

New Evidence on the Economics of Climate and Conflict

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World Bank MENA Research Seminar
12 March 2025



The world is warming fast – what will happen to our societies?

"Climate variability and extremes are associated with increased prevalence of conflict ... (medium confidence)."

>> UN Intergovernmental Panel on Climate Change,
IPCC6 Report (2022, Chapter 16)



Existing evidence base



Hsiang Burke Miguel
(2013): Meta-analysis
on intergroup (N=21),
interpersonal (N=11)
conflict, where panel
data allows climate to be
isolated as a cause
>> 1 SD warmer temp:
+10% intergroup,
+3% interpersonal

RESEARCH ARTICLE

Quantifying the Influence of Climate on Human Conflict

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A rapidly growing body of research examines whether human conflict can be affected by climatic changes. Drawing from archaeology, criminology, economics, geography, history, political science, and psychology, we assemble and analyze the 60 most rigorous quantitative studies and document, for the first time, a striking convergence of results. We find strong causal evidence linking climatic events to human conflict across a range of spatial and temporal scales and across all major regions of the world. The magnitude of climate's influence is substantial: for each one standard deviation (1σ) change in climate toward warmer temperatures or more extreme rainfall, median estimates indicate that the frequency of interpersonal violence rises 4% and the frequency of intergroup conflict rises 14%. Because locations throughout the inhabited world are expected to warm 2σ to 4σ by 2050, amplified rates of human conflict could represent a large and critical impact of anthropogenic climate change.

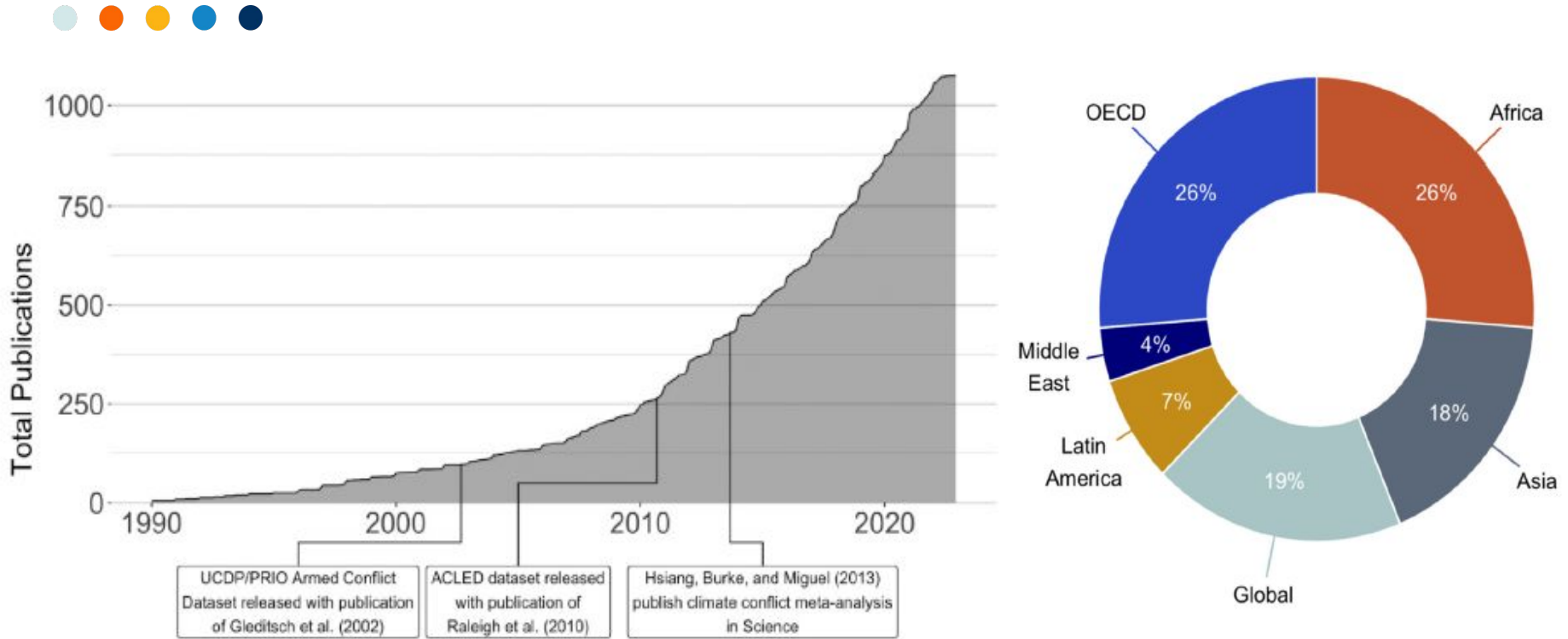
data sets published across 26 different journals and represent the work of more than 190 researchers from around the world. Our evaluation summarizes the recent explosion of research on this topic, with 78% of studies released since 2009 and the median study released in 2011. We collected findings across a wide range of conflict outcomes, time periods spanning 10,000 BCE to the present day, and all major regions of the world (Fig. 1).

Although various conflict outcomes differ in important ways, we find that the behavior of these outcomes relative to the climate system is markedly similar. Put most simply, we find that large deviations from normal precipitation and mild temperatures systematically increase the risk of many types of conflict, often substantially, and that this relationship appears to hold over a variety of temporal and spatial scales. Our meta-analysis of studies that examine populations in the post-1950 era suggests that these relationships contin-

13 SEPTEMBER 2013 VOL 341 SCIENCE www.sciencemag.org



Explosion of research since 2013 *Science* study



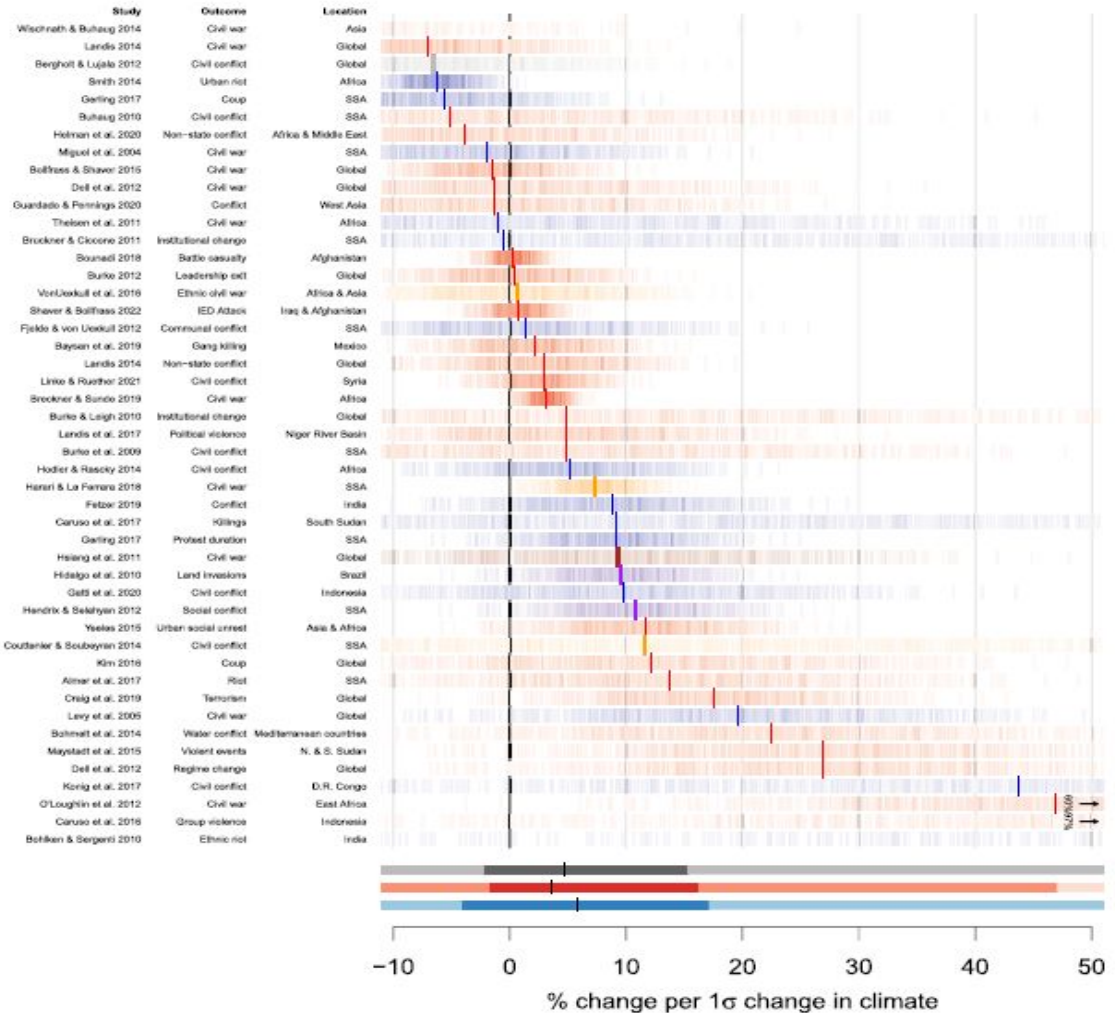
Research output has more than doubled – what does the evidence say **now**?



Intergroup conflict



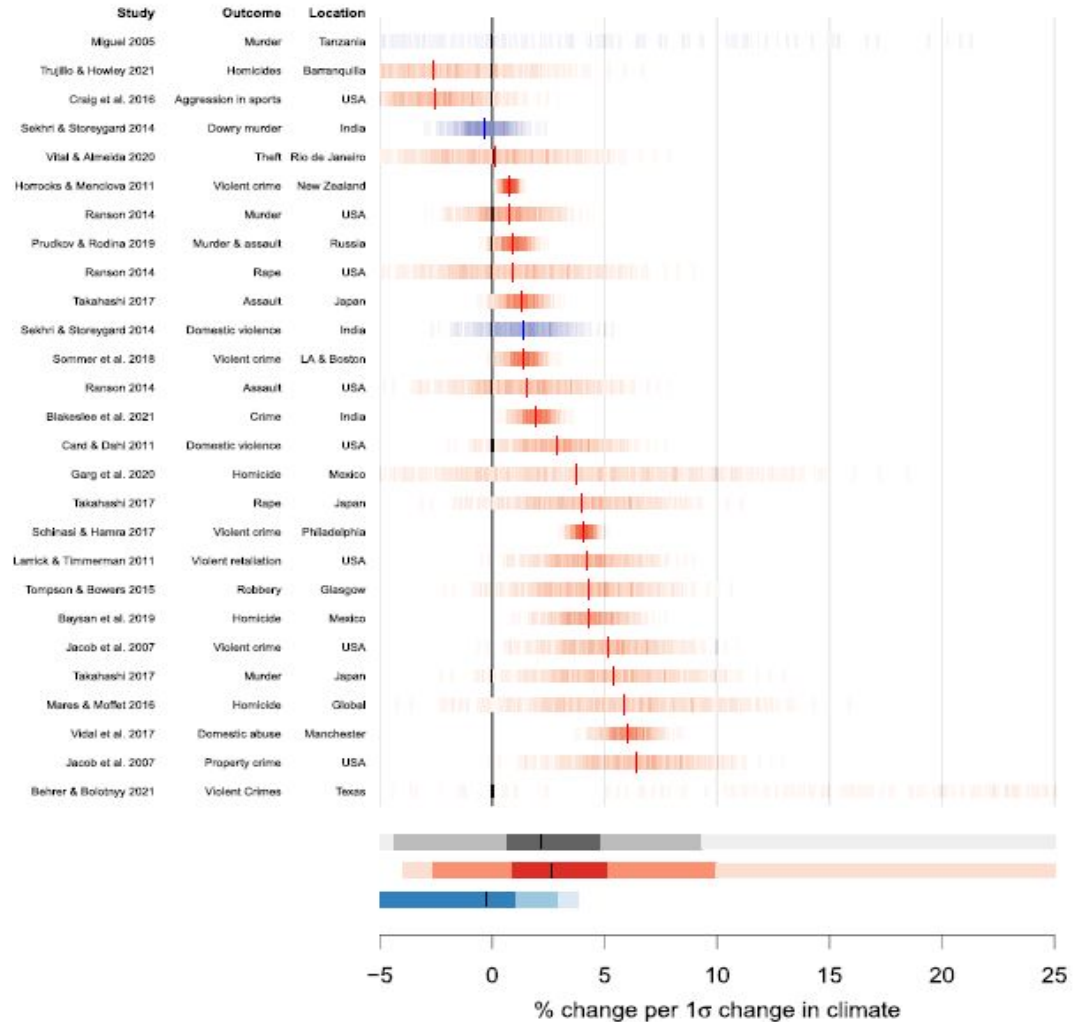
N=47 studies, e.g.,
civil war, riots,
communal conflict
1 SD higher temp
leads to **+5 more**
conflict (median
estimate). Smaller
than 2013 estimate
but meaningful.



Interpersonal conflict



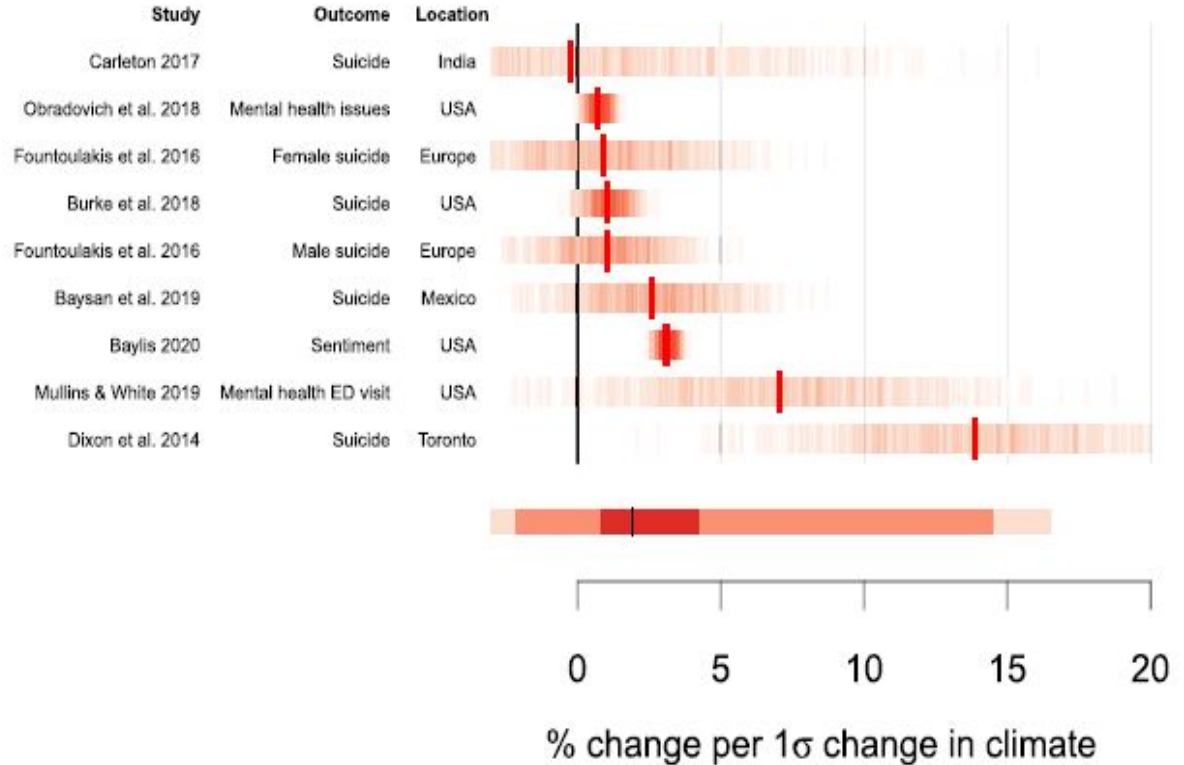
N=27 studies, e.g.,
 homicide, armed
 robbery, assault
 1 SD higher temp
+2% more crime.
 Emerging work on
 self-harm/suicide
 shows effects of
 similar magnitude.



Self-Harm



N=9 studies, e.g., self-harm/suicide. This emerging literature shows effects of similar magnitude: 1 SD higher temp **+1-2% more** self-harm.

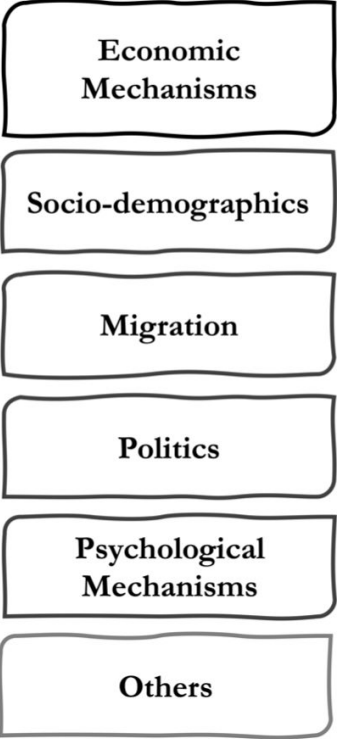


Scientific advances: understanding channels + policy impact

Independent Variable



Mechanisms



Dependent Variable



New evidence on mechanisms: public programs



Improving **living standards** weakens the relationship:

- Access to jobs in rural India (NREGA, Fetzer 2020)
- Cash grants in Mexico (Garg et al 2024)



Public policy choices matter



Effect of high temperature on homicide falls after expansion of the generous Progresa cash transfer in Mexico (Garg et al 2024), Years ≥ 0

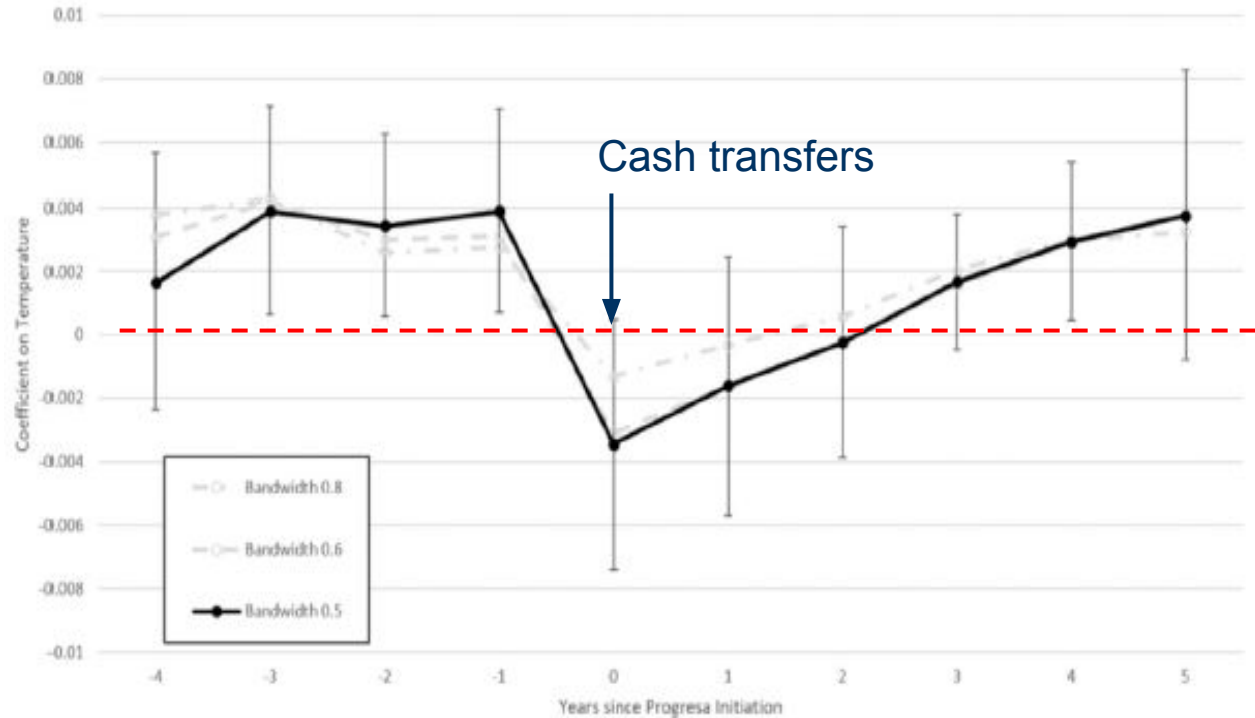


FIG. 11 Event study of progresa program on effect of temperature on homicides in Mexico. Reproduced from Garg et al. (2024), Figure 3.

New evidence on mechanisms: public programs



Improving **living standards** weakens the relationship:

- Access to jobs in rural India (NREGA, Fetzer 2020)
- Cash grants in Mexico (Garg et al 2024)

Poor rainfall triggers conflict in Indonesia but not where there is good local **irrigation infrastructure** (Gatti et al 2021)

Poor rainfall triggers suicides in Indonesia but the relationship falls by 2/3 in magnitude after expansion of a government **cash transfer program** (Christian et al 2019)



Key role of income (Burke et al 2024 AEA P&P)



Armed conflict in
Sub-Saharan Africa,
1989-2018

>> New result: effect of
elevated temperature on
conflict is **far smaller** (less
sensitive) in countries with
higher per capita income

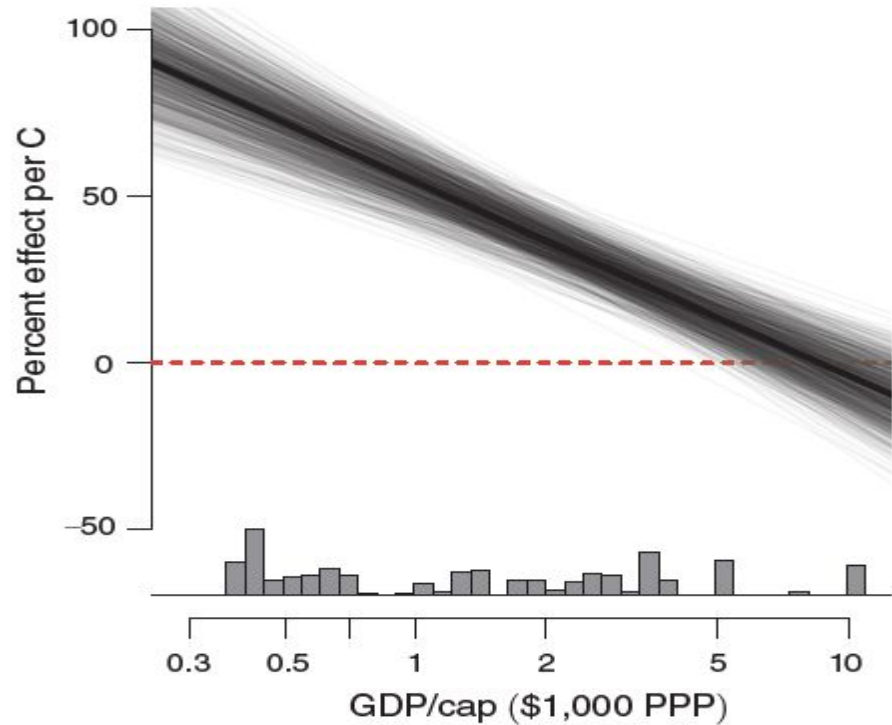


FIGURE 1. SENSITIVITY OF THE TEMPERATURE-CONFLICT
RELATIONSHIP TO WEALTH AND INCOME

Other mechanisms: migration, politics and psychology



Herder-cultivator clashes in West Africa are triggered by low rainfall and the migration of herders into new areas – but are dampened when herders have more **political power** (McGuirk and Nunn 2023)



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Herder-cultivator clashes in West Africa are triggered by low rainfall and the migration of herders into new areas – but are dampened when herders have more **political power** (McGuirk and Nunn 2023)

>> Even beyond economic conditions, psychology and physiology matter: **behavior** is more aggressive in Kenya in a hotter laboratory room (Joy of Destruction game), especially for individuals in politically marginalized groups (Almas et al 2024)



Discussion (1)



A burgeoning research literature reinforces the conclusion that rising temperatures and extreme rainfall will contribute to conflict risk **across many settings** and types of violence. Magnitudes are somewhat smaller than earlier (by roughly 1/2) but remain large and of practical importance.



Discussion (2)



Key **scientific advance**: evidence on multiple mechanisms and public policies that reduce climate risks

>> Higher + more stable incomes reduce sensitivity, making slow global economic growth recently (since 2020) perilous.

Discussion (3)



>> Implication: sustained economic growth in the coming decades could help low and middle income (LMIC) societies limit the risk of climate-related conflicts.

A major challenge is that climate change is projected to **reduce** economic growth in many poor regions (Dell, Jones and Olken 2014; Burke, Hsiang and Miguel 2015), raising the unfortunate prospect of a **climate-conflict poverty trap**.

Discussion (4)



>> Methodological finding: estimating effects over longer time periods and with more temporal lags tends to produce larger effects of climate shocks on conflict outcomes.

The implication is that **adaptation** to a warmer climate may not occur automatically even over an extended time frame (decadal scale).



Four summary “takeaways”

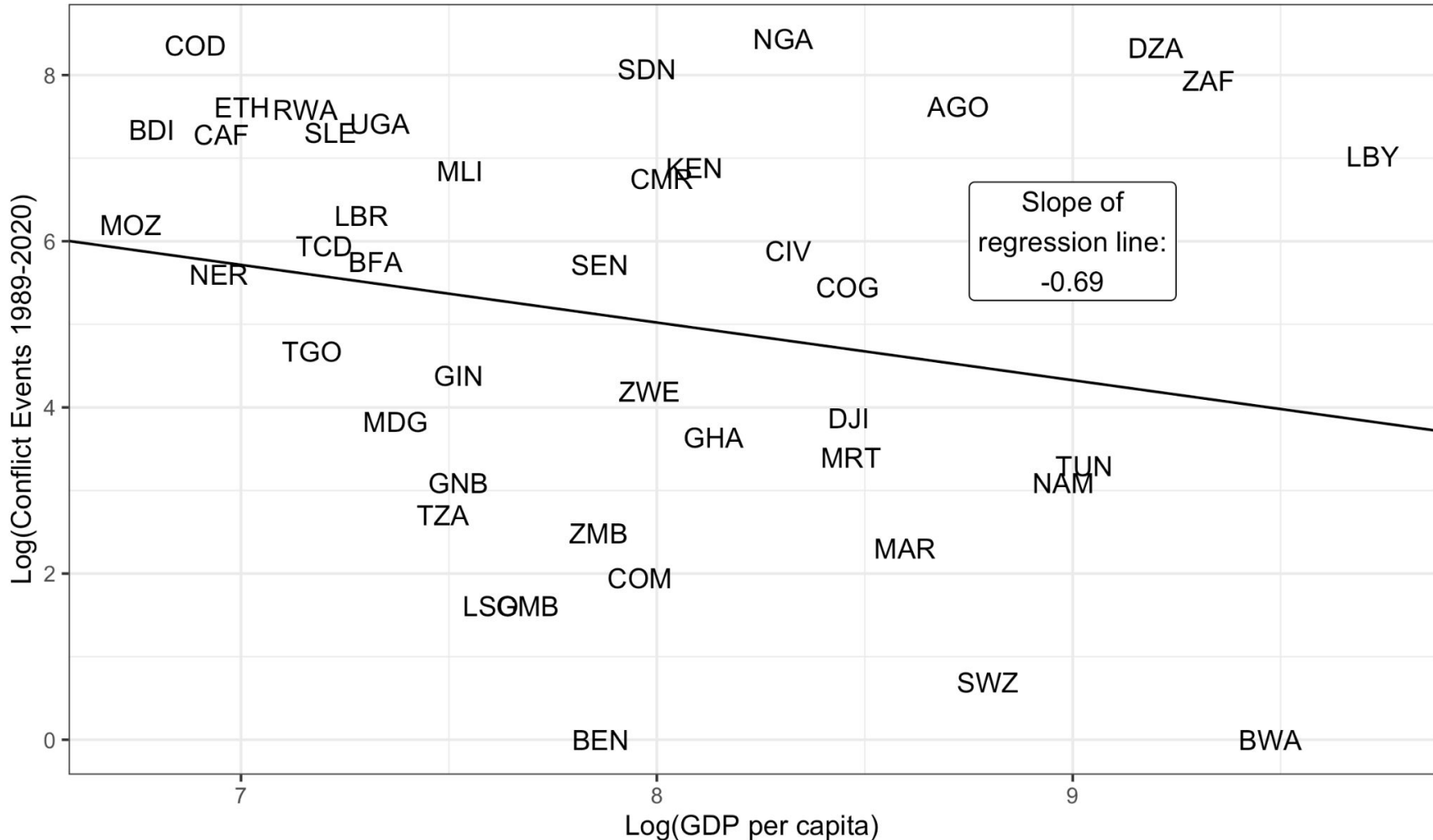


1. Reliance on agriculture, and shocks to agricultural production and prices, are associated with more violent conflict.
2. The effects of agricultural and other income shocks are shaped by local social divisions, migration options, and political institutions.
3. Public policies that reduce income and employment volatility can dampen the risk of violence.
4. Independent of income-related mechanisms, there are psychological and physiological channels that link extreme temperature to conflict.

Extra Slides



Income and Conflict in Africa: 1989-2020



Motivation

- Strong **negative cross-sectional correlation** between income per capita and country-level conflict incidence in Africa and globally.
- Difficult for many economic theories of conflict to explain (Why? There is more to lose by fighting in richer countries but also more to gain.)
- Challenging to establish whether this relationship is causal.

>> Many possible explanations for the pattern:

- Less volatility: income relatively less sensitive to shocks in rich countries.
- More capacity: wealthier states are better able to protect citizens from shocks (through safety nets) **and/or** suppress incipient rebellions.

Motivation (2)

- Large body of empirical evidence (>100 studies): **positive temperature shocks** causally increase the likelihood of group conflict (Hsiang et al., 2013; Burke et al., 2015; [Burke et al., 2023](#)).
- Meta-analysis estimate of 20 studies in Africa: a +1 SD increase in temperature → +3-5% increase in conflict incidence ([Burke et al., 2023](#)).

>> Review recent work: **social safety nets mitigate** effects on violence:

- Fetzer (2020): Effect of monsoon rainfall on inter-group conflict reduced after rollout of India's National Rural Employment Guarantee (NREGA).
- Garg et al. (2024): Reduced effect of temperature on homicide rate in Mexico after rollout of conditional cash transfer program (Progresa).
- Christian et al. (2019): cash transfers moderate impact of climate shocks on suicide in Indonesia.

This Project

- **Main goal:** study the moderating effect of income and wealth on the climate-conflict relationship in Africa over the past three decades

>> Why does this matter? Important for projections of the likely future costs of climate change, and possible policy responses.
- **Data innovation:** Combination of high-resolution local wealth estimates and national accounts allow us to disentangle effects by local versus national living standards.

Data and measurement

Sample: 1°x1° grid covering Africa, 1989-2019

- **Temperature:** Berkeley Earth Surface Temperature (BEST)
- **Conflict:** Uppsala Conflict Data Program Global Event Data (UCDP GED)
- **National Income:** World Bank World Development Indicators (2017 USD PPP per capita)
- **Local Wealth:** Estimates derived from DHS surveys + machine learning applied to satellite imagery (Yeh et al., 2020)

Econometric Strategy / Research Design

$$C_{it} = \alpha_i + \delta_t + \sum_{l=0}^1 [\beta_l T_{it-l} + \gamma_l T_{it-l} W_i] + \varepsilon_{it}$$

- Outcome: Civil conflict incidence (C), indicator variable
- Standard in this literature: include cell (i) and year (t) fixed effects
- β 's capture effects of temperature (T) on conflict, current and 1 year lag
- γ 's capture moderating (interaction) effects of wealth or income (W)
- Error terms spatially clustered at the grid cell-level