

The Environmental Impact of Civil Conflict

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The environment as a casualty of war



Vietnam, Laos & Cambodia, 1961–1973

- 77M litres of herbicides sprayed (at 20× agricultural concentration)
- 5M acres of forest destroyed; 500,000 acres of crops
- 13M tons of ordnance dropped in total; 400,000 tons of napalm
- Laos: a planeload of bombs every 8 minutes for 9 years

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The legacy, 50+ years on

- Dioxin measurable in soil, fish and breast milk in sprayed areas *today*
- Bird species in sprayed forest: 24 vs. 145–170 in adjacent unsprayed forest

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Perhaps the most extreme case in history.
But what does *causal* evidence say more broadly?

But conflict can (accidentally?) preserve ecosystems

The 250 km × 4 km Demilitarized Zone in Korea:

- No human activity since the 1953 armistice.
- Home to rare cranes, Amur leopards, Siberian tigers, and hundreds of plant species absent elsewhere on the peninsula.
- An *accidental nature reserve* created by conflict.

The “**refuge effect**” in conflict ecology: when humans flee or are barred from land, ecosystems recover. We all witnessed this during the pandemic lockdowns.



Red-crowned cranes, Samcheok, South Korea

General idea: the effect of conflict on nature is *not* monotone. **Access costs matter as much as direct destruction.**

Roadmap

- ① Why identification is hard
- ② Colombia: a natural laboratory
- ③ Africa: war and forests
- ④ Mining, pollution, and the environment
- ⑤ Economic activity, military spending,
biodiversity
- ⑥ Open questions
- ⑦ Policy implications

- ① Why identification is hard
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This talk emphasizes causation, not correlation.

“War is bad for nature” — obvious.

How bad? Through which channels?

We focus on papers that take **identification** seriously.

Spoiler: turns out the evidence is scant.

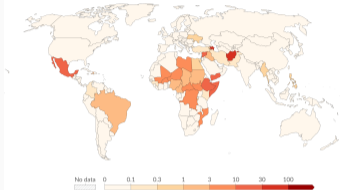
Why identification is hard

The stakes: conflict and nature overlap everywhere

- 🌲 $\approx 40\%$ of tropical forests are in countries with active armed conflict
- 🍃 Conflicts have occurred in **two-thirds** of the world's biodiversity hotspots.
- 🌱 Countries in war are countries with: deforestation, pollution, soil erosion, water contamination, and biodiversity loss.
- 💡 The causal arrow runs *both ways*: environment \rightarrow conflict, **AND** conflict \rightarrow environment.

Death rate in armed conflicts based on where they occurred, 2020

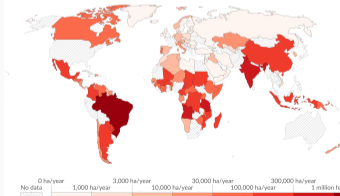
Deaths of combatants and civilians due to fighting, per 100,000 people. Included are armed conflicts* that were ongoing that year.



Data source: Uppsala Conflict Data Program (2025); geoBoundaries (2023); Population based on various sources (2024)
OurWorldInData.org/war-and-peace | CC BY

1. Armed conflict (ICDP and PRIO) A disagreement between organized groups, or between one organized group and civilians, that causes at least 25 deaths during a year. This includes combatant and civilian deaths due to fighting, but excludes deaths due to disease and starvation resulting from the conflict.

Annual deforestation, 2020



Data source: Food and Agriculture Organization of the United Nations (2025)
OurWorldInData.org/deforestation | CC BY
Note: The UN FAO publishes forest data as the annual average on 10- or 5-year timescales. The following year allocation applies: "1990" is the annual average from 1990 to 2000; "2000" for 2000 to 2010; "2010" for 2010 to 2015; "2015" for 2015 to 2020, and "2020" for 2020 to 2025.

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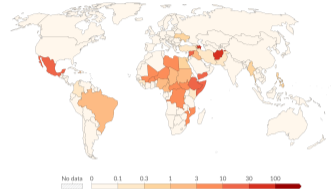
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This talk focuses on: conflict \rightarrow environment.

The other arrow is a large literature in itself — see Vanden Eynde & Vargas (2025) for a full review.

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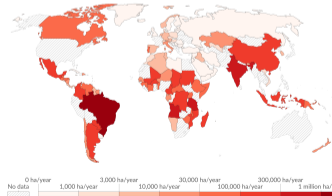
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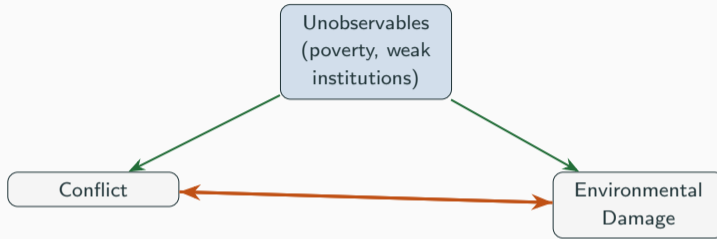


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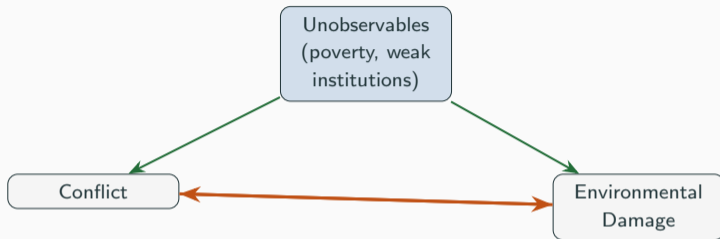
The identification challenge



The identification challenge



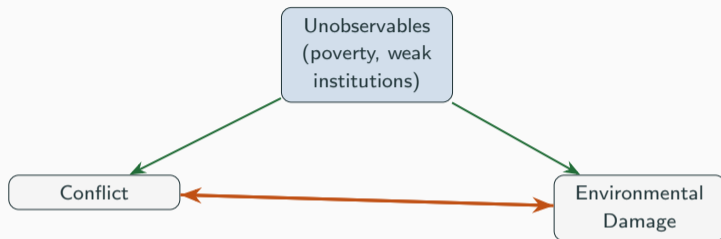
The identification challenge



Two core threats:

1. **Omitted variables:** poor, lawless regions both fight and deforest more.
2. **Reverse causality:** resource-rich forests *attract* conflict (resource curse).

The identification challenge



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1. **Omitted variables:** poor, lawless regions both fight and deforest more.
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Solutions used in the literature:

IV (instrument for conflict intensity)

DiD/Event Study (before/after × treated/control)

RDD (geographic or temporal discontinuity)

Colombia: a natural laboratory

Fergusson, Romero & Vargas (2014)

“The Environmental Impact of Civil Conflict: The Deforestation Effect of Paramilitary Expansion in Colombia”

- **Question:** Did the nation-wide expansion of (pro-extractive land use businesses) paramilitary militias cause deforestation?
- **OLS** yields negative correlation: more paramilitary presence is associated with less forest loss.
- **Why? Selection:** armed groups thrive in dense jungles where they can hide and state presence is scant.
- **Identification:** IV exploiting *distance to Urabá* (the region from which paramilitaries expanded) as instrument.
Falsification: instrument loses relevance after paramilitary demobilization (2003–2006). ✓
- **Mechanisms:** violence → displacement → land grabs → illegal mining, cattle ranching, coca cultivation.
- **Finding:** Paramilitary expansion **significantly increases** deforestation.

Colombia I — Militias cause deforestation

Key mechanism: Deforestation occurs *not* through fighting but through the land-use change that follows displacement and territorial seizure.

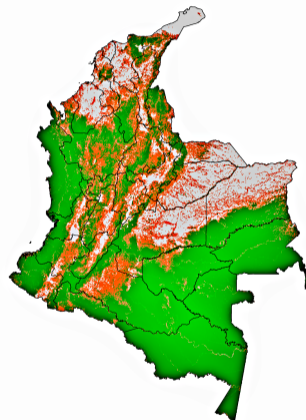
Paramilitary expansion → ↑ displacement and land dispossession
→ ↑ land intensive extractive activities → ↑ deforestation



Prem, Saavedra & Vargas (2020)

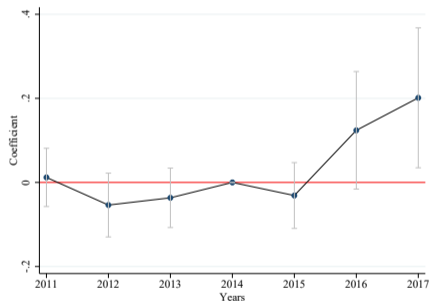
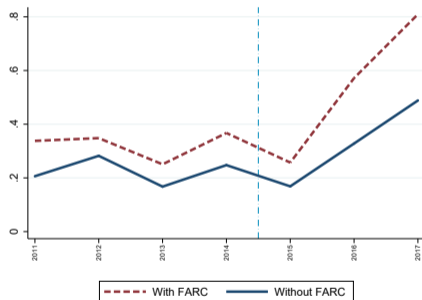
“End-of-Conflict Deforestation: Evidence from Colombia’s Peace Agreement”, World Development

- **Shock:** FARC ceasefire Dec 2014; Peace Agreement signed Nov 2016.
- **Identification:** DiD — FARC-controlled municipalities vs. others.
- **Data:** Unit: 30m² satellite pixel (Global Forest Change).
- **Finding:** Formerly FARC-controlled areas show a **differential surge in deforestation** post-ceasefire. Attenuated by state presence; amplified by land-intensive activity.
- **Scale:** 291,973 ha deforested in 2017 alone — 23% more than 2016 (IDEAM).



More on identification

Forest Loss: raw data vs. event study



Mechanism

Granular (small farmer-based) vs. Massive (large-scale extraction) deforestation?

Raw Data

	16	16	16	17
		15	16	17
		15	16	17
15			16	17
15				

Granular 2015

15				
15				

Massive 2015

		15		
		15		

The peace paradox: Conflict can unintendedly promote environmental conservation. After the FARC ceasefire, extractive firms rushed into the power vacuum — causing the deforestation surge (Prem et al. 2020).

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But this observation is not specific to Colombia...

Africa: war and forests

Burgess, Miguel & Stanton (2015)

“War and Deforestation in Sierra Leone”, Environmental Research Letters

- **Setting:** RUF rebellion, 1991–2002. 151 chiefdoms; satellite land cover 1990–2000.
- **Identification:** OLS with geographic controls; rebel camp locations quasi-random conditional on covariates.
- **Finding:** Conflict-ridden chiefdoms experienced **significantly less forest loss**. Roads deteriorated; timber extraction became impossible; extractive investment fled.

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⚡ **Context is everything.** Similar to Colombia, in Sierra Leone, conflict *protected* forests by eliminating access and investment.

Guidolin & La Ferrara (2007)

"Diamonds Are Forever, Wars Are Not: Is Conflict Bad for Private Firms?", *American Economic Review*

- **Setting:** Angola — diamond mining industry.
- **ID:** Event study around the *sudden death* of rebel leader Jonas Savimbi (Feb 2002). Control: similar diamond firms with no Angolan concessions.
- **Finding:** Peace is **bad news for incumbent firms**: Angolan portfolio drops 4% in abnormal returns.
- **Interpretation:** Conflict created entry barriers, weakened government bargaining power, and reduced transparency — all benefiting insider firms.

Angola — Extractive firms can benefit from conflict

Guidolin & La Ferrara (2007)

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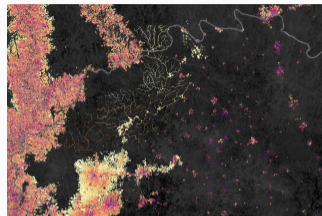
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Kikuta & Kamahara (2024)

Environmental protection after civil war: A difference-in-geographic-discontinuity approach, Journal of Peace Research

- **Setting:** DRC — ongoing civil conflict, massive tropical forest, extensive artisanal and industrial mining.
- **Reform:** 2011–2013 independent monitoring added to mining permit zones with *arbitrary grid-based boundaries*.
- **Identification:** Difference-in-Geographic-Discontinuity (DiGD)
- **Findings:**
 - Reform **reduced deforestation** inside mining zones, even in areas with *continuing armed conflict*.
 - Compliance of existing operators; screening out non-compliant ones.



DRC: satellite view of forest loss near Kisangani

Good governance (even partial and fragile) can reduce environmental damage before peace is consolidated.

Mining, pollution, and the environment

Mining pollution destroys agriculture and livelihoods

Metal mining generates severe negative externalities on local ecosystems — amplified where conflict weakens regulation.

Aragon & Rud (2016), *Economic Journal*:

- Gold mine in Ghana pollutes surrounding water and soil, therefore lowering nearby agricultural productivity by 40%.
- Identification: inverse-distance weighting to pollution source.
- Effect is *local* — attenuates sharply with distance from the mine.

Vashold et al. (2024):

- Mine water pollution reduces downstream agricultural output across Africa.
- Identification: upstream mine locations as IV for river pollution exposure.
- Effect travels along the river network — a cross-community, cross-border externality.



Acid mine drainage, Río Tinto, Spain

Pollution destroys the rural livelihoods that, via the opportunity cost channel, keep people out of conflict.

So mining *may* trigger violence indirectly — but this link is not yet causally identified.

Mining activity drives deforestation

Mining directly also destroys forest cover — and conflict accelerates this by eliminating regulatory oversight.

Girard, Molina-Millán & Vic (2022):

- Artisanal mining *and* adverse weather shocks both independently trigger deforestation across Africa.
- The two drivers are additive — conflict-weakened governance amplifies both.
- Illustrates the climate–resource–conflict nexus operating simultaneously (Vanden Eynde & Vargas 2025).



Artisanal gold mining, Eastern DRC

A vicious cycle:

Resource rents → conflict → weak regulation → more mining → more deforestation → livelihood loss → more conflict.

Each link is documented. The full chain as a unified causal model is still missing.

Mining royalties as a policy instrument

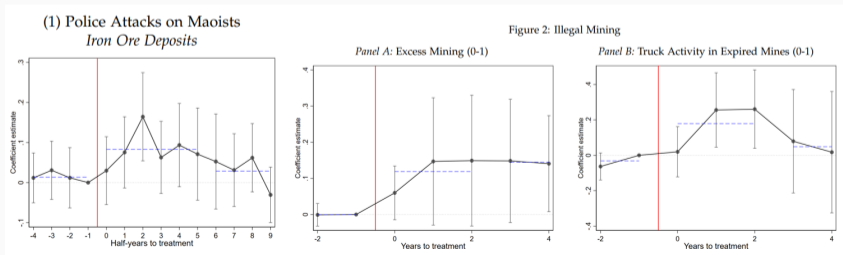
Distribution of mining rents could affect conflict and mining practices alike.

Saavedra and Romero (2021):

- Lower mining royalties for Colombian municipalities increase illegal mining

Shapiro and Vanden Eynde (2023):

- Higher mining royalties for State-level governments in India increase conflict
- ... but also increase illegal mining



Economic activity, military spending, biodiversity

Military buildups → economic booms → biodiversity loss

Liang, Rudik & Zou (2025)

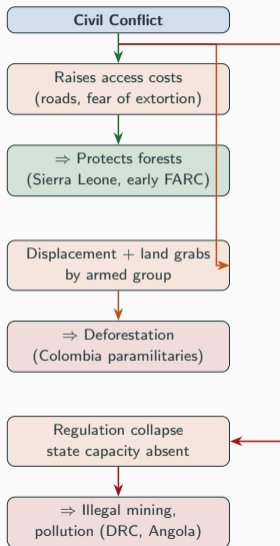
“Economic Activity and Biodiversity in the United States”, Journal of Public Economics, 250, 105482

- **Question:** Does economic activity reduce ecosystem biodiversity?
- **Identification:** **National military buildups** as quasi-exogenous variation in local economic activity. $IV = \text{state's initial military spending share (1966–71)} \times \text{national procurement shocks}$
- **Data:** BioTIME — millions of ecological observations across taxa, US-wide, 1966–2015.
- **Finding:** Economic activity significantly reduces species abundance, richness, and stability. Air pollution accounts for **20–60%** of the effect (upwind-pollution IV for the channel).
- **Policy:** Clean Air Act nonattainment designations improved biodiversity — regulations protecting human health generated large ecological co-benefits.

Two-for-one identification: Military spending instruments for economic activity. One IV connects conflict economics and environmental economics. Also, human health regulation is also conservation policy!

Open questions

Why opposite results? A conceptual framework



Which mechanism dominates?

Depends on:

- *Who* fights (rebels needing forest cover vs. paramilitaries seeking land)
- *Resource endowment* (timber, minerals, coca)
- *State capacity* before and after conflict
- *Post-conflict dynamics*: who fills the power vacuum and with what incentives?
- *Geography* (access routes, borders)

Apparent contradictions are **heterogeneity**, not inconsistency. Context determines the dominant channel.

What we know — and what we don't

Established:

- Conflict can both harm *and* protect ecosystems; access barriers deter extractive activity.
- **Peace \neq green:** post-conflict extractive rushes documented; state presence is decisive.
- Environmental regulation *can* work even during conflict (DRC mining reform).
- Biodiversity responds to military-driven economic booms (USA; air pollution channel).
- Firms may have incentives to perpetuate conflict (Angola; Colombia post-ceasefire).

Open questions:

- Does mine pollution trigger *conflict*? Suspected but not causally established.
- Oceans and marine ecosystems during conflict?
- Long-run wildlife recovery after peace?
- Biodiversity loss \rightarrow conflict via rural livelihoods? Theorised (Vanden Eynde & Vargas 2025) but not identified.
- Dose-response: how does conflict *intensity* shape environmental outcomes?

Policy implications

Turning evidence into policy

1. **Peace agreements need environmental annexes.** State institutions must enter contested territory alongside — not after — armed groups leave. (Prem et al. 2020)
2. **Post-conflict monitoring is cheap and effective.** Independent monitoring works even under continuing armed tension (DRC mining reform).
3. **Regulate firms, not just combatants.** Extractive firms may benefit from conflict or exploit power vacuums. Regulatory frameworks must anticipate this.
4. **Account for military GHG emissions.** Systematically excluded from national inventories and Paris Agreement commitments.
5. **Biodiversity and rural livelihoods deserve more attention.** Ecosystem investment as conflict prevention: biodiversity loss → livelihood loss → conflict. (Vanden Eynde & Vargas 2025)

The environment is a silent victim of war.

(But sometimes it can also be an accidental beneficiary)



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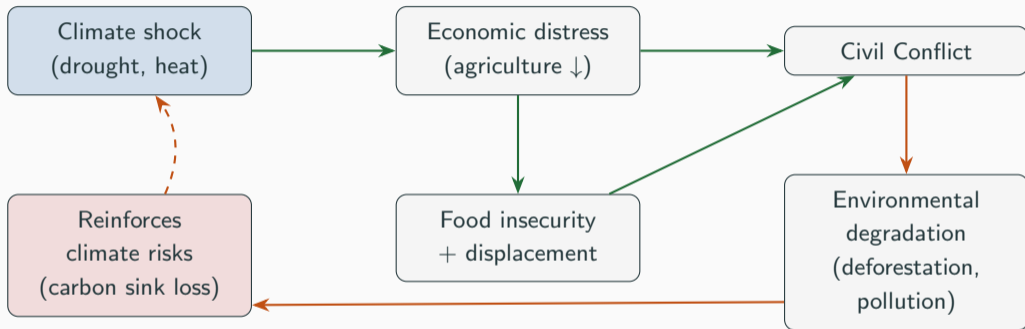
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References i

- Aragon, F.M., & Rud, J.P. (2016). Polluting industries and agricultural productivity: Evidence from mining in Ghana. *Economic Journal*, 126(597), 1980–2011.
- Burgess, R., Miguel, E., & Stanton, C. (2015). War and deforestation in Sierra Leone. *Environmental Research Letters*, 10, 095014.
- Fergusson, L., Romero, D., & Vargas, J.F. (2014). The environmental impact of civil conflict: The deforestation effect of paramilitary expansion in Colombia. *Documentos CEDE* No. 12225, Universidad de los Andes.
- Girard, V., Molina-Millán, T., & Vic, G. (2022). Artisanal mining in Africa: Green for gold? *Novafrica Working Paper Series* 2201.
- Guidolin, M., & La Ferrara, E. (2007). Diamonds are forever, wars are not: Is conflict bad for private firms? *American Economic Review*, 97(5), 1978–1993.
- Liang, Y., Rudik, I., & Zou, E.Y. (2025). Economic activity and biodiversity in the United States. *Journal of Public Economics*, 250, 105482.
- Prem, M., Saavedra, S., & Vargas, J.F. (2020). End-of-conflict deforestation: Evidence from Colombia's peace agreement. *World Development*, 129, 104852.
- Saavedra, S., & Romero, M. (2021). Local incentives and national tax evasion: The response of illegal mining to a tax reform in Colombia. *European Economic Review*.
- Shapiro, J., & Vanden Eynde, O. (2023). Fiscal Incentives for Conflict: Evidence from India's Maoist Belt. *Review of Economics and Statistics*.

- Vanden Eynde, O., & Vargas, J.F. (2025). Climate change, natural resources, and conflict. *Economic Policy*, invited review.
- Vashold, L., Pirich, G., Heinze, M., & Kuschnig, N. (2024). Mines–Rivers–Yields. *Working Paper*.

Appendix — The self-reinforcing feedback loop



Vanden Eynde & Vargas (2025) emphasise this self-reinforcing cycle. Breaking *any* link is simultaneously conflict prevention and climate adaptation.