

Conflicts of rural transformation: The effects of oil palm expansion in Indonesia

Elías Cisneros^{†‡}, Tobias Hellmundt[‡], and Krisztina Kis-Katos[‡]

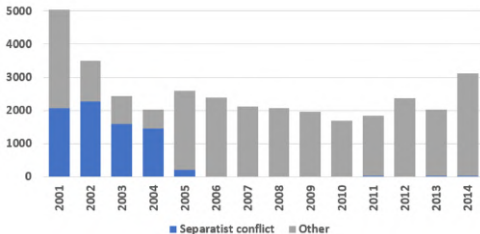
[†]University of Texas at Austin, [‡]University of Göttingen

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Local violence in Indonesia

Violent deaths in Indonesia reported by NVMS

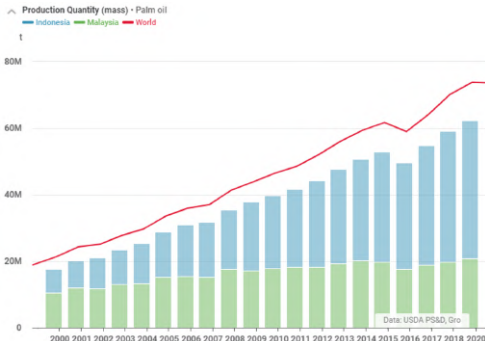


Source: National Violence Monitoring System (NVMS)

- ▶ High ethnic, religious and linguistic diversity
- ▶ Fall of Suharto Regime in 1998 followed by separatist civil wars
- ▶ Successful decentralisation and peace by 2005
- ▶ Monitoring of low-level violence until 2015

The palm oil boom

Palm oil production in Indonesia and Malaysia



Source: USDA/Gro Intelligence, 2021

Benefits

- ▶ **Economic growth and development**
(Sayer et al., 2012; Euler et al., 2017; Gatto et al., 2017; Kraus et al., 2022)

Problems

- ▶ **Deforestation**
(Gaveau et al., 2016; Austin et al., 2019)
- ▶ **Corruption**
(Cisneros et al., 2021)
- ▶ **Social conflict, land disputes, violence, crime**
(Persch-Orth and Mwangi, 2016; Abram et al., 2017; Li, 2018; Kenny et al., 2020)

Land-use change and violent conflict

Theoretical framework

- ▶ Economic development may reduce conflict by increasing opportunity costs (Collier and Hoeffler, 1998, 2004)
- ▶ Land transformation can induce conflict through environmental scarcity, inequality and identity-based grievances (Homer-Dixon, 1991, 1994; Bryant, 1998; Stewart, 2000, 2008)
- ▶ Evidence is mixed and mostly limited to case studies (see De Jong et al., 2021)

Land-use change and violent conflict

Theoretical framework

- ▶ Economic shocks in existing production regions could both increase or decrease violence (e.g., Dal Bo and Dal Bo, 2011; Dube and Vargas, 2013)
→ This is a problem if expansion happens in proximity to existing production and is caused by the same shocks
- ▶ Conflicts can prevent land-use change by deterring economic activity (Burgess et al, 2015; Prem et al., 2020)
- ▶ Direct effect of land-use change on conflict is ambiguous
- ▶ Therefore we focus on the **impact of booms creating strong incentives for additional expansion**

Related literature

- ▶ **Commodity prices, economic shocks, and conflict** (e.g., Dal Bo and Dal Bo, 2011; Dube and Vargas, 2013; Bazzi and Blattmann 2014; Berman and Couttenier, 2015; Dube et al., 2016; Berman et al, 2017; McGuirk and Burke, 2020)
- ▶ **Deforestation and conflict** (Burgess et al, 2015; Prem et al., 2020)
- ▶ **Conflict in Indonesia** (Barron et al., 2009; Bazzi and Gudgeon, 2021; Bazzi et al., 2022)
- ▶ **Natural resource curse** (e.g., Collier and Hoeffler, 2005; Van der Ploeg, 2011; Ross, 2015)
- ▶ **Economic development and conflict** (Ray and Esteban, 2017)
- ▶ **Environment and conflict** (Bernauer et al., 2012)

Research approach & findings

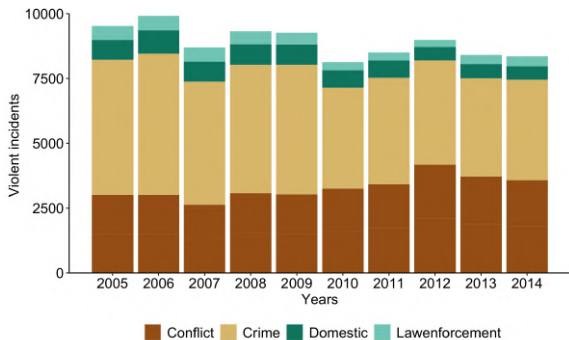
- ▶ Detailed spatio-temporal data on conflict events
- ▶ Remotely sensed yearly plantation maps
- ▶ Exogenous variation via oil palm suitability map

- ▶ Plantations are linked to conflict
- ▶ Incentives to expand production cause resource conflicts and land-use disputes

Dependent variable

Yearly number of violent conflict incidents

Violent incidents reported by NVMS (2005–2014)



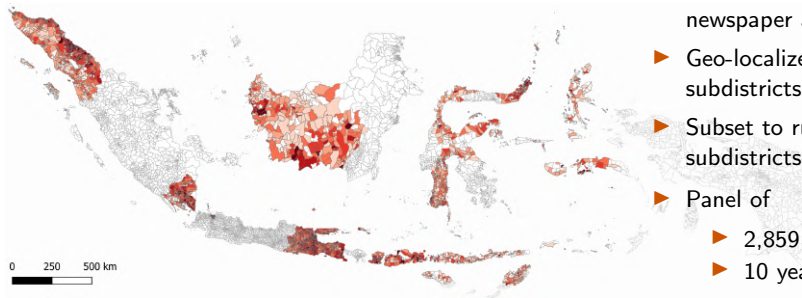
- ▶ Based on newspaper articles
- ▶ Geo-localized to subdistricts
- ▶ Subset to rural subdistricts
- ▶ Panel of
 - ▶ 2,859 units
 - ▶ 10 years

Source: National Violence Monitoring System (NVMS)

Dependent variable

Yearly number of violent conflict incidents

Intensity of violence in subdistricts reported by NVMS
(2005–2014)



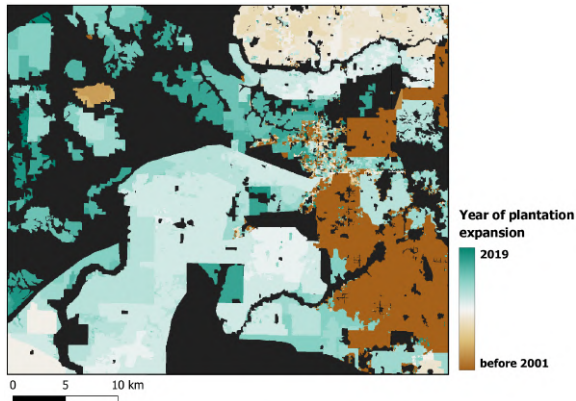
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Source: National Violence Monitoring System (NVMS)

Oil palm expansion

Detailed yearly plantation maps

Example of plantation expansion



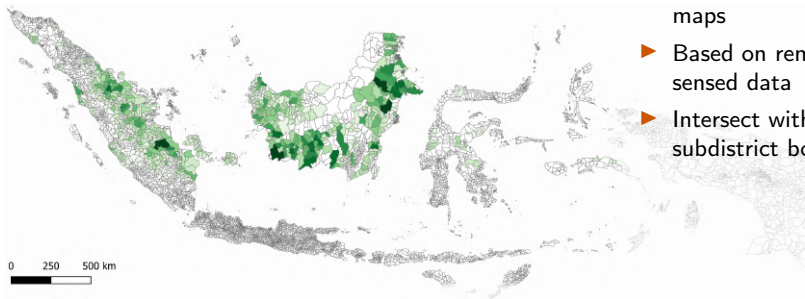
- ▶ Yearly high-resolution oil palm plantation maps
- ▶ Based on remotely sensed data
- ▶ Intersect with subdistrict boundaries

Source: Based on Gaveau et al. (2021)

Oil palm expansion

Detailed yearly plantation maps

Subdistrict-level expansion of oil palm area (2005–2014)



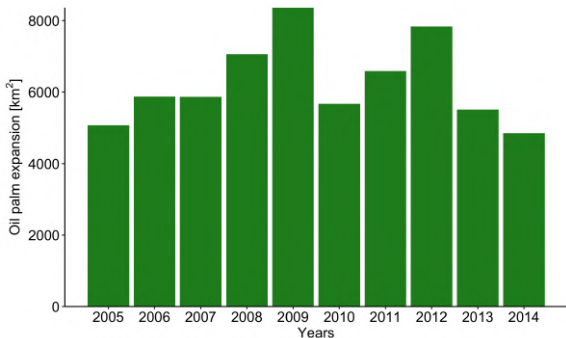
- ▶ Yearly high-resolution oil palm plantation maps
- ▶ Based on remotely sensed data
- ▶ Intersect with subdistrict boundaries

Source: Based on Gaveau et al. (2021)

Oil palm expansion pressure

Instrument based on aggregate trends and exogenous soil suitability

Aggregate oil palm expansion statistics



Source: Gaveau et al. (2021)

Redistribution of

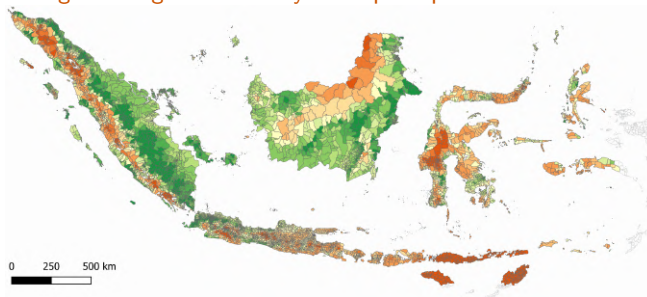
- ▶ National expansion, NE_t , via
- ▶ subdistrict area, α_i , and
- ▶ Soil suitability to plant oil palm s_i

$$EP_{it} = \frac{NE_t \times \alpha_i s_i}{\sum_i \alpha_i s_i}$$

Oil palm expansion pressure

Instrument based on aggregate trends and exogenous soil suitability

Agro-ecological suitability of oil palm production



Redistribution of

- ▶ National expansion, NE_t , via
- ▶ subdistrict area, α_i , and
- ▶ Soil suitability to plant oil palm s_i

$$EP_{it} = \frac{NE_t \times \alpha_i s_i}{\sum_i \alpha_i s_i}$$

Source: Maps for Global Agro-Ecological Zones (FAO/IIASA)

Empirical strategy

(1) OLS:

$$C_{it} = \beta_1 \ln \text{New area}_{it} + \lambda_i + \eta_t + v_{it}$$

(2) Reduced form equation:

$$C_{it} = \beta_2 \ln EP_{it} + \lambda_i + \eta_t + \varepsilon_{it}$$

(3) 2SLS estimation:

$$C_{it} = \beta_3 \ln \text{New area}_{it} + \lambda_i + \eta_t + \varepsilon_{it}$$

$$\ln \text{New area}_{it} = \beta_1 \ln EP_{it} + \lambda_i + \eta_t + v_{it}$$

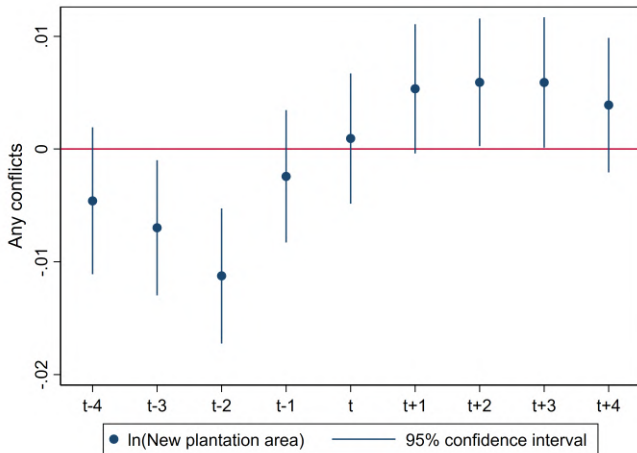
- ▶ $\ln \text{New area}_{it}$ - New oil palm area
- ▶ C_{it} - Any conflict incidents
- ▶ EP_{it} - Oil palm expansion pressure

Main results

Dependent variable:	Any conflict				<i>In</i> New OP
	OLS	OLS lagged exp.	Reduced form	2nd stage	1st stage
	(1)	(2)	(3)	(4)	(5)
<i>In</i> New oil palm area	0.001 (0.003)	0.005* (0.003)		0.178*** (0.065)	
<i>In</i> Expansion pressure			0.114*** (0.039)		0.643*** (0.087)
Subdistrict and year FE	Yes	Yes	Yes	Yes	Yes
Observations	28,590	28,590	28,590	28,590	28,590
Subdistricts	2,859	2,859	2,859	2,859	2,859
Adj. R ²	0.317	0.317	0.317		
Kleibergen-Paap <i>F</i> -stat.					55.03

- ▶ New plantations are not associated with immediate conflict
 - delayed effects due to initially peaceful protests? (De Juan et al., 2022)
 - reverse causality, economic channels?
- ▶ Pressure to expand is strongly associated with rising conflict

Effects of new plantations over time



Economic shocks in oil palm areas and conflict intensity

Dependent variable:	<i>ln</i> Conflict incidents		
	(1)	(2)	(3)
Drought months	-0.004 (0.003)		-0.004 (0.003)
Oil palm area cover (2000) × Drought months	0.032** (0.014)		0.037** (0.015)
Oil palm area cover (2000) × Pos. price shock		-0.023 (0.023)	0.000 (0.026)
Oil palm area cover (2000) × Neg. price shock		0.256* (0.145)	0.312** (0.143)
subdistrict & year FE	Yes	Yes	Yes
Observations	28,470	28,590	28,470
Subdistricts	2,847	2,859	2,847
Adj. R ²	0.454	0.455	0.455

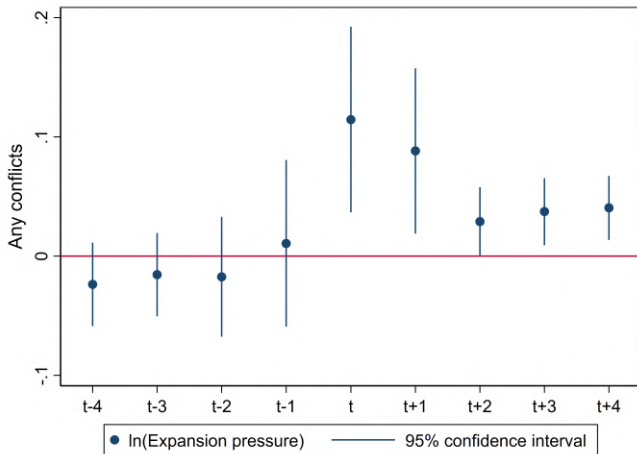
- ▶ Negative income shocks increase conflict intensity

Main results

Dependent variable:	Any conflict				<i>In</i> New OP
	OLS	OLS lagged exp.	Reduced form	2nd stage	1st stage
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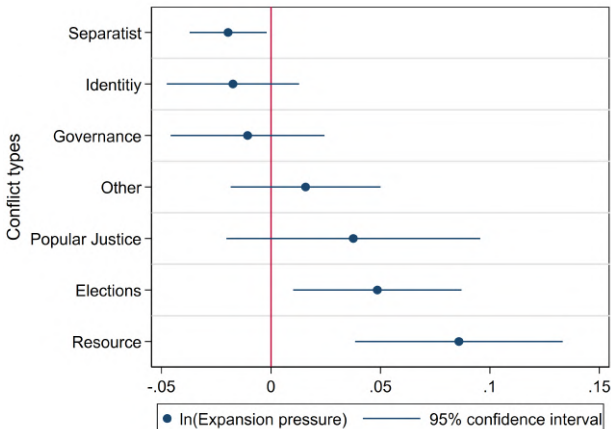
- ▶ New plantations are not associated with immediate conflict
 - delayed effects due to initially peaceful protests? (De Juan et al., 2022)
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- ▶ Pressure to expand is strongly associated with rising conflict

Effects of oil palm expansion pressure over time



Types of conflict

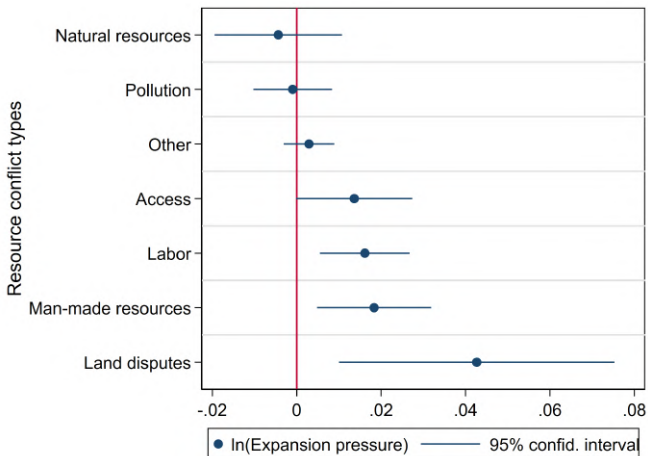
Dependent variable: Any conflict – Reduced form



- ▶ Measured effects are mainly caused by resource-related conflicts

Types of resource conflict

Dependent variable: Any resource conflict – Reduced form



Land scarcity and conflict

Dependent variable:	Any conflict				
	(1)	(2)	(3)	(4)	(5)
<i>ln</i> Expansion pressure	0.187*** (0.051)	0.276*** (0.094)	0.750*** (0.266)	0.095** (0.040)	0.742** (0.307)
<i>ln</i> Expansion pressure × Forest share (2004)	-0.111** (0.048)				-0.048 (0.067)
<i>ln</i> Expansion pressure × Share w/o plantation (2004)		-0.174* (0.092)			-0.204** (0.091)
<i>ln</i> Expansion pressure × <i>ln</i> Subdistrict area			-0.033** (0.014)		-0.022 (0.016)
<i>ln</i> Expansion pressure × Building density (2004)				0.369** (0.174)	0.141 (0.216)
Subdistrict & year FE	Yes	Yes	Yes	Yes	Yes
Observations	28,590	28,590	28,590	28,590	28,590
Subdistricts	2,859	2,859	2,859	2,859	2,859

- Expansion pressure causes conflict in subdistricts with less available land (ex-ante)

Environmental grievances and conflict

Dependent variable:	Any conflict		
	(1)	(2)	(3)
<i>ln</i> Expansion pressure	0.397*** (0.086)	0.450*** (0.089)	0.400*** (0.087)
<i>ln</i> Expansion pressure × Total forest cover loss (2004)	0.503*** (0.145)		
<i>ln</i> Expansion pressure × On-forest expansion		0.121*** (0.043)	
<i>ln</i> Expansion pressure × Illegal expansion			0.067* (0.039)
<i>ln</i> Expansion pressure × <i>ln</i> Forest area (2004)	-0.036*** (0.008)	-0.040*** (0.009)	-0.033*** (0.009)
Subdistrict & year FE	Yes	Yes	Yes
Observations	28,590	28,590	28,590
Subdistricts	2,859	2,859	2,859

- ▶ Oil palm expansion pressure intensifies conflict in subdistricts with high deforestation

Further heterogeneities?

- ▶ Social channels do not seem to play a role (population growth, ex-ante ethnic/religious fractionalization/polarization) [Table](#)
- ▶ Local development does not mitigate the effects (electrification, new schools/health facilities, NTL, ...) [Table](#)

Robustness

- ▶ Controlling for time trends in suitability and in various dimensions of remoteness (population density, accessibility, building density, forest cover) [Table](#)
- ▶ Controlling for expansion in neighboring subdistricts
- ▶ Placebo tests with randomly reshuffled suitability
- ▶ Clustering

Further steps

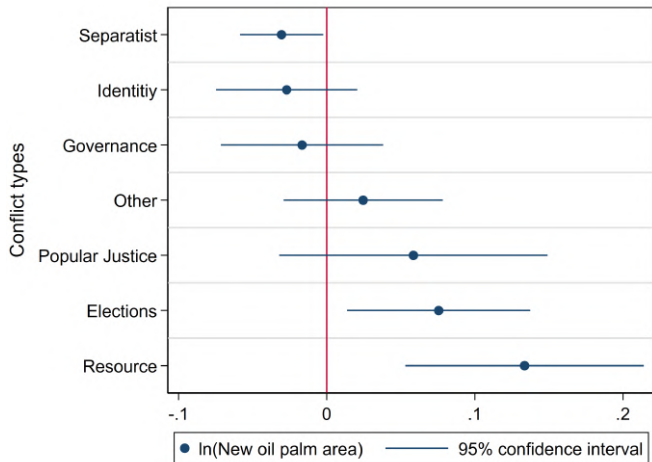
- ▶ Investigate scale-dependence (village and district level)
- ▶ Extend sample to include Papua
- ▶ Additional social channel: Transmigration villages
- ▶ Inequality as a mechanism?

Summary

- ▶ Oil palm boom in Indonesia is associated with local conflicts:
 - negative economic shocks in plantation areas increase conflict
 - incentives to expand production area increase conflict
- ▶ Land scarcity as a likely mechanism
- ▶ Environmental grievances reinforce the effect
- ▶ Implications: agricultural intensification needs to be accompanied by mechanisms to resolve conflicts; property rights need to be clearly defined

Types of conflict

Dependent variable: Any conflict – 2SLS



back

Social factors and conflict

Dependent variable:	<i>ln</i> Conflict incidents		
Mediator:	Stand. pop. growth (1)	Initial ethnic fragm. (2)	Initial religious fragm. (3)
<i>ln</i> Oil palm expansion pressure	0.106*** (0.035)	0.116*** (0.041)	0.097*** (0.037)
<i>ln</i> Oil palm expansion pressure × Mediator	0.009 (0.014)	-0.060 (0.059)	-0.013 (0.076)
Sub-district and year FE	Yes	Yes	Yes
Remoteness × year FE	Yes	Yes	Yes
Observations	26,720	26,180	26,180
Sub-districts	2,672	2,618	2,618
Adj. R ²	0.456	0.462	0.462

back

Development and conflict

Dependent variable:	<i>ln</i> Conflict incidents					
Mediator:	Standardized long-term change (2005–2013) in					
	Night-light intensity	Build-up area	Electrification (hh. share)	Primary school density (p. hh)	Health clinic density (p. hh)	Development index
	(1)	(2)	(3)	(4)	(5)	(6)
<i>ln</i> Oil palm expansion pressure	0.106*** (0.035)	0.106*** (0.035)	0.140*** (0.046)	0.106*** (0.035)	0.107*** (0.035)	0.107*** (0.036)
<i>ln</i> Oil palm expansion pressure × Mediator	-0.002 (0.028)	-0.010 (0.019)	-0.069 (0.060)	-0.010 (0.010)	0.022 (0.012)	-0.007 (0.022)
Village and year FE	Yes	Yes	Yes	Yes	Yes	Yes
Remoteness × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	27,400	27,400	27,400	27,400	27,400	27,400
Villages	2,740	2,740	2,740	2,740	2,740	2,740
Adj. R ²	0.456	0.456	0.456	0.456	0.456	0.456

back

Controlling for trends in suitability and remoteness

Dependent variable:	<i>ln</i> Conflict incidents				<i>ln</i> New oil palm area
	OLS (1)	OLS (2)	Reduced form (3)	2nd stage (4)	1st stage (5)
<i>ln</i> New oil palm area	-0.004 (0.003)	-0.004 (0.003)		0.170*** (0.057)	
<i>ln</i> Oil palm expansion pressure			0.106*** (0.035)		0.624*** (0.052)
Sub-district and year FE	Yes	Yes	Yes	Yes	Yes
Remoteness × year FE	No	Yes	Yes	Yes	Yes
Suitability year trends	No	Yes	Yes	Yes	Yes
Observations	27,400	27,400	27,400	27,400	27,400
Sub-districts	2,740	2,740	2,740	2,740	2,740
Adj. R ²	0.454	0.456	0.456	0.387	0.819
Kleibergen-Paap <i>F</i> -stat.					52.4

back