test of the effect of irrigation on Kurdish farmers' perceptions of the Turkish state. Whereas previous ethnographies focused on well-performing schemes during times of political calm, the interviews conducted herein focused on particularly violent areas of Southeastern Anatolia during a time of protests and a significant intensification of the conflict with the PKK. Because the effect of irrigation on farmers' perceptions of the state is the main mechanism through which irrigation is posited to reduce PKK recruitment, conducting interviews in this political context allowed the durability of this effect to be interrogated.

The table below lists the occupation and location of interviewees, as well as the medium of the interview:

Table B3: List of Fieldwork Interviews

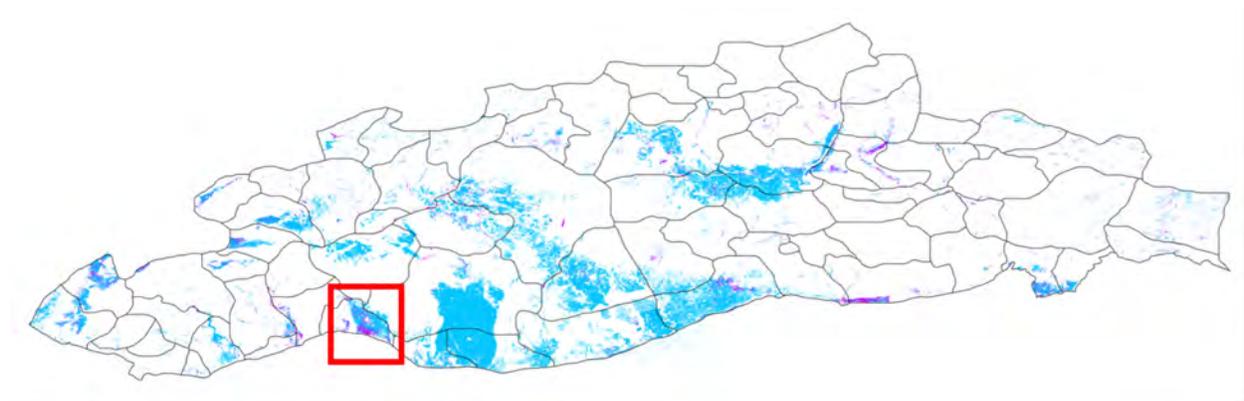
Number	Occupation	Location	Medium
I	Academic	Istanbul	In Person
II	DSİ Field Officer	Diyarbakir	Telephone
III	DSİ Field Officer	Batman-Silvan	Telephone
IV	DSİ Field Officer	Ankara	In Person
V	Retired DSİ General Director	Ankara	Telephone
VI	Turkish Court of Accounts	Ankara	In Person
VII	Judge	Ankara	In Person
VIII	SUBIRDER Official	Ankara	In Person
IX	Irrigation Union Councilor	Suruç	Telephone
X	Farmer	Suruç	Telephone
XI	Farmer	Suruç	Telephone
XII	Farmer	Suruç	Telephone
XIII	Farmer	Suruç	Telephone
XIV	Farmer	Suruç	Telephone
XV	Irrigation Union Councilor	Batman-Silvan	Telephone
XVI	Farmer	Batman-Silvan	Telephone
XVII	Farmer	Batman-Silvan	Telephone
XVIII	Farmer	Batman-Silvan	Telephone
XIX	Farmer	Batman-Silvan	Telephone
XX	Farmer	Batman-Silvan	Telephone
XXI	Farmer	Batman-Silvan	Telephone
XXII	Farmer	Diyarbakir	Telephone
XXIII	Irrigation Union Councilor	Diyarbakir	Telephone

This table reports the occupation and location of individuals interviewed during fieldwork in 2018, as well as the medium through which the interview was conducted. References to these interviews refer to the number column on the left.

Qualitative Case Study 1: Political Violence and Irrigation in Suruç

The Suruç irrigation scheme, highlighted in Figure B6, borders the Syrian city of Kobani which has been controlled by the PKK-affiliated YPG since 2015. At the center of the scheme is the city of Suruç, which has historically sent a large number of recruits to the PKK—more than 98.7% of other grid-cells in this sample. During the summer of 2018, the mere visit of the city’s incumbent Member of Parliament—an AKP deputy running against an HDP candidate widely supported in Suruç—was enough to spark multiple deadly riots (BBC, 2018). During fieldwork, this irrigation scheme ran out of water shortly after management was transferred from the local Suruç Irrigation Union to the State Hydraulics Administration (DSİ). Thus, a city with a long history of violently contesting the Turkish state’s legitimacy was now surrounded by farmers whose crops lay rotting in the sun as a direct result of the state’s mismanagement of water resources. Bearing in mind the quantitative association identified in Chapter 2 crop failures and violent conflict, interviewing farmers in Suruç represents a much more extreme test of the effect of irrigation on farmers’ perceptions of the Turkish state.

Figure B6: Irrigated Areas in Southeastern Anatolia, Highlighting the Suruç Irrigation Scheme



The Suruç Irrigation Scheme highlighted on a map of Southeastern Anatolia.

Under the irrigation union, farmers’ fields were watered every 9 days, and several villages received water at the same time (Interview VI). Under DSİ management, villages would

receive water one by one, and could water their fields every 3 days (Ibid). Because the farmers practice water-intensive flood irrigation, increasing the frequency of the rotation caused the scheme to run out of water in late July, roughly half way through the summer growing season, and right before the hottest month of the year (Interview VII). Crop failures were, in the words of an interviewee, “felâket” [catastrophic] (Interview VIII). An Irrigation Union president was quick to blame DSİ for the debacle:

“We are farmers. We are sons of farmers. We are grandsons of farmers. We know when a crop needs water, and how much it needs. For an outsider, a bureaucrat who has never farmed, to manage our irrigation is not possible. Because of this we are suffering.” (Interview IX)

Such a critique is to be expected, given the depletion of irrigation water occurred shortly after DSİ took control and altered the rotation. Yet the farmers took a very different view of the situation:

“The president of the Irrigation Union wants the management to stay with the Union. But the farmers prefer DSİ. The work of DSİ is better. There is state protection behind DSİ, there are guarantees for timely and good quality maintenance and repair. The farmers are happy with this. We prefer DSİ.” (Interview X)

Thus, while the irrigation union president emphasizes a divide between “locals” (Suruç farmers, including himself) and “outsiders” (state officials and the DSİ), the farmers frame the issue quite differently. Mehmet Faruc Cardirci, a smallholder farmer affected by the lack of irrigation water, expressed his view of the problem in this quote from a local news report:

“There are people who do not share. There is enough water for all, but they do not respect each other. The strong does not give water to the weak. I am speaking to the President of the Republic: we cannot get a single word

across here, everyone has different ideas in their heads, people are lying to each other and harming each other. Our President is the only one who will solve this trouble.” (Urfanatik, 2018)

His account frames the situation among farmers as anarchic—an almost Hobbesian state of nature in which the strong may irrigate and the weak cannot. And just as Hobbes viewed the power of a Sovereign as the only solution to the war of all against all, Cardirci believes that only the President can save the farmers from each other. Despite the fact that crop failures resulted more or less directly from a state policy, the implication seems to be that the switch to 3-day rotations would not be a problem if the farmers behaved honorably. He seems to argue that by switching to a 3-day rotation, the state merely made the depletion of irrigation water possible; but it was the farmers’ abuse of that system that made it a reality.

For weeks, farmers who would otherwise be tending to their crops assembled in protest outside of the regional DSİ office:

However, none of the placards being held by these farmers actually blame DSİ for their problems—quite the contrary: they are appealing to DSİ to solve them. The placards include slogans such as “The low-pressure pumps are not working”, “Solve the water issue”, and “We hope that DSİ will support the farmers”. One placard—the one held by the man on the far left—is of particular interest. He is wearing a Cemedanî, a traditional Kurdish headscarf that was banned until the 2000s because of its association with support for the PKK (Onyebadi, 2017). His placard reads:

“Honorable [Agriculture] Minister, Honorable Member of Parliament, Honorable Governor, Honorable District Governor, Suruç could be a monument to you” (Urfanatik, 2018).

Though “eseriniz” has no direct translation, it is most often used in the context of works of art or monuments created to memorialize gods or rulers, such as the statues of Zeus and King Antiochus on Mount Nemrut (Nemrut Eserleri). As such, this protestor directly appeals

Figure B7: Photograph of Water Protest in front of Suruç DSİ Branch



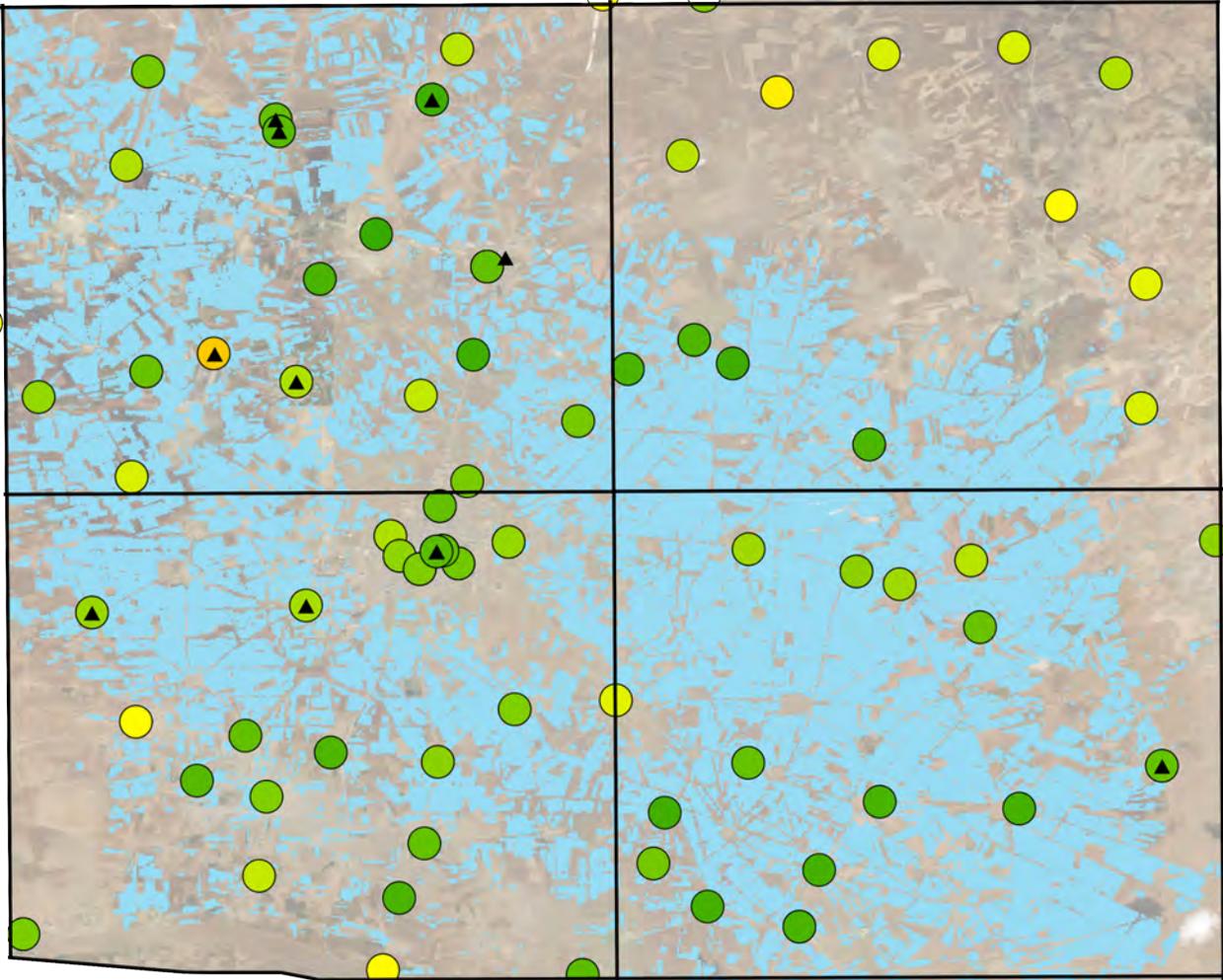
Image taken from a local press report on farmer protests outside of the regional office of the State Hydraulics Administration branch in Suruç, following crop failures due to mismanagement of water resources.

to every level of government, from the Capital to the Province to the District, promising that if they resolve the water shortage, the Suruç irrigation scheme will perform so well that it would become a monument in their honor.

This level of effusive praise and reverence towards the state is extraordinary for Suruç, which has sent more recruits to the PKK than 98.7% of the grid-cells in the sample. Only two weeks prior to this protest, the very Member of Parliament that is being addressed in the placard above—Ibrahim Halil Yıldız, a member of the AKP who represents this district—was attacked by shopkeepers during a tour of Suruç in the run up to the 2018 general election (BBC, 2018). National and government-affiliated press claimed that the shopkeepers were PKK supporters, though this is disputed in local news reports. Though Yıldız survived, the brawl left four dead (including Yıldız's brother and three assailants), eight hospitalized, and over a dozen arrested (Sabah, 2018). During the funeral procession for the assailants, police attempted to interdict the caskets on their way to the cemetery, leading to a riot in which

Yildiz’s rival—HDP candidate Songül Arpaçi—was shot in the head with a teargas canister (Ahval, 2018). Though Suruç later voted over 70% for the HDP, and only 28% for the AKP, Yıldiz received enough support from neighbouring municipalities to win re-election. Figure B8 maps these election results on the four grid-cells that contain the Suruç irrigation scheme, with irrigated cropland highlighted in blue. Dots represent ballot boxes, with green representing HDP support, red representing AKP support, and black triangles indicating that the village has sent recruits to the PKK.

Figure B8: 2018 Election Results, PKK Recruitment, and Irrigation in Suruç



The four 10km-by-10km grid cells shown above encompass the Suruç irrigation scheme. Irrigated cropland is shown in blue, georeferenced ballot box level election results for the 2018 parliamentary election are shown as circles coloured red for high AKP vote shares and green for high HDP (Kurdish Party) vote shares. Triangles denote villages that have sent at least 1 recruit to the PKK in the time period covered by the sample.

Though 10 villages in the scheme sent 75 recruits to the PKK, 69 of them joined before irrigation arrived in 2005. However, urban recruitment from the city of Suruç (in the bottom-left grid-cell) remained high throughout. The overwhelming support for the HDP evident in Figure B8 seems contradictory to the appeals by protesting farmers to AKP officials including the Member of Parliament and the President. However, though interviewees spoke very favorably of the state [devlet], not a single one expressed support for the government [hükümet]. This could suggest that farmers discursively separate their irrigation-related interactions with state bureaucracies such as DSİ from their party-political beliefs and preferences, allowing them to appeal to offices of the state (the President, Parliament, and Ministers) without necessarily supporting the politics of the individuals that populate them.

The juxtaposition of the assault on Yildiz and the water protest appears to be a testament to the extent to which irrigation can instill trust in the state. Suruç and its surrounding villages seem to deeply reject the legitimacy of the state, on the streets—by assaulting their visiting AKP Member of Parliament—and on the battlefield—by fostering record numbers of PKK recruits. Two weeks after the assault, the state took control of an irrigation scheme, and through mismanagement caused catastrophic crop failures. If the mere visit of a government official was enough to spark multiple deadly riots, one would expect the state’s mishandling of a vital economic resource to provoke an even greater response. Yet, many of the farmers not only place the blame for the water shortage on each other, they appeal directly to the President as the “only one” who can help, and promise to become a “monument” to the state if the shortage is resolved. In one interview a farmer expressed that, though the shortage occurred under DSİ management, he would still rather have DSİ manage the water than the Irrigation Union:

“We do not forget who dug the canals. This area was very poor. In the old days, farmers in Harran could not even produce 100 kilos of wheat. Some years there was drought, they could grow nothing and there would be famine. Now,

we export wheat, we grow cotton, we have money for equipment and tractors. After the Atatürk Dam opened up, areas such as Viransehir, Harran, the Suruç plains, and the small towns and villages of Sanliurfa [province] opened up as well. So we are experiencing some problems with water shortages, but this is a new operation and a transition. This whole area will be fully irrigated again very soon.” (Interview XIV)

This response frames the current shortage in irrigation water as a recent aberration in a long and constructive relationship between farmers and the state. The main temporal distinction that he draws is not between the days of DSI management and the days of irrigation union management; it is between the pre-irrigation and post-irrigation period. Despite the fact that irrigation was introduced nearly 15 years ago, the enduring effect thereof on this individual’s trust in the state appears to outweigh short term failures of the state.

The voices of farmers from Suruç—both the ones contained in my own interviews and those from local news reports—echo those of farmers interviewed in the literature, for whom “receiving renewed state attention and services has resulted in an intensified sense of belonging and loyalty as citizen subjects” (Harris, 2009: 11). Yet the present inquiry represents a far more extreme test of this loyalty. The interviews carried out by Harris (2002; 2008; 2009; 2012; 2016) were conducted in the Harran Plain, which has consistently voted for center-right parties (including the AKP) and has not sent a single recruit to the PKK. In contrast, Suruç has maintained a far more conflictual relationship with the state, and interviews were conducted in the midst of DSI’s failure in the management of irrigation water. Nevertheless, the positive effect of irrigation on farmers’ perception of the state persisted.

Though this reinforces the validity of the causal mechanism linking agricultural income and conflict, it also highlights a general limitation in the scope of this analysis. While irrigation appears to have been successful in fostering better relations between farmers and the state and may even have directly deterred some farmers from joining the PKK, a substantial

portion of the PKK's support base is unaffected by irrigation. Urban residents—including the shop-keepers who attacked Yildiz—continue to harbor grievances against the Turkish state, regardless of whether the farmers on the outskirts of town grow wheat or cotton.

This case study sheds greater light on the precise ways in which irrigation might deter an individual from joining the PKK when it is considered in tandem with detailed information on the recruitment process. In an interview conducted by Aytakin (2019: 72), one of the founding members of the PKK described their recruitment strategy as follows:

“One day we went into the villages to get to know the local population and gain supporters. We knocked on a door and asked to be let in, we sat next to an old Kurdish man who was giving a speech. I later learned he was a ‘Dede’ [an Alawite preacher]. I asked him stating ‘Dede, while playing your Saz [a traditional guitar style string instrument] you mentioned the region of Dersim, if you give permission I would like to mention a few things in regards to Kurdistan and Kurdish history.’ The Dede then gave me permission to speak whereby I gave an effective speech stating, ‘we have a land, we have a history.’ [...] The Dede then asked who we were, we replied stating we are a new organization. That night, we then gave a speech to the men of the village between the regions of Pertek and Mazgirt. These were in the control of TIKKO [Communist Party of Turkey], but even though this was the situation, the whole village had joined our organization.”

Rather than promising lavish salaries or attempting to persuade tribal leaders to pledge their allegiance, PKK recruiters seek permission from village elders to give speeches about Kurdish history, identity, and class consciousness, appealing directly to the potential recruits themselves. The success of this strategy is thus largely contingent on how receptive the audience is. The above quote suggests that it is most successful in areas that already displayed an affinity towards ideologies similar to that of the PKK. One recruit described the efficacy of this approach:

“My main reason for joining the PKK were the PKK guerrillas. Every time I saw them, I would ask ‘what are they doing?’ I would get a reply stating ‘they are fighting for us.’” (Aytekin, 2019: 72).

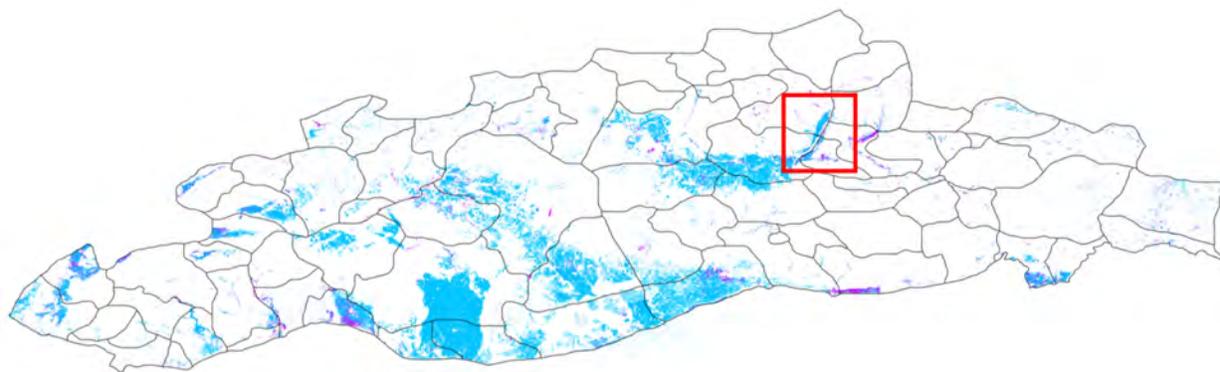
Thus, if irrigation strongly impacts how individuals perceive of the Turkish state, it likely has a strong impact on how receptive villagers would be to a guerrilla’s speech. A report by Turkish Police Intelligence notes, as “the perception of the government’s legitimacy declines, the insurgent movement wins over the populace’s heart” (Unal, 2012: 449).

The analysis in this case study must be taken with several grains of salt. Firstly, fieldwork interviews must be interpreted in light of the circumstances under which they were produced. The interviews were carried out by phone using a snowball sampling method whereby I asked farmers to refer me to other farmers in the area. Though this process of referral established a baseline level of trust, one must still question the extent to which farmers would feel comfortable openly criticizing the government to me, a stranger on a cellphone, in a political climate in which doing so could have severe consequences. To alleviate this problem, I took care in interviewing several across several strata and stakeholder groups (government officials, Union members, farmers, etc.), and integrating local news reports to create a plurality of perspectives on the issue. The conclusions drawn in this chapter are thus tentative and would greatly benefit from more detailed follow-up fieldwork. However, qualitative evidence generally supports the causal framework and quantitative results.

Qualitative Case Study 2: Tribalism, Irrigation, and Violence in Batman-Silvan

The Batman-Silvan irrigation scheme, highlighted in Figure B9, stands out in the data as the strongest outlier in the generally negative relationship between irrigation and recruitment. Unlike Suruç, PKK recruitment remained high even after irrigation was introduced, and news reports suggest that irrigation was actually directly implicated in fueling the conflict. Data on tribal control indicated an unusually high concentration of HDP-affiliated tribes living in close proximity to an AKP-affiliated tribe. Local news reports documented a large number of deadly feuds over irrigation water, which drew involvement from the PKK and the Village Guards. In Batman-Silvan, the conflict seems to have taken on the character of local disputes—in this case, over irrigation—as hypothesized by Kalyvas (2003).

Figure B9: Irrigated Areas in Southeastern Anatolia, Highlighting the Batman-Silvan Irrigation Scheme



The Batman-Silvan Irrigation Scheme highlighted on a map of Southeastern Anatolia.

Many of the responses from interviews carried out in the area via telephone touched on themes that were suggestive of a strong tribal presence. The farmers in Batman noted that while they make more money with irrigation, their landlords are the primary beneficiaries thereof:

“The math is like this: before irrigation, I made TL150,000 per dönüm growing wheat. Now, for one dönüm, I make TL1.5 million in income, of which

TL800,000-900,000 goes to rent. A farmer who rents from a landlord makes about TL300,000 per dönüm. If the farmer owns the land, one dönüm of irrigated land brings TL600,000-700,000.” (Interview XVI)

The exaction of excruciatingly high rent—in this case, roughly 2/3 of income—seems to fit with Guida’s (2014: 179) description of tribal land tenure arrangements, whereby “Ağas became landlords, and their followers became sharecroppers”.

Further interviews with government officials and irrigation union councilors indicated patterns of violence related to irrigation reminiscent of the literature on blood feuds over irrigation water. A DSI official working on the process of renationalization in Batman-Silvan offered a succinct summary of the situation:

“our relationship with the farmers is very bad. That area is very dangerous. Last week one of our engineers was severely beaten [darp etmiş]” (Interview III).

The president of a local Irrigation Union offered an explanation for the violence that seemed to double as a threat:

“Allah korusun [God forbid], if one or two people start to die in each region and murders start taking place, who can do anything? There is fire all around us, there are wars, our soldiers are dying. You come here and take the bread out of the farmer’s hand and give it to others? The consequences are high.” (Interview XV)

The reference to “wars” and “soldiers dying” was made in the midst of Operation Olive Branch, the Turkish military incursion into Northern Syria to fight the Kurdish (and PKK affiliated) YPG. The implication seems to be that DSI retaking control of irrigation infrastructure would open up a new front in this war, in Batman. His description of the history of irrigation management in the area bears the hallmarks of a blood feud:

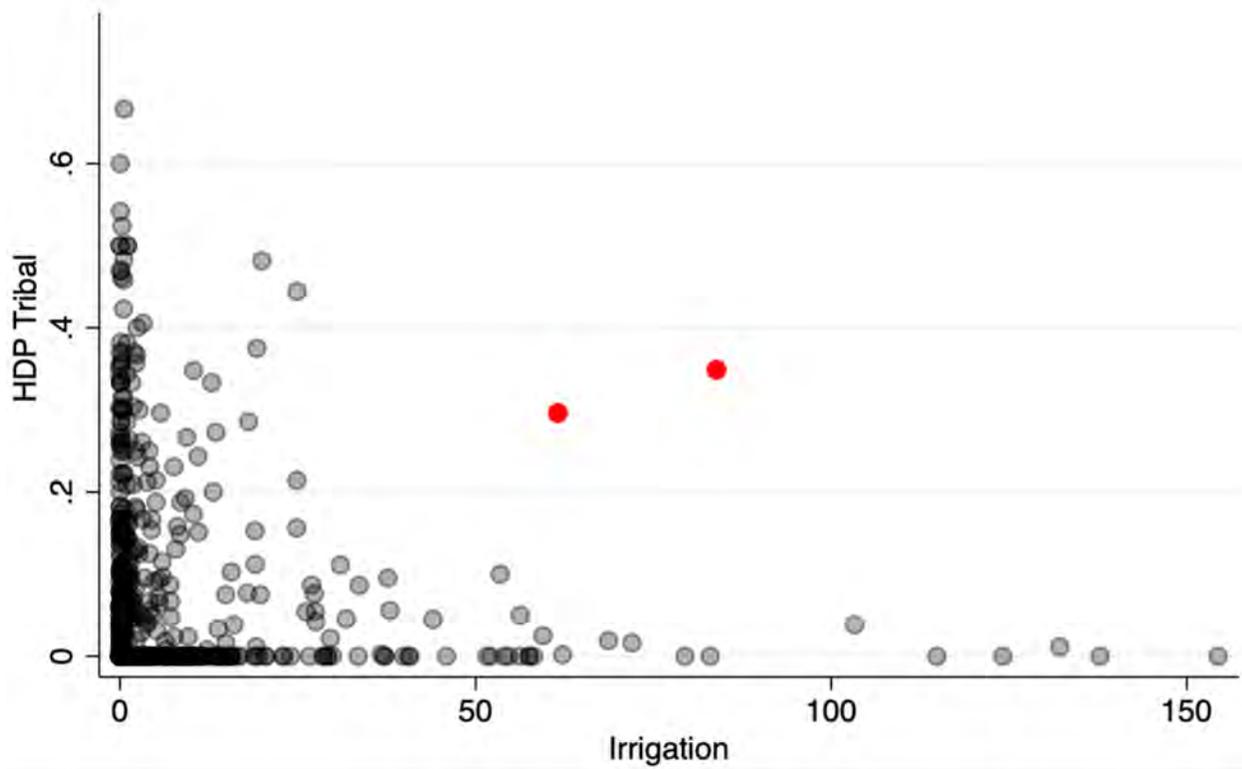
“During DSI management, many of our villages did not receive water. I lived on the left bank of the irrigation scheme, in the central village of the plain. We were the third village on the list for water. DSI brought the water to our village, but when they tried to bring it to other farther villages, the farmers came out with sticks and said, ‘we will not let the water pass.’ When management was transferred back to DSI [in 2018], people came and said, ‘village A, this water is yours, village B, that water is yours’. But when a government worker comes, the villagers don’t know these people. Farmers pump illegally and when the police comes, they say ‘I’m getting water for my field, how can you stop me, my crops will die’. But then villages at the end of the canal lines started to suffer. So there were beatings and fights and people got hurt and injured. We had to get in the middle to stop the chaos.” (Interview XV)

What is being described above appears to be a “tragedy of the commons” which generates violence between farmers and against state officials. Though this passage does not mention aşirets directly, it bears striking similarities to Tezcan’s (1981: 64) aforementioned description of a tribal blood feud that began with the words “you are going to irrigate now? No, I am going to irrigate now!”, and ended with the decimation of three generations from two clans in Kirşehir.

A re-examination of the data based on these interviews revealed that the grid-cells containing the Batman-Silvan irrigation scheme (highlighted in Figure B10) are indeed not only outliers in the relationship between irrigation and PKK recruitment—they also feature unusually high levels of tribal voting [birleşik oy]—mostly for the HDP.

The two grid-cells that contain the bulk of the irrigation scheme also displayed instances of birleşik oy in a relatively large proportion of the ballot boxes contained within the cells. Figure B11 superimposes the locations of ballot boxes on 2018 satellite imagery of the scheme (with irrigated fields highlighted in blue); yellow circles denote villages, and crosses denote ballot boxes in which block voting took place—green for HDP, red for AKP.

Figure B10: Relationship between Irrigation and Tribal Block Voting for HDP

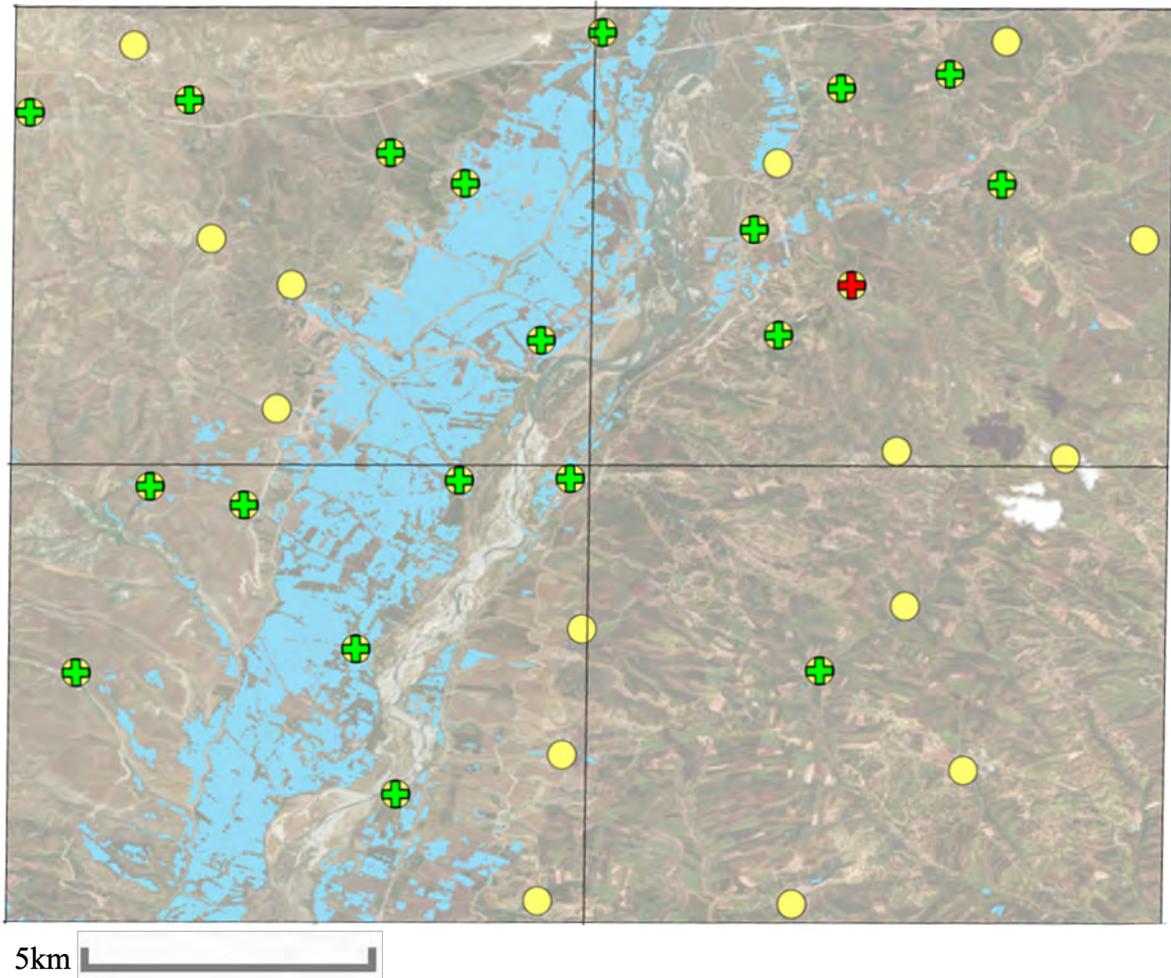


A scatterplot showing the relationship between the percent of a 10km by 10km grid cell under irrigation and the proportion of ballot boxes displaying tribal block voting behaviour for the HDP. The two grid cells containing the majority of the Batman-Silvan irrigation scheme are clear outliers in that they have high levels of irrigation and HDP-affiliated tribal presence.

The grid-cells on the left display tribal voting behaviour in nearly every ballot box directly on the irrigation scheme. In the top right, however, *birlesik oy* took place in favor of the AKP, where the party won by an average margin of 96% across five elections. In the nearest village—less than a mile to the South-West—98% of the vote went to the HDP. The villages contain 198 and 207 voters, respectively. These data suggest an exceptionally large presence of HDP-affiliated tribes living in close quarters with an AKP-affiliated tribe, in the vicinity of a scarce and lucrative resource. The potential for blood feuds—defined as inter- and intra-tribal “struggle over ownership of the primary means of production” (Akpolat, 2009: 423)—thus appears to be high.

Local news reports indicate that the Batman-Silvan irrigation scheme was beset blood

Figure B11: Tribal Block Voting on the Batman-Silvan Irrigation Scheme



The four 10km-by-10km grid cells shown above encompass the Batman-Silvan irrigation scheme. Irrigated cropland is shown in blue, georeferenced ballot box level election results for the 2018 parliamentary election are shown as circles. Green crosses denote ballot boxes displaying tribal block voting behaviour for the HDP (the main Kurdish party) while red crosses indicate block voting for the AKP (ruling party).

feuds between large clans, which induced a recruitment drive for Village Guards. In 2013, a dispute over a 500-hectare land purchase between two aşirets in Silvan led to a gun battle that left eight dead (Milliyet, 2013). The following year, the District Governor led a recruitment drive for 180 Village Guards to defend maintenance and repair work on irrigation canals and the Silvan dam, which feeds the Batman-Silvan irrigation scheme (Milliyet, 2014). Many of these Village Guards were killed, one by one, in PKK attacks over the following years (Malabadi Gazeti, 2015; Milliyet, 2016; Milliyet, 2018). Mediators who ended a similar 14-

year long blood feud over an agricultural debt between the 15,000-strong Mendan and Devan aşirets in Silvan claim to have intervened in 437 feuds in the area (Hürriyet, 2007).

Kalyvas (2003: 479) suggests that “the local dynamics of conflict are more about local issues than the ‘master narrative’ of the war”; indeed, the conflict between the PKK and the government in the environs of the Batman-Silvan irrigation scheme seems to have taken on the character of local disputes over land, resources, and water. In this case, it seems that the positive effect that irrigation might have had on individuals’ perceptions of the state was overshadowed by the increase in feuds over irrigation water, which quickly gave way to conflict between the PKK and Village Guards. Rather than writing this irrigation scheme off as a mere outlier, a qualitative analysis of the Batman-Silvan irrigation scheme demonstrates it to be a substantively important vindication of Kalyvas’ (2006) call for integrating “local cleavages” into the analysis of civil war.

Georeferenced data on tribal block-voting behaviour shows significant clustering of HDP-affiliated aşirets on the irrigation scheme itself, but also the presence of an AKP-affiliated tribe only a few kilometers away. Interview responses indicated that this tribal presence had two main effects on the process of irrigation: firstly, many of the economic benefits to farmers were curtailed because of the highly unequal land tenure system. Secondly, competition over irrigation water and land between aşirets led to blood feuds that gradually became militarized, with both the PKK and Village Guards taking sides, as indicated by local news reports. Though the general trend appears to be that irrigation reduces PKK recruitment, the very opposite can be true. In Batman, the introduction of a highly lucrative common resource intersects with historical competition between aşirets over means of production, and the government’s policy of deepening these divisions by selectively arming one side through the village guard system. The confluence of these factors may have resulted in the conflict between the PKK and the state taking on the character of local disputes over irrigation, thereby fueling even more recruitment.

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