

Online Appendix

Responses to Extreme Temperatures: Migrant Networks and International Migration from El Salvador

Ana Maria Ibáñez, Juliana Quigua, Jimena Romero, Andrea Velásquez

A1. Background

EXTREME WEATHER IN EL SALVADOR. — The frequency of extreme weather events in El Salvador, particularly droughts and high temperatures, has intensified during recent decades with three extreme droughts in the last 10 years alone. In 2012, a severe and prolonged drought reduced coffee production by 70 percent. Between 2014 and 2015, more than 100,000 farmers suffered losses from another drought and the onset of *El Niño* (IFRC, 2016). In 2018, a new drought struck the country before it had recovered from the previous one. This led to a sharp loss of staple crops such as corn and to the declaration of a “red alert” by the government.³²

Recurring droughts and extreme temperatures are driving incomes down while pushing food insecurity and migration up. This is particularly worrying for small countries like El Salvador; one-quarter of its labor force works in agriculture, and most agricultural producers are small family farms dedicated to subsistence farming that largely depend on the rain cycle (WB, 2024a; FAO, 2016).

MIGRATION FROM EL SALVADOR TO THE UNITED STATES. — Migration to the United States from El Salvador started in the 1980s due to its civil war and migratory flows have persisted since then. Migrant network in the United States have provided newly arrived families with financial assistance, shelter, and connections to labor markets. This aid has helped to attract new waves of migrants (Donato and Sisk, 2015; Clemens, 2021).³³ By 2021, 2.5 million Hispanics of Salvadoran origin lived in the United States—the third-largest group of Hispanic-origin immigrants in the country.³⁴

The costs of migration from Central America to the United States have risen significantly in the past decade.³⁵ Figure A1 depicts the rising costs of migrant smugglers and

³²<https://www.reuters.com/article/us-el-salvador-drought/el-salvador-declares-emergency-to-ensure-food-supply-in-severe-drought-idUSKBN1KE338>

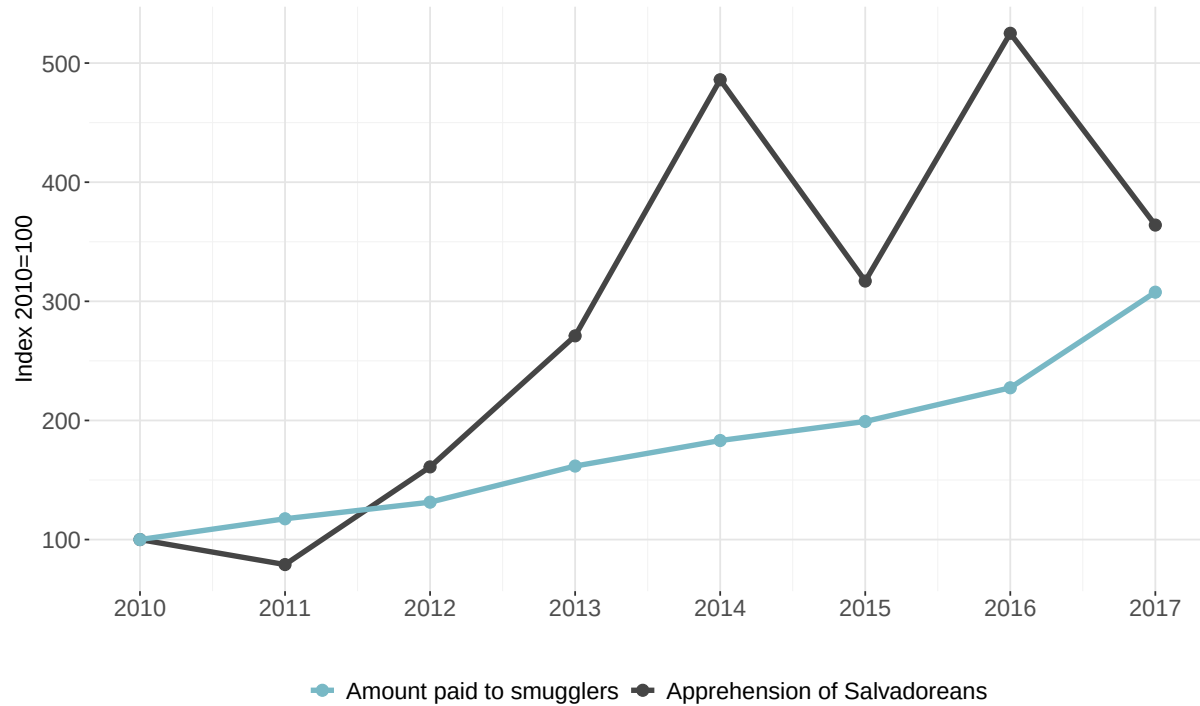
³³Clemens (2021) finds that past migration flows explain one-third of the current flows caused by violence.

³⁴<https://www.pewresearch.org/race-and-ethnicity/fact-sheet/us-hispanics-facts-on-salvadoran-origin-latinos/>

³⁵This article provides an example of the decision to migrate in spite of high costs: <https://www.nytimes.com/interactive/2020/07/23/magazine/climate-migration.html> retrieved on June 28, 2024.

apprehensions at the border, illustrating that suppressive measures have not succeeded.

Figure A1. : Border Apprehension of Salvadorans and Cost of Smugglers

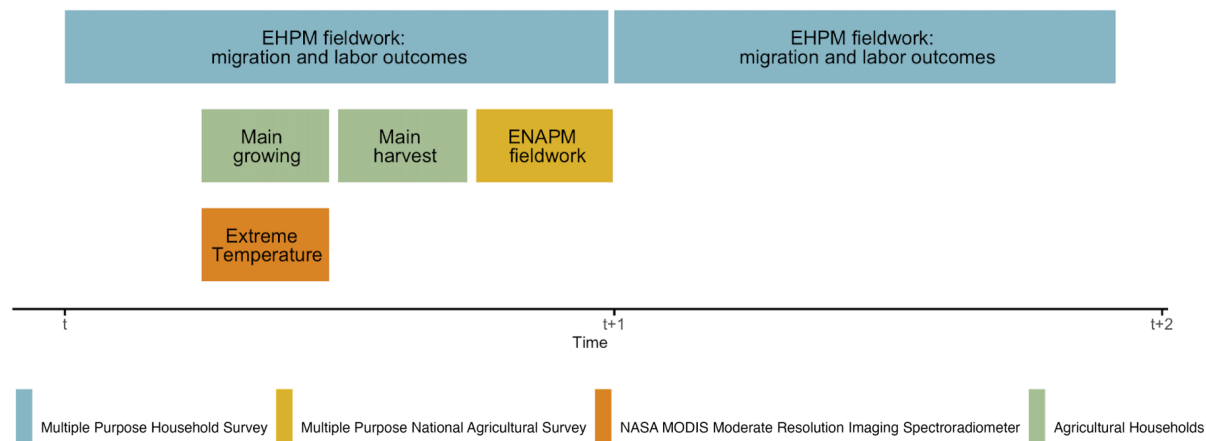


Notes: Own elaboration based on American Community Survey (ACS) and Customs and Border Protection (CBP). The figure shows the time series of an index (2010=100) on border apprehensions of Salvadorans and the cost of smugglers. In 2010, the number of border apprehensions was 11,696 and the cost was USD 1,881.

A2. Data

Figure A2 provides an overview of our three main data sources, the fieldwork calendar, and key outcomes.

Figure A2. : Timeline of Data

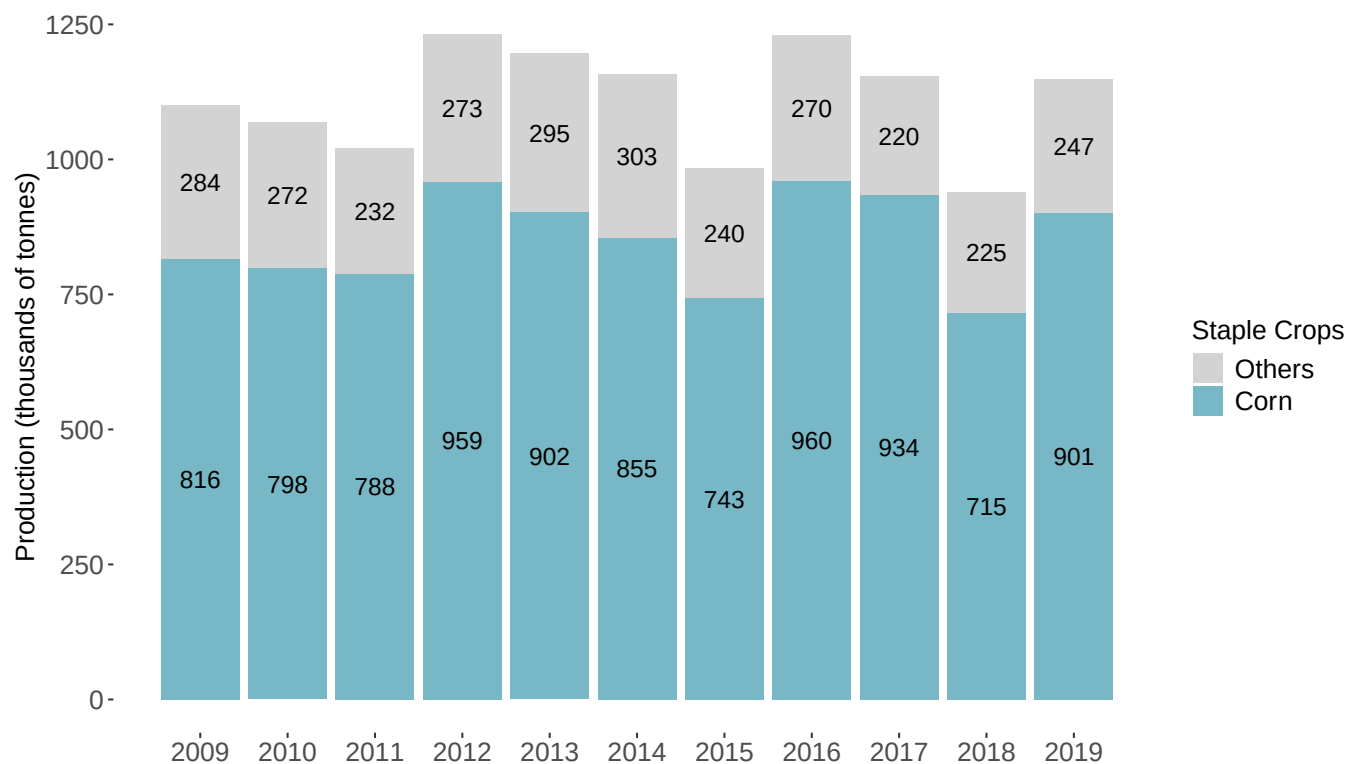


Note: Own elaboration based on El Salvador's Multiple Purpose Household Survey (EHPM), El Salvador's Multiple Purpose National Agricultural Survey (ENAPM) and NASA – Moderate Resolution Imaging Spectroradiometer (MODIS). The figure depicts that our main specification leverages extreme temperatures during the main growing season. We use three main sources of data: the Multiple Purpose Household Survey for migration and labor outcomes, which is collected throughout the whole year; the Multiple Purpose National Agricultural Survey for agricultural outcomes such as harvest production, use of inputs, and land size (among others), which is collected the last quarter of the year (after the main harvest); and NASA - Moderate Resolution Imaging Spectroradiometer (MODIS) for temperatures.

AGRICULTURAL PRODUCTION. — The Multiple Purpose National Agricultural Survey (ENAPM) is representative at the provincial level for grain crops such as corn. For the other items, it is representative at the national level. There was a two-stage random selection process within each of El Salvador's 14 provinces: first at the cluster level and then at the individual level. Our sample includes 19,325 agricultural producers of corn. The total number of agricultural producers in El Salvador in 2007 was 395,588 according to the latest agricultural census "IV Censo Agropecuario."

We focus on corn production because it is the main staple crop in El Salvador as well as in the rest of Central America (Figure A3).

Figure A3. : Production of Corn versus Other Staple Crops in El Salvador



Notes: Own elaboration based on FAOSTAT. Staple crops include corn (maize), rice, sorghum, and beans. The numbers in black indicate the production of each category in thousands of tonnes.

Corn is a primary source of caloric intake for rural households and its production is widespread (Nawrotzki, 2015; WB, 2018). Across survey years, between 83% and 90% of the sample produce corn. An average agricultural producer has a yield per hectare of 2.3 tons and a land plot of 1.5 hectares, of which 0.7 hectares are cultivated with corn. Access to irrigation—crucial for managing periods of drought and extreme temperatures—is practically nonexistent (0.4 percent). (Tables A1 and A2). In addition, other papers have found a significant association between temperature and corn production.³⁶

³⁶See Deschênes and Greenstone (2007), Schlenker and Roberts (2009), Schlenker and Lobell (2010), Feng, Krueger and Oppenheimer (2010), Roberts and Schlenker (2011), Ortiz-Bobea et al. (2019), and Burke and Emerick (2016). Most of these papers study the effects of weather shocks on crop-yield use data for developed countries that also produce corn.

The corn production calendar is as follows: *primera*, the main growing season (June–July), *postrera* (August–September), and *apante* (November–December). The survey is administered during the last quarter of the year once the harvest has occurred for the first two seasons, *primera* and *postrera*, as shown in Figure A2. At that time, respondents are asked to predict the third harvest of the year, *apante*. Figure A4 illustrates the yearly contributions of the three seasons for our period of analysis. Corn production occurs mostly in the main growing season, so our estimates measure the effect of extreme temperatures during *primera*. In addition, we perform robustness tests using the other seasons and only the lean season, when we would expect a weak effect or no effect of extreme temperatures on production.

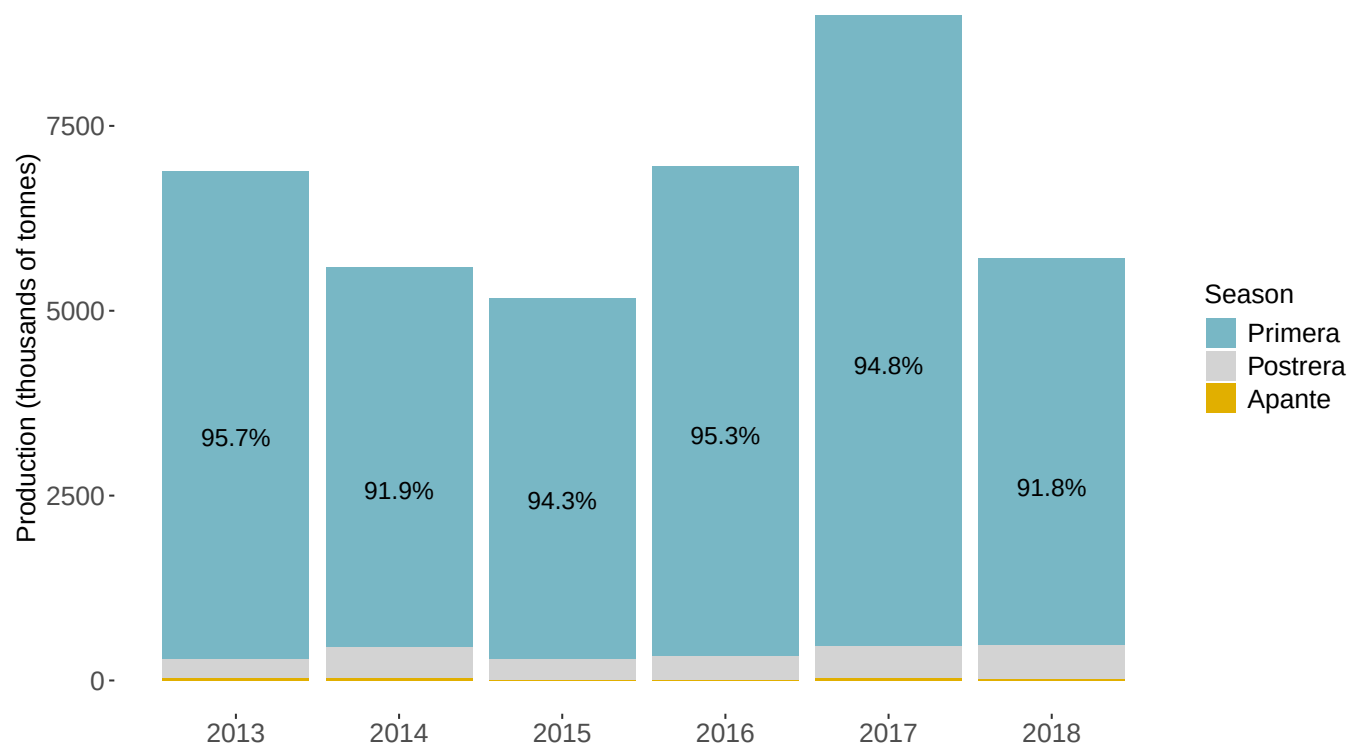
LABOR MARKETS AND MIGRATION. — To study labor outcomes and migration, we use the Multiple Purpose Household Survey (EHPM). The survey is representative at the national level and for 50 self-represented municipalities. Self-represented municipalities are the provincial capitals and other municipalities that are significantly relevant and distinctive due to their sociodemographic characteristics. Municipalities that are not self-represented are classified as co-represented. The latter term indicates a group of municipalities that share similar sociodemographic characteristics within a province and are represented jointly.

Labor outcomes are constructed based on the labor module of the survey for the working-age population aged 10–65 years. Labor outcomes include employment, hourly wages, weekly hours, and monthly wages.³⁷ The module also enables us to identify an occupational sector for each working member of the household.

Migration outcomes are identified using the migration module, which collects information on household members who live abroad, their year of migration, and their destination country. To measure migration, we use a question that asks: “Currently, is there any current or past member of this household who resides abroad?” followed by questions: “For how long? (Register the most recent one)” and “country of residence.” Therefore, even if the household reports more than one migrant, we don’t have information about the year of migration for each, only for the last one(s) who migrated. In our period of interest, between 93 percent and 95 percent of household members living abroad resided in the United States. Our outcome variable is a dummy equal to one when at least one

³⁷Variables in Salvadoran Colons (SVC\$) are deflated using the deflator of Banco Central de Reserva de El Salvador in <https://www.bcr.gob.sv/bcrsite/?cdr=123>.

Figure A4. : Corn Production across Yearly Seasons in El Salvador



Notes: Own elaboration based on El Salvador's Multiple Purpose National Agricultural Survey (ENAPM) data for 2013 to 2018. *Primera* corresponds to the main growing season (June–July). *Postrera* or the lean season corresponds to August and September, and *apante* corresponds to November and December. The numbers in black represent the percentage of the total production for *primera* over the total yearly production of corn.

household member migrated abroad one year prior to the survey. Therefore, this analysis is conducted at the household level.

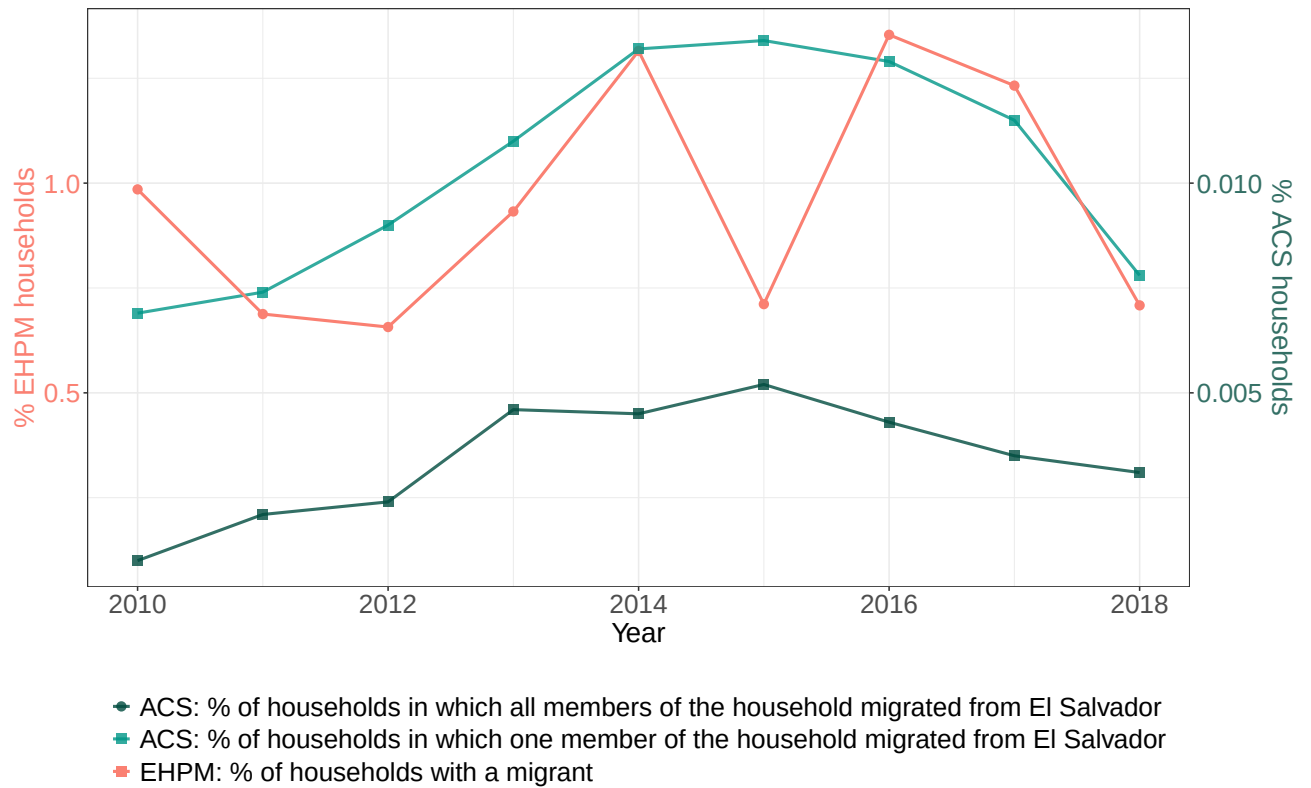
Ideally, we would measure migration using data on migrants rather than on households with migrants. The latter may underestimate the number of migrants as, in some cases, all household members may migrate together, especially following extreme temperatures. On the other hand, US data on Salvadoran migrants may underreport undocumented ones (Halliday, 2006). To evaluate potential underreporting of entire-household migration, we compare migration trends from the EHPM and the American Community Survey (ACS).³⁸

³⁸The ACS is a repeated cross-sectional dataset that covers a one percent random sample of the US population

Using the ACS, we calculate the percentage of households in the United States with at least one or all members who migrated from El Salvador the previous year. Figure A5 shows similar trends for both surveys for most years except for 2015. That year, the percentage of entire-household migration reported in the ACS spiked while in the EHPM, households reporting migrant members fell sharply. This suggests 2015 might have been a year when international migration was more common for entire Salvadoran households than for individuals. Reassuringly, our results are robust with and without the 2015 data.

Tables A1 and A2 present descriptive statistics for the variables employed in our study. Table A1 consists of three panels. Panel A provides individual-level labor outcome statistics from the EHPM survey, Panel B presents the migration outcome measured at the household level, and Panel C shows agricultural outcome statistics at the producer level from the ENAPM survey. Table A2 provides descriptive statistics of the control variables. Panel A shows household-level data from the EHPM, and Panel B shows aggregated data at the municipal level on temperature, rainfall, geographical controls, and baseline socioeconomic characteristics.

Figure A5. : Migration Trends of Salvadorans – EHPM and ACS



Notes: Own elaboration based on the American Community Survey (ACS) and El Salvador's Multiple Purpose Household Survey (EHPM). The lighter green line indicates the percentage of households with a member who was living in El Salvador a year earlier, and the darker green line indicates the percentage of households in which all members were living in El Salvador a year earlier. The red line indicates the percentage of households surveyed in El Salvador with a member living outside the country who migrated in the same year.

Table A1—: Descriptive Statistics: Outcome Variables

Variable	N	Mean	Std. Dev	Min	Max
<i>Panel A: EHPM Individual level</i>					
Employed	639412	51.342	49.982	0.000	100.000
Employed in agricultural sector	639412	12.476	33.045	0.000	100.000
Employed in agricultural sector (seasonal)	639412	8.033	27.180	0.000	100.000
Employed in agricultural sector (corn)	639412	7.224	25.888	0.000	100.000
Employed in the non agricultural sector	639412	38.987	48.772	0.000	100.000
Weekly hours worked	328288	40.742	16.417	1.000	84.000
Hourly wage (\$SCV)	265442	2.260	10.376	0.003	2072.144
<i>Panel B: EHPM Household level</i>					
=100 if at least one migrant member last year	207249	0.790	8.800	0.000	100.000
<i>Panel C: EHPM Municipal level</i>					
Share of working age population	2239	0.974	0.0785	0.560	1.000
Share of working age population that is employed	2239	50.046	7.528	8.696	75.163
Share of working age population that is employed in corn	2239	18.454	17.071	0.000	85.714
Mean municipal salary per hour	2239	2.171	1.336	0.167	28.072
Mean municipal salary per hour in corn	1782	0.927	0.881	0.0201	13.579
<i>Panel D: ENAPM Agricultural unit level</i>					
Corn production (ton.)	19325	1.915	1.890	0.001	58.880
Corn - productivity (ton. per ha)	19325	2.339	1.209	0.000	19.189
TFP production	16548	-0.000	0.694	-21.823	1.545
Corn - productivity (ton. per worker)	18847	0.447	0.414	0.000	9.660
Total workers	18908	5.407	7.326	0.000	494.000
Hired workers	18908	3.700	7.380	0.000	494.000
Household workers	18908	1.707	1.571	0.000	43.000
Principal Component Index of inputs (PCI)	16983	0.147	0.367	-7.259	0.299
Planting material (=100 if used)	16983	99.623	6.127	0.000	100.000
Fertilizer (=100 if used)	16983	99.576	6.498	0.000	100.000
Pesticide and Fungicide (=100 if used)	16983	99.323	8.201	0.000	100.000
Post Harvest Chemical agents (=100 if used)	16983	92.916	25.656	0.000	100.000
Agroecological (=100 if used)	16983	1.896	13.639	0.000	100.000
Land Size (Ha)	16983	1.420	4.163	0.077	210.000
Land Size cultivated in corn (Ha)	16983	0.711	0.711	0.056	45.500

Notes: Panel A shows descriptive statistics for El Salvador's Multiple Purpose Household Survey (EHPM) from 2009–2018 at the individual level. Panel B presents the migration outcome that is measured at the household level. Panel C shows descriptive statistics for the EHPM aggregated at the municipal level using municipal weights. Panel D shows data from 2013–2018 of El Salvador's Agricultural Household Survey at the agricultural unit level.

Table A2—: Descriptive Statistics: Control Variables

Variable	N	Mean	Std. Dev	Min	Max
<i>Panel A: EHPM Individual level</i>					
Years of education	639412	5.869	4.488	0.000	25.000
Male	639412	0.469	0.499	0.000	1.000
Age	639412	30.758	15.173	10.000	65.000
<i>Panel B: EHPM Household level</i>					
Male head	207249	0.647	0.478	0.000	1.000
Age of head	207249	48.893	16.760	14.000	98.000
Household size	207249	3.848	1.973	1.000	24.000
Has agricultural credit	207249	0.033	0.178	0.000	1.000
<i>Panel C: ENAMP Agricultural unit level</i>					
Highest education level of the household	19325	2.465	0.925	0.000	6.000
Has irrigation	19325	0.004	0.067	0.000	1.000
Household size	19325	4.285	2.064	1.000	16.000
<i>Panel D: Municipalities</i>					
Weeks temperature 2sd > historic mean during main growing season	244	1.838	0.991	0.000	4.400
Weeks rainfall 2sd > historic mean during main growing season	244	0.335	0.162	0.000	1.000
Weeks rainfall 2sd < historic mean during main growing season	244	7.632	0.516	0.000	8.000
Mean temperature during main growing season	244	29.246	2.206	22.417	35.959
Mean rainfall during main growing season	244	66.148	21.634	0.000	130.660
Mean elevation	244	498.362	278.794	9.677	1522.368
Extension	244	83.733	88.237	5.400	668.360
Poverty rate (2005)	244	50.632	14.944	10.370	88.500
Extreme poverty (2005)	244	25.751	12.596	4.200	60.400
Income per capita (2005)	244	561.074	266.001	212.600	2763.520
% employed in agriculture (2005)	244	38.471	18.494	0.520	78.510
% young adults (16 and 18) not enrolled in school (2005)	244	52.183	13.539	5.500	84.270
% households with no access to drinking water (2005)	244	34.707	20.223	0.100	98.600
% people less than 19 years old (2007)	244	47.541	4.145	30.800	57.300
% people more than 60 years old (2007)	244	9.879	1.954	5.400	19.000
% internal immigrants	244	19.031	13.552	1.245	108.087
% external immigrants	244	29.947	26.330	3.862	234.916

Notes: Panel A shows descriptive statistics for El Salvador's Multiple Purpose Household Survey (EHPM) at the individual level from 2009–2018, while Panel B shows descriptive statistics at the household level. Panel C shows data of El Salvador's Agricultural Household Survey at the producer level from 2013 – 2018. Panel D shows municipality-level statistics for 2009–2018. The temperature statistics are calculated using the municipal average. The historic mean and standard deviation are calculated for the period between 2000 and 2003.

EXTREME TEMPERATURE. — Temperature data come from two sources: NASA’s Moderate Resolution Imaging Spectroradiometer (MODIS) Land Surface Temperature for 2000–2018 (MOD11)³⁹, and the ERA5-Land dataset for 1980 to 2018 (ECMWF ERA5)⁴⁰. MODIS provides higher spatial resolution with a data grid of one kilometer and reports temperatures in eight-day averages, while ERA5 offers daily measurements at a coarser spatial resolution of approximately nine kilometers at the equator. Consequently, while MODIS offers superior spatial granularity, ERA5-Land allows us to establish a longer historical baseline for identifying temperature anomalies. To construct our measure of extreme temperature, we follow several steps. First, to ensure consistency between the datasets, we aggregate ERA5’s daily measurements into eight-day averages to match MODIS’s temporal structure. Second, we aggregate both datasets to the district level using weighted means based on the area covered. Third, we implement a conversion procedure to leverage the advantages of both datasets while maintaining consistency. Specifically, we transform earlier ERA5 data (1980–1999) to match MODIS-equivalent values during their common period (2000–2018):

$$(4) \quad T^{MODIS}_{i,t} = \beta_0 + \beta_1 T^{ERA5}_{i,t} + \sum_{m=1}^{12} \gamma_m (T^{ERA5}_{i,t} \times Month_m) + \sum_{i=1}^N \delta_i (T^{ERA5}_{i,t} \times District_i) + \sum_{m=1}^{12} \alpha_m Month_m + \sum_{i=1}^N \phi_i District_i + \epsilon_{i,t}$$

where $T^{MODIS}_{i,t}$ and $T^{ERA5}_{i,t}$ represent temperature measurements from MODIS and ERA5, respectively, for district i at time t . $Month_m$ and $District_i$ are indicator variables for each month and district, respectively. The model includes interactions between ERA5 temperatures and month fixed effects, district fixed effects, and month-by-month interactions to capture both spatial and temporal patterns in the relationship between the two datasets.

³⁹Wan, Hook and Hulley (2021)

⁴⁰Muñoz Sabater et al. (2024)

The following table shows the result for β_1 from regression 4:

Table A3—: MODIS and ERA5 temperatures correlation

	<i>Dependent variable:</i>
	MODIS
ERA5-Land	1.030*** (0.057)
Constant	7.581*** (1.341)
Observations	215,132
R ²	0.818
Adjusted R ²	0.817
Residual Std. Error	1.823 (df = 214588)
F Statistic	1,770.576*** (df = 543; 214588)
<i>Note:</i> *p<0.1; **p<0.05; ***p<0.01	

Using the resulting coefficients, we predict MODIS-equivalent temperatures for the ERA5 data from 1980 to 2000, effectively creating a harmonized dataset with MODIS-level resolution for the entire 1980–2018 period. The following image shows the correlation between MODIS and the predicted MODIS using ERA5-Land for the years 2000–2018. The coefficient of correlation is 0.904.

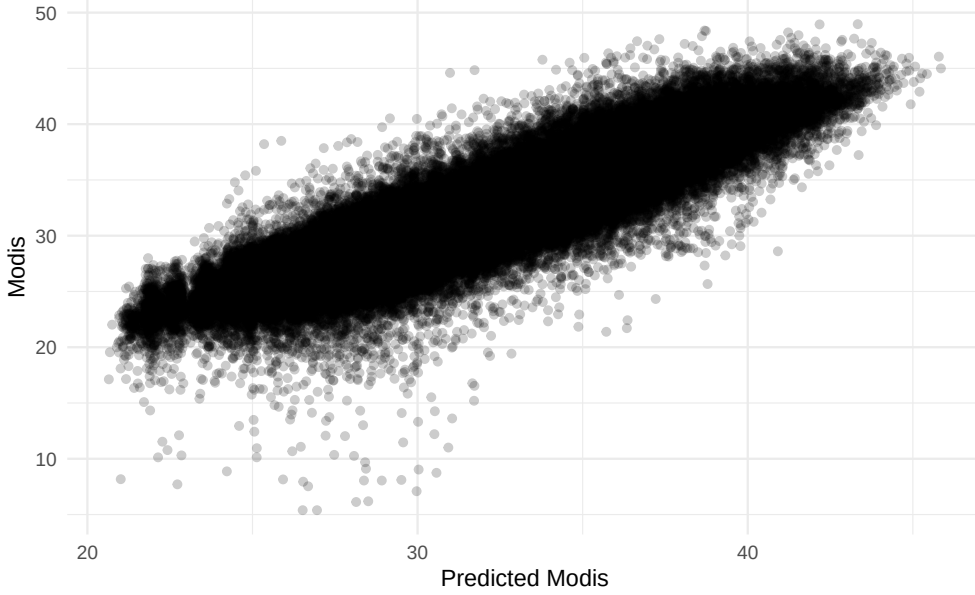
The statistics for MODIS and predicted MODIS temperatures are:

Table A4—: Summary Statistics for MODIS and predicted MODIS temperatures

Statistic	MODIS	Predicted MODIS
Mean	30.852	30.859
Median	29.956	30.123
Standard Deviation	4.258	3.854

Our primary measure of extreme temperatures is the number of weeks during the main growing season in which the temperature was two standard deviations above its historic mean during that same week. To create our “Extreme Temperature” variable, we follow the next steps: first, we estimate historical means and standard deviations for temperature for the main growing season from 1980 to 2003. Second, we standardize the temperature of municipality j during week w of year y using the historic mean $\mu_{j,w,1980-2003}$ and standard

Figure A6. : Correlation between MODIS and the Predicted MODIS temperatures



deviations $\sigma_{j,w,1980-2003}$ of municipality j during week w , between 1980 and 2003 (McKee, Doesken and Kleist, 1993; Marchiori, Maystadt and Schumacher, 2012):⁴¹

$$\frac{\text{Temperature}_{j,w,y} - \mu_{j,w,1980-2003}}{\sigma_{j,w,1980-2003}}$$

where $\text{Temperature}_{j,w,y}$ is the temperature of municipality j and time w (week) during the main growing season of year y . Third, we define “Extreme Temperature” as being two standard deviations above the mean.⁴²

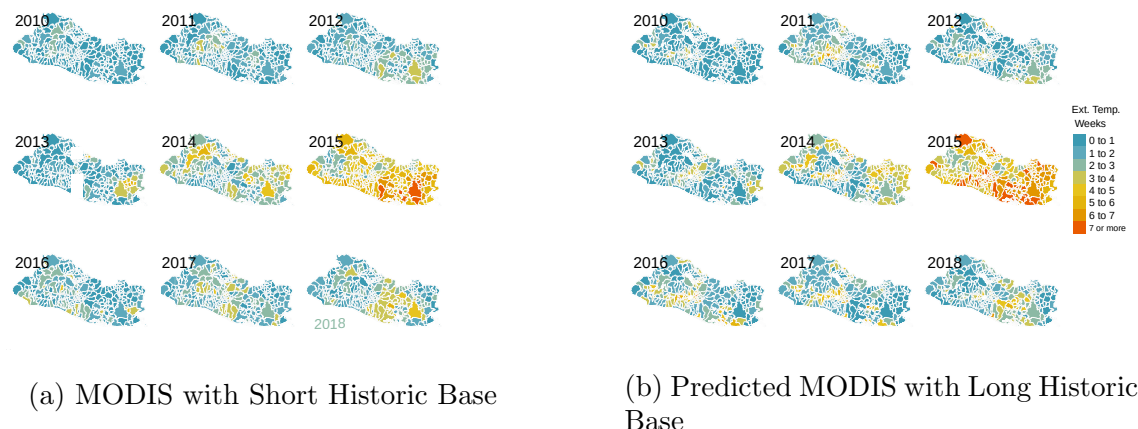
$$\text{Extreme Temperature}_{j,w,y} = 1 \left[\frac{\text{Temperature}_{j,w,y} - \mu_{j,w,1980-2003}}{\sigma_{j,w,1980-2003}} \geq 2 \right]$$

⁴¹This is similar to the method implemented by McKee, Doesken and Kleist (1993) to estimate SPI (standardized precipitation index) and the definition of weather anomaly by Marchiori, Maystadt and Schumacher (2012).

⁴²McKee, Doesken and Kleist (1993) use this method to classify extreme droughts, using the SPI.

The following map shows the number of extreme temperature weeks with the predicted MODIS temperature:

Figure A7. : Extreme Temperature Weeks with Distinct Historic Bases



The statistics on the number of extreme temperature weeks per municipality and year are:

Table A5—: Extreme Temperature Weeks using MODIS and Predicted MODIS

Statistic	Shorter Period (MODIS)	Longer Period (Predicted MODIS)
Mean	0.985	1.590
Median	1.00	1.00
Standard Deviation	1.233	1.679

EXTREME RAINFALL. — Precipitation information comes from the Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS)⁴³, which provides high-resolution satellite data at 0.05° degrees, covering the period from 1981 to the current date. To construct our measures of extreme rainfall (high rainfall and low rainfall), we implemented the following process.

First, to ensure consistency between the rainfall and temperature data sets, we aggregated the daily measurements into eight-day averages to match the frequency of MODIS.

⁴³Funk et al. (2015)

Second, we aggregated the data to the district level using weighted means based on the area covered. Third, we estimate historical means and standard deviations for rainfall for the main growing season from 1980 to 2003. Finally, we standardize the rainfall of municipality j during week w of year y , using the historic mean $\mu_{j,w,1980-2003}$ and standard deviations $\sigma_{j,w,1980-2003}$ of municipality j , during week w , between 1980 and 2003:

$$\frac{\text{Rainfall}_{j,w,y} - \mu_{j,w,1980-2003}}{\sigma_{j,w,1980-2003}}$$

where $\text{Rainfall}_{j,w,y}$ is the rainfall of municipality j and time w (week) during the main growing season of year y . Third, we define “High Extreme Rainfall” as being two standard deviations above the mean and “Low Extreme Rainfall” as being two standard deviations below the mean. We include these two measures as controls for Extreme Rainfall.

CONTROLS. — Table A6 shows the controls used for each specification, including municipality controls, fixed effects, extreme rainfall, and corn producer, individual or household controls.

Table A6—: Controls employed for each specification

Outcomes	Agricultural	Individual Labor	Migration
Specification	(1)	(5)	(3)
Main data source	ENAPM	EHPM	EHPM
Extreme temperatures T_{jk}	t	t	$t - 1$
Lagged temperatures $\sum_{k=t-4}^{k=t-1} T_{jk}$	$t - 1$ to $t - 4$	$t - 1$ to $t - 4$	$t - 2$ to $t - 5$
<i>Controls:</i>			
Extreme rainfall Z_{jt}	t	t	$t - 1$
Baseline municipality controls $\times$ year $W'_{j2005} * t$	Yes	Yes	Yes
Municipality and year fixed effects $\mu_j + \phi_t$	Yes	Yes	Yes
Corn Producer, Individual or Household Controls X'_{ijt}	Household head's education, number of household members, and irrigation for corn	Age, gender and years of education	Household head's gender and age, and number of household's members

Extreme Rainfall Z_{jt} : This is the number of months of extreme rainfall during the main growing season, estimated as two standard deviations above and below the historic mean (1981–2003). Precipitation data were extracted from CHIRPS daily Rainfall Data⁴⁴, with a resolution of 0.05 degree with daily periodicity and available from 1981.

Baseline municipality controls $\times$ year $W'_{j2005} * t$: This includes variables from the 2005 Poverty Map of El Salvador⁴⁵ and the 2007 Nacional Census.⁴⁶ From the 2005 Poverty Map of El Salvador, we employ the following variables: poverty and extreme poverty rates, income per capita, percentage of households with no access to drinking water, percentage of people employed in agriculture, and percentage of young adults (16–18 years of age) who are not enrolled in school. From the 2007 census, we estimate the percentage of the population below 19 years of age, the percentage of the population above 60 years of age, population density, the number of internal migrants and emigrants,⁴⁷ and the percentage of households with members living abroad. Lastly, we also include linear time trends interacted with the municipality's elevation, calculated at the grid level and averaged for the municipality. We extract this information from ASTER Global Digital Elevation Model NetCDF V003, NASA EOSDIS.

Corn producer, individual or household controls X'_{ijt} : Household controls vary by source of information and specification. Household controls for agricultural outcomes estimated using the ENAPM are the household head's education, number of household members, and access to irrigation for corn. Household controls for migration outcomes estimated using the EHPM are the household head's gender, and age and number of household members. There are no household controls for outcomes at the municipality level.

A3. Agricultural Outcomes

⁴⁴Funk et al. (2015)

⁴⁵Briones, Castro and López (2005)

⁴⁶General Directorate of Statistics and Census (DIGESTYC)

⁴⁷The number of internal migrants is estimated by the difference in birthplace and place of residence.

Table A7—: Impact of Extreme Temperatures on Corn Agricultural Outcomes Varying Controls

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Log(Corn Production)</i>						
Extreme Temperature _t	−0.063*** (0.023)	−0.027** (0.012)	−0.027** (0.011)	−0.024* (0.013)	−0.027** (0.013)	−0.030** (0.012)
Extreme Temperature _{t−1} ^{t−4}	−0.0004 (0.016)	0.017** (0.008)	0.018** (0.008)	0.019** (0.009)	0.010 (0.010)	0.009 (0.009)
Mean	1.915	1.915	1.915	1.915	1.915	1.915
Observations	19,325	19,325	19,325	19,325	19,325	19,325
Adjusted R ²	0.018	0.223	0.223	0.223	0.225	0.238
<i>Panel B: Log(Production of Corn per Ha.)</i>						
Extreme Temperature _t	−0.056*** (0.017)	−0.045** (0.018)	−0.045** (0.018)	−0.042** (0.018)	−0.041** (0.018)	−0.039** (0.018)
Extreme Temperature _{t−1} ^{t−4}	0.025* (0.014)	−0.009* (0.005)	−0.008 (0.005)	−0.008 (0.006)	−0.009 (0.007)	−0.009 (0.007)
Mean	2.339	2.339	2.339	2.339	2.339	2.339
Observations	19,325	19,325	19,325	19,325	19,325	19,325
Adjusted R ²	0.022	0.262	0.262	0.264	0.264	0.270
<i>Panel C: TFP(Log Production)</i>						
Extreme Temperature _t	−0.064*** (0.015)	−0.034*** (0.011)	−0.034*** (0.010)	−0.031*** (0.011)	−0.032*** (0.011)	−0.032*** (0.011)
Extreme Temperature _{t−1} ^{t−4}	0.015 (0.015)	0.014** (0.006)	0.015** (0.006)	0.016** (0.007)	0.009 (0.008)	0.008 (0.008)
Mean	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
Observations	16,548	16,548	16,548	16,548	16,548	16,548
Adjusted R ²	0.026	0.282	0.282	0.283	0.285	0.290
<i>Panel D: Log(Labor Productivity)</i>						
Extreme Temperature _t	−0.044** (0.021)	−0.006 (0.014)	−0.006 (0.014)	−0.006 (0.015)	−0.007 (0.014)	−0.007 (0.015)
Extreme Temperature _{t−1} ^{t−4}	−0.001 (0.014)	0.021 (0.014)	0.019 (0.017)	0.019 (0.018)	0.012 (0.014)	0.012 (0.014)
Mean	0.447	0.447	0.447	0.447	0.447	0.447
Observations	18,847	18,847	18,847	18,847	18,847	18,847
Adjusted R ²	0.009	0.168	0.168	0.168	0.171	0.172
Controls						
Year Fixed Effects		x	x	x	x	x
Municipality Fixed Effects		x	x	x	x	x
Extreme Rainfall _t			x	x	x	x
Geographic*Year				x	x	x
Baseline Municipality ₂₀₀₅ *Year					x	x
Corn Producer Controls _t						x

Notes: We use data from El Salvador's Multiple Purpose National Agricultural Survey (ENAPM) for corn-producing agricultural units for 2013 to 2018. Each panel has a different dependent variable: Panel A uses the logarithm of corn production from the main harvest; Panel B, the logarithm of corn production per hectare from the main growing season; Panel C, the Total Factor Productivity (TFP) of corn calculated as the logarithm of production from the main growing season, using area, labor, and inputs; Panel D, the logarithm of production per worker from the main harvest. Regressions have the same controls and independent variables as in Table 1. Standard errors are clustered by municipality and year. *p<0.1; **p<0.05; ***p<0.0

Table A8—: Impact of Extreme Temperatures on the Probability of Having Household and Hired Workers in the Agricultural Producer Unit

	Any workers		Hired Workers		Household Workers	
	(1)	(2)	(3)	(4)	(5)	(6)
Extreme Temperature _t	−0.056 (0.046)	−0.073 (0.049)	−1.167*** (0.343)	−0.815** (0.366)	0.002 (0.315)	0.430 (0.336)
Extreme Temperature _{t−1} ^{t−4}		−0.034 (0.034)		0.698*** (0.254)		0.848*** (0.233)
Probability	99.677	99.677	75.428	75.428	77.613	77.613
Observations	18,908	18,908	18,908	18,908	18,908	18,908
Adjusted R ²	0.023	0.023	0.069	0.069	0.162	0.162
Controls						
Year Fixed Effects	x	x	x	x	x	x
Municipality Fixed Effects	x	x	x	x	x	x
Extreme Rainfall _t	x	x	x	x	x	x
Geographic*Year	x	x	x	x	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x	x	x	x	x
Corn Producer Controls _t	x	x	x	x	x	x

Notes: We use data from El Salvador’s Multiple Purpose National Agricultural Survey (ENAPM) for corn-producing agricultural units for 2013 to 2018. Columns (1) and (2) correspond to the dependent variable of the likelihood (0 to 100) of having workers in these households. Columns (3) and (4) correspond to the likelihood of having hired workers. Columns (5) and (6) correspond to the likelihood of having household workers. Regressions have the same controls and independent variables as in Table 1. Standard errors are clustered by municipality and year. *p<0.1; **p<0.05; ***p<0.01

A4. Labor Outcomes at the Municipality Level

At the municipality level, we estimate the following model:⁴⁸

$$(5) \quad l_{jts} = \alpha + \delta_1 T_{jt} + \delta_2 \sum_{k=t-4}^{k=t-1} T_{jk} + \beta Z_{jt-1} + \mu_j + \phi_t + W'_{j2005} * t + \epsilon_{jts}.$$

where l_{jts} represents the employment share of municipality j in year t and sector s (agricultural and non-agricultural), using the same controls as in equation (1).⁴⁹

The odd-numbered columns of Table A9 show results without controlling for cumulative exposure to extreme temperatures in previous seasons, while the even-numbered columns

⁴⁸For the EHPM, we have data from 2009–2018, but the earliest year in the ENAPM is 2013. We estimate the labor and migration models for 2013–2018 and the results are robust for this sample.

⁴⁹Employment Share in Sector s and municipality $j = \frac{\#Workers_{sj}}{WorkingAgePop_j}$.

include this control.⁵⁰ Regarding our preferred specification in the even-numbered columns in Panel A, we find that the share of workers in the agricultural sector falls. Due to the lack of significance, we refrain from drawing strong conclusions based on the magnitude of the coefficients. At face value, though, we find that the effect on the agricultural sector is a drop of 0.8 p.p., similar in magnitude to the effect on the nonagricultural sector.

To understand, if the effects on shares are coming from the numerator or the denominator, we estimate the effect of extreme temperature on the number of working age individuals in municipality j and year t . Table A10 shows these effects. In columns 1 to 4, the dependent variable is the logarithm of the number of working-age individuals in the municipality, defined as ages 10 to 65 (columns 1 and 2) and ages 18 to 65 (columns 3 and 4). In columns 5 and 6, the dependent variable is the migration rate, estimated as the ratio between the number of international migrants at time t and the working-age population aged 10 to 65. The number of migrants in year t is based on households reporting a migrant for that year. Since we cannot determine the exact number of migrants per year, we assume only one migrant per household. This indicates that the effects on employment shares are not driven by population changes or by entire households migrating out of El Salvador.

⁵⁰The sample size changes across columns because some municipalities do not have observations for some sectors. The results are robust when estimating all the models for a balanced sample of municipalities.

Table A9—: Impact of Extreme Temperatures on Municipal Labor Outcomes

	Employed		Agricultural (Seasonal)		Agricultural (Corn)		Non-Agricultural	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Panel A: Employment Share</i>								
Extreme Temperature _t	0.068 (0.127)	0.052 (0.129)	−0.001 (0.100)	0.006 (0.101)	−0.008 (0.098)	−0.014 (0.099)	0.065 (0.131)	0.032 (0.134)
Extreme Temperature _{t-1} ^{t-4}		−0.043 (0.083)		0.019 (0.062)		−0.017 (0.059)		−0.087 (0.086)
Mean	50.046	50.046	9.864	9.864	9.080	9.080	35.078	35.078
Observations	2,239	2,239	2,239	2,239	2,239	2,239	2,239	2,239
Adjusted R ²	0.385	0.384	0.716	0.716	0.731	0.731	0.773	0.773
<i>Panel B: Sectoral Wages per hour (log)</i>								
Extreme Temperature _t	0.001 (0.008)	0.0004 (0.008)	−0.013 (0.019)	−0.018 (0.020)	−0.031 (0.021)	−0.035* (0.021)	0.002 (0.008)	0.003 (0.009)
Extreme Temperature _{t-1} ^{t-4}		−0.002 (0.005)		−0.013 (0.013)		−0.010 (0.014)		0.001 (0.005)
Mean	2.171	2.171	0.945	0.945	0.927	0.927	2.413	2.413
Observations	2,239	2,239	1,857	1,857	1,782	1,782	2,237	2,237
Adjusted R ²	0.348	0.348	0.499	0.499	0.540	0.540	0.274	0.273
<i>Controls</i>								
Year Fixed Effects	x	x	x	x	x	x	x	x
Municipality Fixed Effects	x	x	x	x	x	x	x	x
Extreme Rainfall _t	x	x	x	x	x	x	x	x
Geographic*Year	x	x	x	x	x	x	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x	x	x	x	x	x	x

Notes: We use municipality-level data from El Salvador's Multiple Purpose Household Survey (EHPM) for people 10–65 years old from 2009–2018. The dependent variable in Panel A is the share of the working-age population employed per sector (multiplied by 100). The dependent variable in Panel B is the logarithm of the average wage per sector. It is calculated by converting the most recent salary or wage received into an hourly rate. Columns (1) and (2) show the overall share of employed people over the working-age population in Panel A, and the average wage per hour in logarithms in Panel B. Columns (3) and (4) correspond to those employed in the agriculture of seasonal crops, including cereals, corn, rice, beans, seeds, and tubers, over the working-age population in Panel A, and the average wage per hour in this specific agricultural sector in Panel B. Columns (5) and (6) present data for those employed in the agriculture of corn over the working-age population in Panel A, and the average wage per hour in the corn agriculture sector in Panel B. Columns (7) and (8) correspond to those employed in any sector other than agriculture over the working-age population in Panel A, and the average wage per hour in these non-agricultural sectors in Panel B. The independent variable Extreme Temperature_t is the number of weeks with a temperature two standard deviations higher than that week's historic value in that municipality during the main growing season in the same year. The independent variable Extreme Temperature_{t-1}^{t-4} is the number of weeks with a temperature two standard deviations higher than that week's historic value in that municipality during the main growing season from year t-1 to t-4. The means correspond to the mean of the dependent variable without transformation. Controls are at the municipal level. Fixed effects, rainfall, and geographic and municipal controls are the same as in Table 1. The number of observations varies due to a lack of municipal wage information in certain sectors. We include sample weights in the estimations. Standard errors are robust to heteroskedasticity and are adjusted by sample size. *p<0.1; **p<0.05; ***p<0.01

Table A10—: Impact of Extreme Temperatures on Municipal Demographics

	Working Age 10-65 (log)		Working Age 18-65 (log)		Migration Rate	
	(1)	(2)	(3)	(4)	(5)	(6)
Extreme Temperature _{<i>t</i>}	−0.0002 (0.0004)	0.00001 (0.0004)	0.001 (0.001)	0.001 (0.001)	0.191 (0.183)	0.217 (0.187)
Extreme Temperature _{<i>t</i>−1} ^{<i>t</i>−4}		0.001* (0.0003)		0.00003 (0.001)		0.069 (0.122)
Mean	97.414	97.414	73.405	73.405	18.696	18.696
Observations	2,239	2,239	2,239	2,239	2,239	2,239
Adjusted R ²	0.957	0.957	0.650	0.650	0.603	0.602
Controls						
Year Fixed Effects	x	x	x	x	x	x
Municipality Fixed Effects	x	x	x	x	x	x
Extreme Rainfall _{<i>t</i>}	x	x	x	x	x	x
Geographic*Year	x	x	x	x	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x	x	x	x	x

Notes: We use municipal-level data of El Salvador's Multiple Purpose Household Survey (EHPM) for people 10–65 years old from 2009–2018. In columns (1) to (4), the dependent variable is the logarithm of the number of working-age individuals in the municipality, defined as ages 10 to 65 (columns (1) and (2)) and ages 18 to 65 (columns (3) and (4)). In columns (5) and (6), the dependent variable is the migration rate, estimated as the ratio between the number of international migrants at time *t* and the working-age population aged 10 to 65. Independent variables and controls are the same as Table A9. Standard errors are robust to heteroskedasticity and are adjusted by sample size. *p<0.1; **p<0.05; ***p<0.01

A5. Additional Tables

Table A11—: Impact of Extreme Temperatures on Migration Likelihood – Varying Controls

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: All Households</i>						
Extreme Temperature _{<i>t</i>−1}	0.046 (0.039)	0.057*** (0.013)	0.057*** (0.013)	0.057*** (0.013)	0.060*** (0.014)	0.061*** (0.014)
Extreme Temperature _{<i>t</i>−2} ^{<i>t</i>−5}	−0.053*** (0.015)	−0.023* (0.013)	−0.023* (0.013)	−0.024* (0.013)	−0.016 (0.013)	−0.016 (0.013)
Mean	0.788	0.788	0.788	0.788	0.788	0.788
Observations	207,249	207,249	207,249	207,249	207,249	207,249
Adjusted R ²	0.001	0.004	0.004	0.004	0.004	0.005
<i>Panel B: Agricultural Households (all)</i>						
Extreme Temperature _{<i>t</i>−1}	0.072*** (0.022)	0.049 (0.035)	0.050 (0.034)	0.052 (0.037)	0.064 (0.041)	0.066 (0.042)
Extreme Temperature _{<i>t</i>−2} ^{<i>t</i>−5}	−0.079*** (0.019)	−0.031 (0.032)	−0.031 (0.032)	−0.039 (0.031)	−0.026 (0.029)	−0.025 (0.028)
Mean	0.839	0.839	0.839	0.839	0.839	0.839
Observations	33,237	33,237	33,237	33,237	33,237	33,237
Adjusted R ²	0.001	0.003	0.003	0.003	0.003	0.006
<i>Panel C: Agricultural Households (seasonal)</i>						
Extreme Temperature _{<i>t</i>−1}	0.135*** (0.030)	0.119** (0.055)	0.122** (0.054)	0.123** (0.053)	0.134*** (0.050)	0.134*** (0.050)
Extreme Temperature _{<i>t</i>−2} ^{<i>t</i>−5}	−0.076*** (0.029)	−0.081** (0.040)	−0.082** (0.041)	−0.082** (0.041)	−0.070* (0.036)	−0.072** (0.033)
Mean	0.621	0.621	0.621	0.621	0.621	0.621
Observations	15,143	15,143	15,143	15,143	15,143	15,143
Adjusted R ²	0.001	−0.002	−0.002	−0.002	−0.002	0.001
<i>Panel D: Agricultural Households (corn)</i>						
Extreme Temperature _{<i>t</i>−1}	0.147*** (0.036)	0.126** (0.057)	0.129** (0.056)	0.131** (0.055)	0.147*** (0.051)	0.148*** (0.052)
Extreme Temperature _{<i>t</i>−2} ^{<i>t</i>−5}	−0.079** (0.033)	−0.099** (0.048)	−0.100** (0.048)	−0.099** (0.048)	−0.079** (0.039)	−0.079** (0.035)
Mean	0.655	0.655	0.655	0.655	0.655	0.655
Observations	13,440	13,440	13,440	13,440	13,440	13,440
Adjusted R ²	0.001	−0.003	−0.003	−0.003	−0.003	0.00003
<i>Panel E: Non-Agricultural Households</i>						
Extreme Temperature _{<i>t</i>−1}	0.034 (0.040)	0.038* (0.022)	0.037* (0.023)	0.037* (0.023)	0.037 (0.024)	0.037 (0.024)
Extreme Temperature _{<i>t</i>−2} ^{<i>t</i>−5}	−0.035*** (0.011)	−0.007 (0.016)	−0.007 (0.016)	−0.007 (0.016)	−0.005 (0.014)	−0.005 (0.014)
Mean	0.579	0.579	0.579	0.579	0.579	0.579
Observations	131,011	131,011	131,011	131,011	131,011	131,011
Adjusted R ²	0.0004	0.002	0.002	0.002	0.002	0.003
<i>Controls</i>						
Year Fixed Effects		x	x	x	x	x
Municipality Fixed Effects		x	x	x	x	x
Extreme Rainfall _{<i>t</i>−1}			x	x	x	x
Geographic*Year				x	x	x
Baseline Municipality ₂₀₀₅ *Year					x	x
Household Controls _{<i>t</i>}						x

Notes: Same notes as Table 5

Table A12—: Impact of Extreme Temperatures on Migration Likelihood – Heterogeneity by Working-Age Household Members Characteristics

	Method 1: Preferred specification	Method 2: Household head works in agriculture (corn)		Method 3: At least 50 % of working-age members work in agriculture (corn)		Method 4: At least one of the working-age members works in agriculture (corn)	
	(1)	No (2)	Yes (3)	No (4)	Yes (5)	No (6)	Yes (7)
Extreme Temperature _{<i>t</i>−1}	0.148*** (0.052)	0.046*** (0.013)	0.150*** (0.051)	0.078*** (0.017)	0.121* (0.070)	0.066*** (0.013)	0.140* (0.074)
Extreme Temperature _{<i>t</i>−2} ^{<i>t</i>−5}	−0.079** (0.035)	−0.012 (0.015)	−0.038 (0.034)	−0.022 (0.019)	−0.009 (0.035)	−0.023 (0.020)	−0.011 (0.034)
Mean	0.655	0.782	0.826	0.794	0.716	0.760	0.892
Observations	13,440	178,810	28,439	158,904	19,984	145,587	33,301
Adjusted R ²	0.00003	0.005	0.005	0.006	0.0001	0.006	0.004
Controls							
Year Fixed Effects	x	x	x	x	x	x	x
Municipality Fixed Effects	x	x	x	x	x	x	x
Extreme Rainfall _{<i>t</i>−1}	x	x	x	x	x	x	x
Geographic*Year	x	x	x	x	x	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x	x	x	x	x	x
Household Controls _{<i>t</i>}	x	x	x	x	x	x	x

Notes: Household-level data of El Salvador's Multiple Purpose Household Survey (EHPM) from 2009–2018. The dependent variable is 100 if a household member migrated in the surveyed year. Method 1 uses the preferred specification to define corn agricultural households, in which the household head works in agriculture and at least 50 percent of the members of working age are employed producing corn. Method 2 defines corn agricultural households as those in which the head of the household is employed producing corn. Method 3 defines corn agricultural households as those in which at least 50 percent of the working-age members are employed producing corn. Method 4 defines corn agricultural households as those in which at least one working-age member is employed producing corn. Regressions have the same controls and independent variables as Table 5. Standard errors are clustered by municipality and year.

*p<0.1; **p<0.05; ***p<0.01

Table A13—: Impact of Extreme Temperatures in Main Outcomes with Contemporaneous and Lag Interactions

	(1)	(2)
<i>Panel A: Log(Corn Production)</i>		
Extreme Temperature _t	−0.030** (0.012)	−0.035** (0.014)
Extreme Temperature _{t−1} ^{t−4}	0.009 (0.009)	0.007 (0.009)
Extreme Temperature $t \times \sum_{t-1}^{t-4}$		0.001 (0.002)
Mean	1.915	1.915
Observations	19,325	19,325
Adjusted R ²	0.238	0.238
<i>Panel B: Employed in Agricultural Sector (corn)</i>		
Extreme Temperature _t	−0.080 (0.059)	−0.125 (0.079)
Extreme Temperature _{t−1} ^{t−4}	0.049 (0.038)	0.037 (0.042)
Extreme Temperature $t \times \sum_{t-1}^{t-4}$		0.006 (0.006)
Mean	7.224	7.224
Observations	639,412	639,412
Adjusted R ²	0.129	0.129
<i>Panel C: Migration Likelihood in Agricultural Household (corn)</i>		
Extreme Temperature _{t−1}	0.148*** (0.052)	0.228 (0.146)
Extreme Temperature _{t−2} ^{t−5}	−0.079** (0.035)	−0.045 (0.067)
Extreme Temperature $t \times \sum_{t-1}^{t-4}$		−0.019 (0.018)
Mean	0.655	0.655
Observations	13,440	13,440
Adjusted R ²	0.00003	0.0001
Controls		
Year Fixed Effects	x	x
Municipality Fixed Effects	x	x
Extreme Rainfall	x	x
Geographic*Year	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x
Corn Producer _t / Individual _t / Household Controls _t	x	x

Notes: Each panel corresponds to a different outcome. Panel A corresponds to the logarithm of corn production from the main growing season using ENAPM dataset. Panel B corresponds to the likelihood of being employed in the employed in the agriculture of corn, using the EHPM dataset at the individual level. Panel C corresponds to the likelihood of migration in corn agricultural households using the EHPM dataset at the household level. Extreme Temperature is the number of weeks with a temperature 2 standard deviations higher than that week's historic value in that municipality during the main growing season). In Panel A and B, Extreme Temperature $t \times \sum_{t-1}^{t-4}$ is the interaction of the contemporaneous and cumulative Extreme Temperature variable. In Panel C, Extreme Temperature $t - 1 \times \sum_{t-2}^{t-5}$ is the interaction of the lagged and the cumulative Extreme Temperature variable. Controls are the same as Table 6. Standard errors are clustered by municipality and year in Panel A and C. In Panel B, standard errors are robust. *p<0.1; **p<0.05; ***p<0.01

Table A14—: Impact of Extreme Temperatures on Migration Likelihood

	(1)	(2)
<i>Panel A: Interaction with Agricultural Households (all)</i>		
Extreme Temperature _{t-1} × Agricultural Household	0.005 (0.032)	0.009 (0.034)
Extreme Temperature _{t-2} ^{t-5} × Agricultural Household		-0.006 (0.016)
Extreme Temperature _{t-1}	0.066*** (0.021)	0.059*** (0.022)
Extreme Temperature _{t-2} ^{t-5}		-0.016 (0.014)
Agricultural Household	0.030 (0.075)	0.050 (0.093)
Mean	0.788	0.788
Observations	207,249	207,249
Adjusted R ²	0.005	0.005
<i>Panel B: Interaction with Agricultural Households (seasonal)</i>		
Extreme Temperature _{t-1} × Agricultural Household (seasonal)	0.073 (0.046)	0.074 (0.047)
Extreme Temperature _{t-2} ^{t-5} × Agricultural Household (seasonal)		-0.002 (0.024)
Extreme Temperature _{t-1}	0.062*** (0.021)	0.056*** (0.021)
Extreme Temperature _{t-2} ^{t-5}		-0.016 (0.014)
Agricultural Household (seasonal)	-0.394*** (0.101)	-0.387*** (0.128)
Mean	0.788	0.788
Observations	207,249	207,249
Adjusted R ²	0.005	0.005
<i>Panel C: Interaction with Agricultural Households (corn)</i>		
Extreme Temperature _{t-1} × Agricultural Household (corn)	0.088* (0.048)	0.089* (0.050)
Extreme Temperature _{t-2} ^{t-5} × Agricultural Household (corn)		-0.001 (0.026)
Extreme Temperature _{t-1}	0.062*** (0.021)	0.055*** (0.021)
Extreme Temperature _{t-2} ^{t-5}		-0.017 (0.014)
Agricultural Household (corn)	-0.416*** (0.106)	-0.413*** (0.135)
Mean	0.788	0.788
Observations	207,249	207,249
Adjusted R ²	0.005	0.005
Controls		
Year Fixed Effects	x	x
Municipality Fixed Effects	x	x
Extreme Rainfall _{t-1}	x	x
Geographic*Year	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x
Household Controls _t	x	x

Notes: Household-level data of EHPM: 2009–2018. Dependent variable is 100 if household member migrated in the surveyed year. Following household definitions from Table 5, Panel A shows interactions with a dummy indicating if the observation corresponds to an agricultural household; Panel B interactions with a dummy indicating if the observation corresponds to seasonal agricultural household; Panel C interactions with a dummy indicating if the observation corresponds to an agricultural household that produces corn. Controls are the same as Table 5. Standard errors are clustered by municipality and year. *p<0.1; **p<0.05; ***p<0.01

A6. Spillover Effects

Table A15 shows the estimated effect of extreme temperatures on households in which no working-age individuals report labor force participation. Panel A shows that an additional week of extreme temperatures increases the probability of migration by 0.2 percentage points.

Panel B focuses on the subgroup of households with some connection to agriculture—either because a member is currently out of work while awaiting the start of the agricultural cycle, or because their most recent employment was in the agricultural sector. While these households are not classified as agricultural in our main definition (which requires current employment in agriculture), their exposure to agricultural income cycles makes them vulnerable to extreme temperatures. The coefficient for this group is sizable and statistically significant, consistent with the mechanism discussed for agricultural households in the main analysis.

More unexpected are the results in Panel C. For these households, we observe significant increases in the likelihood of migration among unemployed households with no apparent connection to the agricultural sector. These effects are surprising and raise important questions about the channels through which extreme temperatures influence migration decisions in this group.

In Panel D, we present the effects on households with undefined sector, which are those with at least one employed individual that can not be clearly categorized as agricultural or non-agricultural. While contemporaneous extreme temperatures do not have a significant effect on migration likelihood, lagged cumulative exposure reduces it.

One possibility is that these households are indirectly affected by higher food prices. This is a reasonable mechanism in El Salvador given that national trends show a positive correlation between corn and bean prices and average extreme temperatures during the corn agricultural season, as shown in Figure A8. This suggests that food availability may be affected by extreme temperatures. Food insecurity in El Salvador has been widely documented, where more than half of households had some degree of chronic food insecurity between 2015 and 2020.⁵¹ Food insecurity is worsen by extreme temperatures.⁵²

⁵¹Source: IPC

⁵²Source: Humanitarian Action, World Food Program

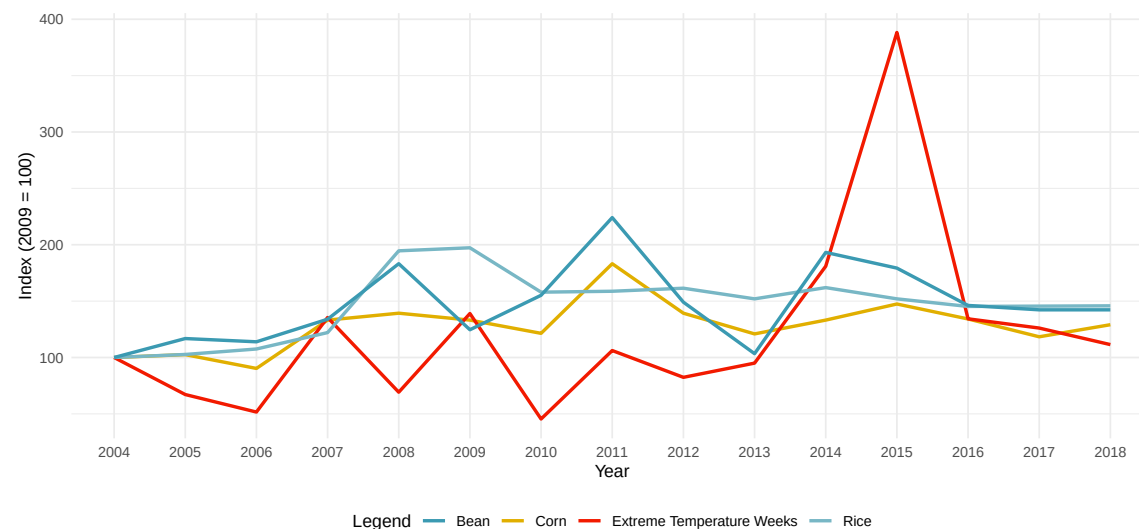


Figure A8. : Trends in food prices and extreme temperatures

Notes: We use consumption prices from the El Salvador's Ministry of Agriculture and Livestock on beans ("Frijol Rojo de Seda"), corn ("Maiz Blanco"), and rice ("Arroz Oro"). Extreme Temperature Weeks are the number of weeks with a temperature two standard deviations higher than that week and municipality's historic value during the main growing season in the same year. All variables are indexed to 100 in 2009.

In order to explore this mechanism, we estimate the effect of extreme temperatures on food expenditure per capita using a similar identification strategy as in equation 3, with the key difference that we examine contemporaneous effects—estimating the impact of extreme temperatures in time t on food consumption in the same period. It is important to note that we cannot disentangle whether changes in food expenditure are driven by price fluctuations or changes in quantity purchased. The results in Panel D of Table A16 support this hypothesis. We find a significant reduction in food expenditure among unemployed households. Among households with undefined sector, the results also suggest a reduction in food expenditure, yet results are not statistically significant. In this sense, the evidence suggests that unemployed and undefined sector households may have fewer options to adjust to income shocks and rising food prices during years of extreme temperatures, making them particularly vulnerable. They may substitute towards cheaper items or reduce the quantity purchased. Further research is needed to better disentangle the effects on food consumption and food availability. In contrast, corn-agricultural households do not experience a significant change in per capita food expenditure.

Table A15—: Impact of Temperature Shocks on Migration Likelihood - Unemployed Households

	(1)	(2)
<i>Panel A: Unemployed Households</i>		
Extreme Temperature _{<i>t</i>-1}	0.152* (0.078)	0.155* (0.080)
Extreme Temperature _{<i>t</i>-2} ^{<i>t</i>-5}		0.007 (0.049)
Mean	1.547	1.547
Observations	31,277	31,277
Adjusted R ²	0.012	0.012
<i>Panel B: Unemployed Households - Agricultural link</i>		
Extreme Temperature _{<i>t</i>-1}	0.252* (0.134)	0.285** (0.144)
Extreme Temperature _{<i>t</i>-2} ^{<i>t</i>-5}		0.079 (0.088)
Mean	1.158	1.158
Observations	4,059	4,059
Adjusted R ²	0.001	0.001
<i>Panel C: Unemployed Households - Non agricultural link</i>		
Extreme Temperature _{<i>t</i>-1}	0.146* (0.085)	0.145* (0.084)
Extreme Temperature _{<i>t</i>-2} ^{<i>t</i>-5}		-0.004 (0.056)
Mean	1.562	1.562
Observations	28,417	28,417
Adjusted R ²	0.013	0.013
<i>Panel D: Households with Undefined Sector</i>		
Extreme Temperature _{<i>t</i>-1}	0.087 (0.153)	0.055 (0.145)
Extreme Temperature _{<i>t</i>-2} ^{<i>t</i>-5}		-0.077* (0.043)
Mean	0.955	0.955
Observations	11,724	11,724
Adjusted R ²	0.003	0.003
Controls		
Year Fixed Effects	x	x
Municipality Fixed Effects	x	x
Extreme Rainfall _{<i>t</i>-1}	x	x
Geographic*Year	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x
Household Controls _{<i>t</i>}	x	x

Notes: We use household-level data from El Salvador's Multiple Purpose Household Survey (EHPM) from 2009–2018. The dependent variable is 100 if a household member migrated in the surveyed year. The independent variable Extreme Temperature_{*t*-1} is the number of weeks with a temperature two standard deviations higher than that week's historic value in that municipality during the main growing season in the year before the survey. The independent variable Extreme Temperature_{*t*-2}^{*t*-5} is the number of weeks with a temperature two standard deviations higher than that week's historic value in that municipality during the main growing season from year *t* - 2 to *t* - 5. Panel A represents households that do not have any member employed (from the question "Have you worked last week?"). Panel B includes unemployed households with a connection to agriculture, either because a member did not work but is waiting for the agricultural season to begin or because their previous employment was in agriculture. Panel C comprises unemployed households with no agricultural ties. Panel D comprises households with at least one employed individual that can not be clearly categorized as agricultural or non-agricultural. This typically occurs when information about the household head's occupation is missing, incomplete, or does not align with the defined sector categories. Consequently, these households are economically active but cannot be confidently assigned to a specific employment sector. Controls are the same as Table 5. Standard errors are clustered by municipality and year. *p<0.1; **p<0.05; ***p<0.01

Table A16—: Impact of Extreme Temperatures on Food Expenditure

	(1)	(2)
<i>Panel A: All Households</i>		
Extreme Temperature _{<i>t</i>}	0.015 (0.081)	−0.011 (0.081)
Extreme Temperature _{<i>t</i>−1} ^{<i>t</i>−4}		−0.066 (0.052)
Mean	0.788	0.788
Observations	207,249	207,249
Adjusted R ²	0.261	0.261
<i>Panel B: Agricultural Households</i>		
Extreme Temperature _{<i>t</i>}	0.099 (0.112)	0.075 (0.113)
Extreme Temperature _{<i>t</i>−1} ^{<i>t</i>−4}		−0.065 (0.075)
Mean	0.839	0.839
Observations	33,237	33,237
Adjusted R ²	0.284	0.284
<i>Panel C: Non-Agricultural Households</i>		
Extreme Temperature _{<i>t</i>}	0.095 (0.095)	0.078 (0.095)
Extreme Temperature _{<i>t</i>−1} ^{<i>t</i>−4}		−0.043 (0.072)
Mean	0.579	0.579
Observations	131,011	131,011
Adjusted R ²	0.231	0.231
<i>Panel D: Unemployed Households</i>		
Extreme Temperature _{<i>t</i>}	−0.472*** (0.148)	−0.463*** (0.139)
Extreme Temperature _{<i>t</i>−1} ^{<i>t</i>−4}		0.024 (0.107)
Mean	1.547	1.547
Observations	31,277	31,277
Adjusted R ²	0.281	0.281
<i>Panel E: Households with Undefined Sector</i>		
Extreme Temperature _{<i>t</i>}	−0.184 (0.242)	−0.227 (0.233)
Extreme Temperature _{<i>t</i>−1} ^{<i>t</i>−4}		−0.109 (0.102)
Mean	0.955	0.955
Observations	11,724	11,724
Adjusted R ²	0.291	0.291
Controls		
Year Fixed Effects	x	x
Municipality Fixed Effects	x	x
Extreme Rainfall _{<i>t</i>−1}	x	x
Geographic*Year	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x
Household Controls _{<i>t</i>}	x	x

Notes: We use household-level data from El Salvador's Multiple Purpose Household Survey (EHPM) from 2009–2018. The dependent variable is the food expenditure per capita. The independent variable Extreme Temperature_{*t*} is the number of weeks with a temperature two standard deviations higher than that week's historic value in that municipality during the main growing season in the year of the survey. The independent variable Extreme Temperature_{*t*−1}^{*t*−4} is the number of weeks with a temperature two standard deviations higher than that week's historic value in that municipality during the main growing season from year *t* − 1 to *t* − 4. Panel A corresponds to all households. Panel B corresponds to agricultural households, defined as those in which the household head and at least 50 percent of the working-age members are employed in agriculture. Panel C corresponds to non-agricultural households defined as those in which neither the household head nor less than 50 percent of the members of working age are employed in an agricultural sector. Panel D represents households that do not have any member employed (from the question “Have you worked last week?”). Panel E comprises households with at least one employed individual that can not be clearly categorized as agricultural or non-agricultural. This typically occurs when information about the household head's occupation is missing, incomplete, or does not align with the defined sector categories. Consequently, these households are economically active but cannot be confidently assigned to a specific employment sector. Controls are the same as Table 5. Standard errors are clustered by municipality and year. *p<0.1; **p<0.05; ***p<0.01

Moreover, given that unemployed households are more likely to receive remittances, relative to other households, we test whether migrant networks play a significant role in their migration decisions. In Section A.A7, we show in Table A17 that the migration effect among unemployed households is driven by those with stronger networks, proxied by the total number of household members who have migrated, both contemporaneously and in the past.

A7. Migrant Networks

Section III.E discussed the role of migrant networks and remittances as a potential pull-factor that renders feasible migrating internationally in El Salvador. We provide additional details of the empirical models discussed in that section.

We begin by estimating a model that interacts our measure of exposure to extreme temperature with the number of additional migrants reported in the household (Table A17), following the model below:

$$(6) \quad m_{ijt} = \alpha + \delta_1 T_{jt-1} + \sum_{k=1}^{k=3} \delta_{2,k} T_{jt-1} \times \Gamma_k + \delta_3 \sum_{k=t-5}^{k=t-2} T_{jk} + X'_{ijt} \gamma + \beta Z_{jt-1} + \mu_j + \phi_t + W'_{j2005} * t + \epsilon_{ijt}$$

Where $T_{jt-1} \times \Gamma_k$ is the interaction of the extreme temperatures measured with three indicators Γ_k which are equal to 1 if the household contains two migrants, three migrants, or more than three migrants, proxy of migrant networks of the household. $\delta_{2,k}$ gives the additional effect of extreme temperatures by having a larger number of migrants.

Although we can not distinguish if two or more migrants within a household migrated at the same time, information from the U.S. Border Patrol (USBP) and Office of Field Operations (OFO) reports that between 2021-2023, 66.3% of individuals of the southwest land border encounters were single adults or accompanied minors. This suggests that most of the migrants who go to the United States through the Mexican border do it by themselves. If we assume that households with more than one migrant are households who had a member living abroad prior to year $t-1$, the previous table evidences the importance of migration networks in the decision of migrating since we find a higher effect of a extreme temperature in the probability of migration for households with more than one migrant. This is suggestive evidence as, with our available data, we are unable to discern whether migrants within each household households migrated at the same time or not.

Table A17—: Heterogeneity by Access to Networks: Migration

	Corn Agricultural Households	Non Agricultural Households	Unemployed Households
	(1)	(2)	(3)
Extreme Temperature $_{t-2}^{t-5}$	-0.078** (0.039)	-0.002 (0.013)	0.013 (0.049)
Extreme Temperature $_{t-1}$	0.066 (0.048)	0.032 (0.020)	0.091 (0.081)
Extreme Temperature $_{t-1} \times$ two migrants	1.077*** (0.765)	0.087 (0.226)	0.769** (0.303)
Extreme Temperature $_{t-1} \times$ more than two migrants	1.617 (0.415)	0.144 (0.260)	0.093 (0.216)
Share household with two migrants	0.030	0.026	0.075
Share household with more than two migrants	0.026	0.021	0.082
F-test: Extreme Temp = Extreme Temp $\times$ Two Migrants	0.179	0.813	0.042
F-test: Extreme Temp = Extreme Temp $\times$ More Migrants	0.001	0.666	0.994
Observations	13,440	131,011	31,277
Adjusted R ²	0.026	0.015	0.021
Controls			
Year Fixed Effects	x	x	x
Municipality Fixed Effects	x	x	x
Extreme Rainfall $_{t-1}$	x	x	x
Geographic*Year	x	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x	x
Household Controls $_t$	x	x	x

Notes: Household-level data from 2009–2018 of El Salvador’s Multiple Purpose Household Survey (EHPM). The dependent variable is 100 if a household member migrated in the surveyed year. The sample in column 1) corresponds to corn agricultural households, defined if the household head works in agriculture and at least 50 percent of the members of working age are employed producing corn, in column 2) corresponds to non agricultural households, defined if the household head does not work in agriculture and less than 50 percent of the members of working age are employed producing corn, and column 3) to households that do not have an employed member (from the question “Have you worked last week?”). The independent variable and controls are the same as Table 5. Standard errors are clustered by municipality and year. *p<0.1; **p<0.05; ***p<0.01

Table A18—: Impact of Extreme Temperatures on Migration Likelihood – Varying Seasons and Time Frame

	Main Growing Season (1)	All Year (2)	Apante Season (3)	Lean Season (4)	2013–2018 (5)	Excluding 2015 (6)
<i>Panel A: Log(Corn Production)</i>						
Extreme Temperature _t	−0.030** (0.012)	−0.018*** (0.006)	−0.032** (0.013)	−0.006 (0.019)	−0.030** (0.012)	−0.016 (0.014)
Extreme Temperature _{t−1} ^{t−4}	0.009 (0.009)	0.003 (0.003)	0.009 (0.009)	0.006 (0.010)	0.009 (0.009)	0.009 (0.010)
Observations	19,325	19,325	19,325	19,325	19,325	16,648
Adjusted R ²	0.238	0.239	0.238	0.236	0.238	0.233
<i>Panel B: Employed in Agricultural Sector (corn)</i>						
Extreme Temperature _t	−0.080 (0.059)	−0.054** (0.027)	−0.116* (0.060)	0.055 (0.090)	−0.091 (0.083)	−0.073 (0.071)
Extreme Temperature _{t−1} ^{t−4}	0.049 (0.038)	0.003 (0.019)	0.011 (0.047)	0.079 (0.072)	0.061 (0.073)	0.034 (0.038)
Observations	639,412	639,412	639,412	639,412	356,980	573,366
Adjusted R ²	0.129	0.129	0.129	0.129	0.126	0.130
<i>Panel C: Migration Likelihood in Agricultural Households (corn)</i>						
Extreme Temperature _{t−1}	0.148*** (0.052)	0.026 (0.027)	−0.062 (0.101)	0.062 (0.111)	0.097 (0.079)	0.140** (0.066)
Extreme Temperature _{t−2} ^{t−5}	−0.079** (0.035)	−0.001 (0.018)	0.058 (0.046)	−0.060 (0.060)	−0.144** (0.071)	−0.080* (0.043)
Observations	13,440	13,440	13,440	13,440	7,229	11,871
Adjusted R ²	0.00003	−0.0004	−0.0004	−0.0004	−0.007	−0.0002
Controls						
Year Fixed Effects	x	x	x	x	x	x
Municipality Fixed Effects	x	x	x	x	x	x
Extreme Rainfall	x	x	x	x	x	x
Geographic*Year	x	x	x	x	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x	x	x	x	x
Corn Producer _t / Individual _t / Household Controls _t	x	x	x	x	x	x

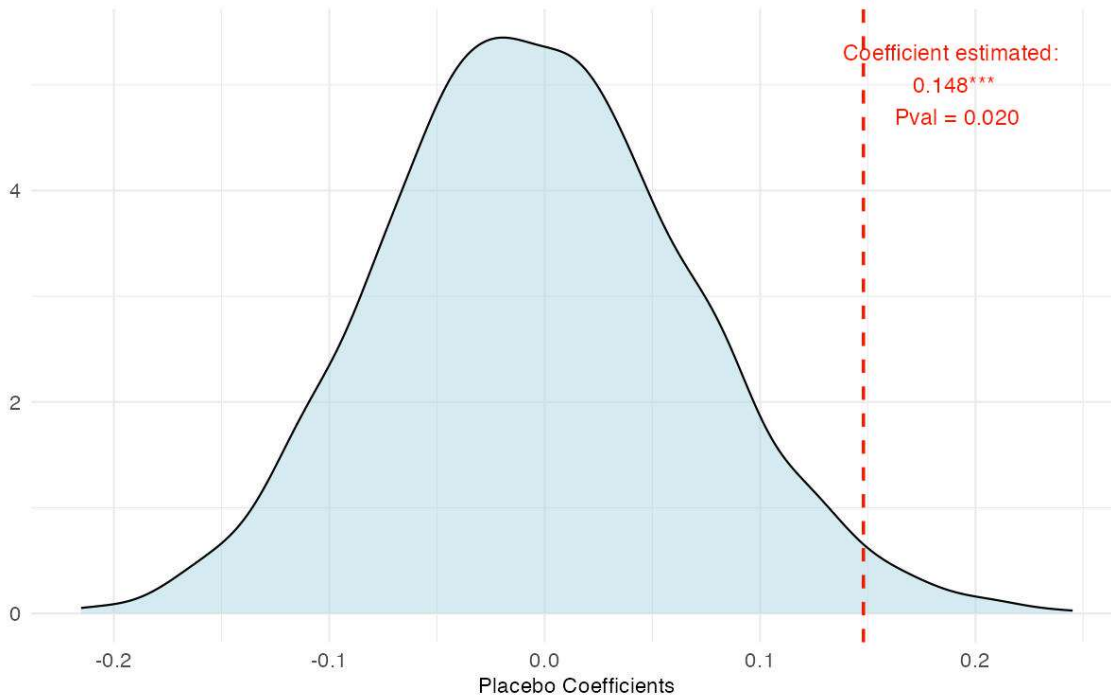
Notes: Each panel corresponds to a different outcome. Panel A corresponds to the logarithm of corn production from the main growing season using ENAPM dataset. Panel B corresponds to the likelihood of being employed in the agriculture of corn, using the EHPM dataset at the individual level. Panel C corresponds to the likelihood of migration in corn agricultural households using the EHPM dataset at the household level. Column (1) corresponds to our main specification, in which Extreme Temperature is the number of weeks with a temperature 2 standard deviations higher than that week's historic value in that municipality during the main growing season (June - July). Columns (2) to (4) estimate Extreme Temperature for different seasons: Column (2) for the whole year, Column 3 for *apante* season (November-December), and Column (4) for lean season or *postrera* (August - September). Columns (5) and (6) estimate the main specification (number of weeks with a temperature 2 standard deviations higher than that week's historic value in that municipality during the main growing season) through different periods: Column 5 estimates the results for 2013-2018 (years where ENAPM and EHPM overlap), and column (6) excluding 2015 (a particularly hot year). Controls are the same as Table 6. Standard errors are clustered by municipality and year.*p<0.1; **p<0.05; ***p<0.01

Table A19—: Impact of Extreme Temperatures in Main Outcomes - Varying Definitions of Extreme Temperatures

	1 SD	1.5 SD	Higher 29	Higher 35	HDW
	(1)	(2)	(3)	(4)	(5)
<i>Panel A: Log(Corn Production)</i>					
Extreme Temperature _t	−0.029*** (0.010)	−0.033*** (0.010)	−0.033*** (0.011)	−0.027 (0.022)	−0.005 (0.004)
Extreme Temperature _{t−1} ^{t−4}	0.008 (0.007)	0.008 (0.006)	0.007 (0.010)	0.021 (0.020)	0.005 (0.003)
Mean	1.915	1.915	1.915	1.915	1.915
Observations	19,325	19,325	19,325	19,325	19,325
Adjusted R ²	0.238	0.238	0.238	0.237	0.237
<i>Panel B: Employed in Agricultural Sector (corn)</i>					
Extreme Temperature _t	−0.068* (0.038)	−0.031 (0.047)	−0.073 (0.059)	−0.147*** (0.046)	−0.029*** (0.011)
Extreme Temperature _{t−1} ^{t−4}	−0.001 (0.039)	0.046 (0.036)	0.008 (0.042)	−0.073 (0.062)	0.001 (0.011)
Mean	7.224	7.224	7.224	7.224	7.224
Observations	639,412	639,412	639,412	639,412	639,412
Adjusted R ²	0.129	0.129	0.129	0.129	0.129
<i>Panel C: Migration Likelihood in Agricultural Households (corn)</i>					
Extreme Temperature _{t−1}	0.112* (0.061)	0.083 (0.071)	0.077 (0.065)	0.245*** (0.088)	0.045* (0.024)
Extreme Temperature _{t−2} ^{t−5}	−0.067* (0.037)	−0.109** (0.049)	−0.084** (0.037)	0.051 (0.087)	0.009 (0.021)
Mean	0.655	0.655	0.655	0.655	0.655
Observations	13,440	13,440	13,440	13,440	13,440
Adjusted R ²	0.00003	0.0001	−0.00000	−0.0002	−0.0002
Controls					
Year Fixed Effects	x	x	x	x	x
Municipality Fixed Effects	x	x	x	x	x
Extreme Rainfall	x	x	x	x	x
Geographic*Year	x	x	x	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x	x	x	x
Corn Producer _t / Individual _t / Household Controls _t	x	x	x	x	x

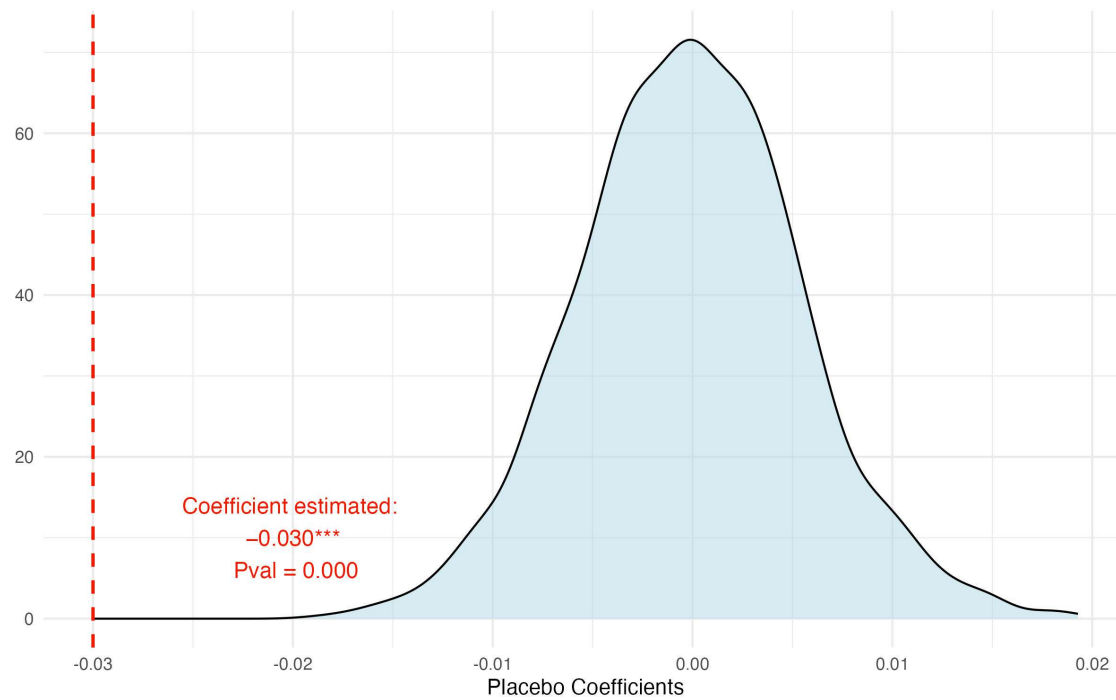
Notes: Each column estimates the independent variable with a different specification. Column (1) and (2) modify our main specification to different cutoffs. Column (1) specification is the number of weeks with a temperature 1 standard deviations higher than that week's historic value in that municipality during main growing season. Column (2) corresponds to the number of weeks with a temperature 1.5 standard deviations higher than that week's historic value in that municipality during main growing season. Column (3) and (4) define the independent variable as the number of weeks during main growing season with a temperature higher than 29 and 35 Celsius. Column (5) estimates armful Degree Weeks (HDW) during main growing season, where every 1-degree Celsius increase in the average temperature above 32 degrees Celsius corresponds to a one-unit increase in HDWs. Each panel corresponds to a different outcome. Panel A corresponds to the logarithm of corn production from the main harvest using ENAPM dataset. Panel B corresponds to the likelihood of being employed in the agriculture of corn, using the EHPM dataset at the individual level. Panel C corresponds to the likelihood of migration in corn agricultural households using the EHPM dataset at the household level. Controls are the same as Table 6. Standard errors are clustered by municipality and year in Panel A and C. In Panel B, standard errors are robust. *p<0.1; **p<0.05; ***p<0.01

Figure A9. : 2,000 Permutations of Extreme Temperature by Geography:
Coefficients on Migration Likelihood



Notes: Own elaboration based on Household-level data of El Salvador's Multiple Purpose Household Survey (EHPM) from 2009–2018. The figure shows the density of placebo coefficients of Extreme Temperature on migration likelihood, employing the same controls and independent variables as Table 5 for corn agricultural households. The red dotted line shows our main specification's coefficient of Extreme Temperature on migration likelihood for corn agricultural households. P-values are estimated based on the share of placebo T-statistics as extreme as the main specification.

Figure A10. : 2,000 Permutations of Extreme Temperature by Geography:
Coefficients on Agricultural Productivity



Notes: Own elaboration based on Data from 2013–2018 of El Salvador's Agricultural Household Survey (ENAPM). The figure shows the density of placebo coefficients of Extreme Temperature on the log of corn production employing the same controls and independent variables as Table 1. The red dotted line shows our main specification's coefficient of Extreme Temperature on corn production (in logarithms). P-values are estimated based on the share of placebo T-statistics as extreme as the main specification.

Table A20—: Impact of Extreme Temperatures on Labor and Migration Outcomes – Varying Standard Errors

	Main specification	Conley (25 KM)	Conley (50 KM)	Conley (100 KM)	FWER Bonferroni	FWER Holm
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Log(Corn Production)</i>						
Extreme Temperature _t	−0.030** (0.012)	−0.030*** (0.011)	−0.030** (0.012)	−0.030** (0.012)	−0.030** (0.012)	−0.030** (0.012)
Extreme Temperature _{t−1} ^{t−4}	0.009 (0.009)	0.009 (0.009)	0.009 (0.011)	0.009 (0.013)	0.009 (0.009)	0.009 (0.009)
Observations	19,325	19,325	19,325	19,325	19,325	19,325
R ²	0.245	0.245	0.245	0.245	0.245	0.245
Adjusted R ²	0.238	0.238	0.238	0.238	0.238	0.238
<i>Panel B: Migration likelihood in Agricultural Households (corn)</i>						
Extreme Temperature _{t−1}	0.148*** (0.052)	0.148* (0.088)	0.148** (0.061)	0.148*** (0.051)	0.148*** (0.052)	0.148*** (0.052)
Extreme Temperature _{t−2} ^{t−5}	−0.079** (0.035)	−0.079 (0.052)	−0.079* (0.047)	−0.079* (0.042)	−0.079** (0.035)	−0.079** (0.035)
Observations	13,440	13,440	13,440	13,440	13,440	13,440
R ²	0.019	0.019	0.019	0.019	0.019	0.019
Adjusted R ²	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
Controls						
Year Fixed Effects	x	x	x	x	x	x
Municipality Fixed Effects	x	x	x	x	x	x
Extreme Rainfall	x	x	x	x	x	x
Baseline Municipality ₂₀₀₅ *Year	x	x	x	x	x	x
Corn Producer Controls _t / Household Controls _t	x	x	x	x	x	x

Notes: Each panel corresponds to a different outcome. Panel A corresponds to the logarithm of corn production from the main harvest using ENAPM dataset. Panel B corresponds to the likelihood of migration in corn agricultural households using the EHPM dataset at the household level. Extreme Temperature is the number of weeks with a temperature 2 standard deviations higher than that week's historic value in that municipality during the main growing season. Controls are the same as in Table 6. All regressions include municipality and year fixed effects. In column (1), standard errors are clustered by municipality and year in Panel A and C. In Panel B, standard errors are robust. In columns (2) to (4) we use Conley standard errors to account for spatial correlation. In columns (4) to (5) we use Family Wise Error Rate (FWER) adjusted p-values. *p<0.1; **p<0.05; ***p<0.01

Table A21—: Impact of Extreme Temperatures and Homicide Rate in Main Outcomes

	(1)
<i>Panel A: Log(Corn Production)</i>	
Extreme Temperature _t	−0.031** (0.013)
Extreme Temperature _{t−1} ^{t−4}	0.007 (0.009)
Homicide per capita _t	−0.014 (0.026)
Mean	1.91
Observations	19,261
Adjusted R ²	0.238
<i>Panel B: Employed in Agricultural Sector (corn)</i>	
Extreme Temperature _t	−0.080 (0.059)
Extreme Temperature _{t−1} ^{t−4}	0.049 (0.038)
Homicide per capita _t	0.006 (0.206)
Mean	7.22
Observations	639,412
Adjusted R ²	0.129
<i>Panel C: Migration Likelihood in Agricultural Households (corn)</i>	
Extreme Temperature _{t−1}	0.148*** (0.052)
Extreme Temperature _{t−2} ^{t−5}	−0.075** (0.031)
Homicide per capita _{t−1}	0.165 (0.223)
Mean	0.655
Observations	13,440
Adjusted R ²	−0.00002
Controls	
Year Fixed Effects	x
Municipality Fixed Effects	x
Extreme Rainfall	x
Geographic*Year	x
Baseline Municipality ₂₀₀₅ *Year	x
Corn Producer _t / Individual _t / Household Controls _t	x

Notes: Each panel corresponds to a different outcome. Panel A corresponds to the logarithm of corn production from the main harvest using ENAPM dataset. Panel B corresponds to the likelihood of being employed in the agriculture of corn, using the EHPM dataset at the individual level. Panel C corresponds to the likelihood of migration in corn agricultural households using the EHPM dataset at the household level. Extreme Temperature is the number of weeks with a temperature 2 standard deviations higher than that week's historic value in that municipality during the main growing season. Homicides per capita is the number of recorded homicides per 1000 habitants by municipality. The source of information is the National Police of El Salvador (Policia Nacional Civil). Controls are the same as Table 6. Standard errors are clustered by municipality and year. *p<0.1; **p<0.05; ***p<0.01

REFERENCES

- Briones, C., J. R. Castro, and O. A. López.** 2005. *Mapa de pobreza: Indicadores para el manejo social del riesgo a nivel municipal: Tomo II.* . 1st ed., Social Investment Fund for Local Development (Fondo de Inversión Social para el Desarrollo Local).
- Burke, Marshall, and Kyle Emerick.** 2016. “Adaptation to Climate Change: Evidence from US Agriculture.” *American Economic Journal: Economic Policy*, 8(3): 106–40.
- CBP.** 2021. “U.S. Border Patrol Nationwide Apprehensions by Citizenship and Sector (FY2007 - FY 2020).” Data retrieved on June 28, 2024.
- Clemens, Michael A.** 2021. “Violence, development, and migration waves: Evidence from Central American child migrant apprehensions.” *Journal of Urban Economics*, 124: 103355.
- Deschênes, Olivier, and Michael Greenstone.** 2007. “The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather.” *American Economic Review*, 97(1): 354–385.
- Donato, Katharine, and Blake Sisk.** 2015. “Children’s Migration to the United States from Mexico and Central America: Evidence from the Mexican and Latin American Migration Projects.” *Journal of Migration and Human Security*, 3(1): 58–79.
- FAO.** 2016. “World Agriculture Watch.” Retrieved on June 28, 2024.
- FAO.** 2021. “Crops and livestock products.” Retrieved on June 28, 2024.
- Feng, Shuaizhang, Alan Krueger, and Michael Oppenheimer.** 2010. “Linkages among climate change, crop yields and Mexico–US cross-border migration.” *Proceedings of the National Academy of Sciences*, 107(32): 14257–14262.
- Funk, Chris, Pete Peterson, Martin Landsfeld, Diego Pedreros, James Verdin, Shraddhanand Shukla, Gregory Husak, James Rowland, Laura Harrison, Andrew Hoell, and Joel Michaelsen.** 2015. “The Climate Hazards Infrared Precipitation with Stations—A New Environmental Record for Monitoring Extremes.” *Scientific Data*, 2: 150066.
- General Directorate of Statistics and Census (DIGESTYC) of the Ministry of Economics of El Salvador.** 2007. *National Census: VI Population and V Housing Census, 2007. Volume IV: Municipalities. Volume I: General Population Characteristics.* San Salvador, El Salvador: DIGESTYC. Accessed May 8, 2025.
- Halliday, Timothy.** 2006. “Migration, Risk, and Liquidity Constraints in El Salvador.” *Economic Development and Cultural Change*, 54(4): 893–925.

- IFRC.** 2016. “El Salvador: Drought Emergency Appeal no. MDRSV010 Operations Update.” International Federation of Red Cross And Red Crescent Societies. Retrieved on June 28, 2024.
- Marchiori, Luca, Jean-François Maystadt, and Ingmar Schumacher.** 2012. “The impact of weather anomalies on migration in sub-Saharan Africa.” *Journal of Environmental Economics and Management*, 63(3): 355–374.
- McKee, Thomas B, Nolan J Doesken, and John Kleist.** 1993. “The Relationship of Drought Frequency and Duration to the Time Scales.”
- Muñoz Sabater, J., E. Comyn-Platt, H. Hersbach, B. Bell, P. Berrisford, G. Biavati, A. Horányi, J. Muñoz Sabater, J. Nicolas, C. Peubey, R. Radu, I. Rozum, D. Schepers, A. Simmons, C. Soci, D. Dee, J.-N. Thépaut, C. Cagnazo, and M. Cucchi.** 2024. “ERA5-land post-processed daily-statistics from 1950 to present.” <https://doi.org/10.24381/cds.e9c9c792>.
- NASA EOSDIS.** 2019. “ASTER Global Digital Elevation Model V003.” Retrieved on June 28, 2024.
- Nawrotzki, Raphael J.** 2015. “Climate change as a migration driver from rural and urban Mexico.” *Environmental Research Letters*, 10(114023).
- Ortiz-Bobea, Ariel, Haoying Wang, Carlos M. Carrillo, and Toby R. Ault.** 2019. “Unpacking the climatic drivers of US agricultural yields.” *Environmental Research Letters*, 14(6): 064003.
- Policía Nacional Civil de El Salvador.** 2019. “Homicides by municipality.” Data shared in 2019.
- Roberts, Michael, and Wolfram Schlenker.** 2011. “The Evolution of Heat Tolerance of Corn: Implications for Climate Change.” In *The Economics of Climate Change: Adaptations Past and Present*. 225–251. University of Chicago Press.
- Ruggles, Steven, Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek.** 2017. “Integrated Public Use Microdata Series: Version 7.0. [dataset].”
- Schlenker, Wolfram, and David B. Lobell.** 2010. “Robust negative impacts of climate change on African agriculture.” *Environmental Research Letters*, 5(1).
- Schlenker, Wolfram, and Michael J. Roberts.** 2009. “Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change.” *Proceedings of the National Academy of Sciences*, 106(37): 15594–15598.
- Wan, Z., S. Hook, and G. Hulley.** 2021. “MODIS/Terra Land Surface Temperature/Emissivity 8-Day L3 Global 1km SIN Grid V061 [Data set].” <https://doi.org/10.5067/MODIS/MOD11A2.061>

WB. 2018. “Groundswell: Preparing for Internal Climate Migration.” World Bank.

WB. 2024. “Agricultural irrigated land (% of total agricultural land).” Sourced from Food and Agriculture Organization. Data retrieved on June 28, 2024.