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PRIN 2022
Climate Change, Violent Conflicts and Welfare: A Multi-Scale Investigation of Causal Pathways in Different Institutional Contexts (CC2C)

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Ministero dell'Università e della Ricerca

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Climate Change – Agrifood – Conflict Nexus Pathways Assessment: A Scoping Review of the Literature

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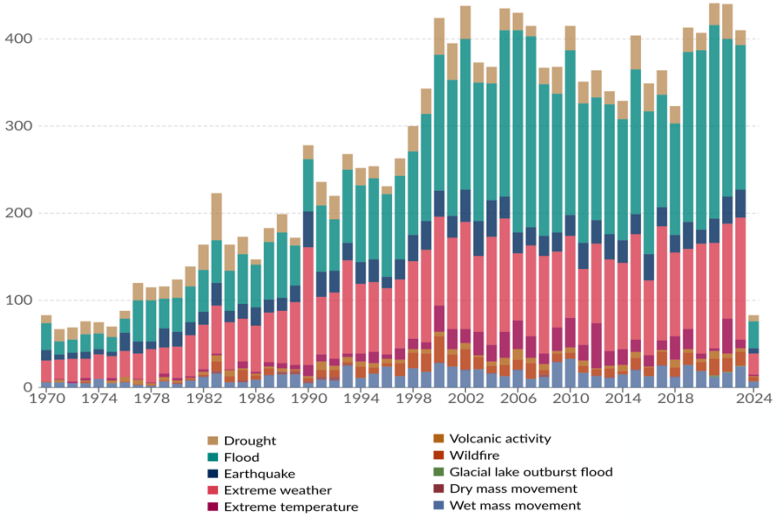
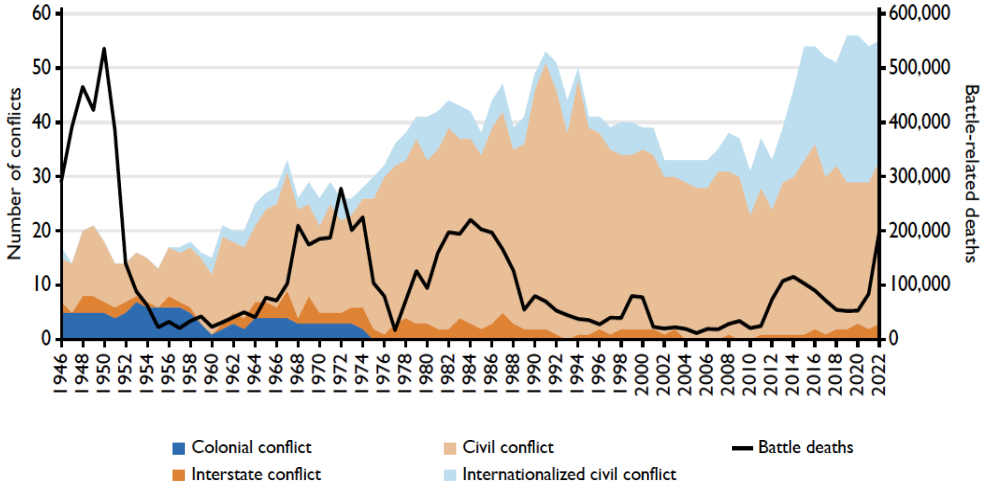
Shocks are on the rise

Natural risks



Source: Our World in Data, 2024

(State-based) Conflicts



Source: Obermeier & Rustad, 2023

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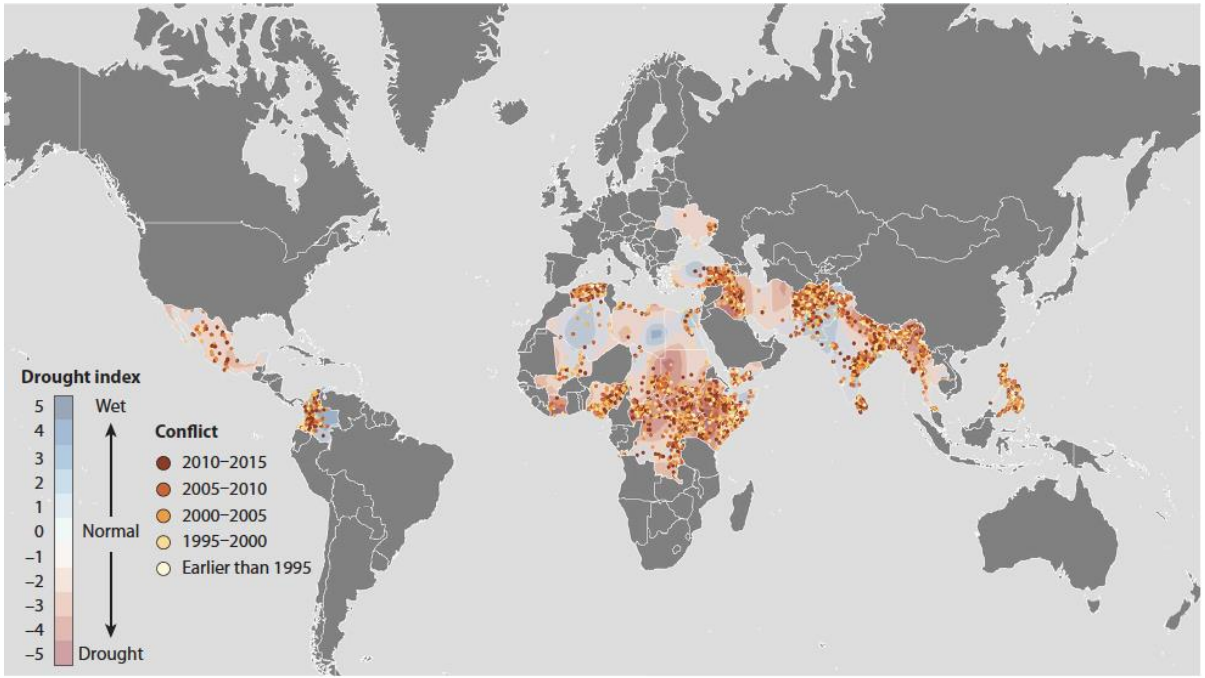
Correlation btw climate change and conflict



Source: Koubi, 2019

… but what about the mechanisms? And causal inference?

The critical role of agrifood systems

Two Key Strains of Literature:

- **AgEcon:**
  - Focus: **CC** → **Agriculture** → **Conflict**
  - Primarily **micro-level** studies
- **Peace Science:**
  - Focus: **Food security/agricultural livelihood** → **Conflict** and vice versa
  - Primarily **macro/meso-level** studies

Joining the Two Literatures: Exploring **pathways** that link CC, agriculture, and conflict

Methodology: Scoping review (PRISMA protocol from Moher et al., 2009; Levac et al., 2010; Page et al., 2021 and Tricco et al., 2018) of the literature from the last 10 years to identify key trends and gaps

3 steps

- identifying the research question
- identifying and selecting relevant studies
- collating, summarizing and reporting results

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Scoping/systematic review

Research question

What are the conceptual frameworks and empirical applications studying the relationships between climate change and conflict via the mediation of the agrifood system with specific reference to socio-economic analyses?

Search queries

SCOPUS Search Query "TITLE-ABS-KEY ((climat* OR weather OR temperature OR rain* OR spei) AND (change OR shock* OR drought OR flood*) AND (conflict* OR violen* OR unrest* OR war OR theft* OR dispute*) AND (agricultur* OR food OR farm* OR livestock* OR (resource AND competition) OR yield*)) AND (pathway* OR mechanism* OR channel* OR linkage*)" = **1,887 records**

SCOPUS Search Query "TITLE-ABS-KEY ((climat* OR weather OR temperature OR rain* OR spei) AND (change OR shock* OR drought OR flood*) AND (conflict* OR violen* OR unrest* OR war OR theft* OR dispute*) AND (agricultur* OR food OR farm* OR livestock* OR (resource AND competition) OR yield*)) AND (pathway* OR mechanism* OR channel* OR linkage*) AND PUBYEAR > 2014" = **1,463 records**

SCOPUS Search Query "TITLE-ABS-KEY ((climat* OR weather OR temperature OR rain* OR spei) AND (change OR shock* OR drought OR flood*) AND (conflict* OR violen* OR unrest* OR war OR theft* OR dispute*) AND (agricultur* OR food OR farm* OR livestock* OR (resource AND competition) OR yield*)) AND (pathway* OR mechanism* OR channel* OR linkage*) AND PUBYEAR > 2014 AND (LIMIT-TO (SUBJAREA,"ENVI") OR LIMIT-TO (SUBJAREA,"ECON") OR LIMIT-TO (SUBJAREA,"SOCI") OR LIMIT-TO (SUBJAREA,"AGRI"))" = **1,192 records**

SCOPUS Search Query "TITLE-ABS-KEY ((climat* OR weather OR temperature OR rain* OR spei) AND (change OR shock* OR drought OR flood*) AND (conflict* OR violen* OR unrest* OR war OR theft* OR dispute*) AND (agricultur* OR food OR farm* OR livestock* OR (resource AND competition) OR yield*)) AND (pathway* OR mechanism* OR channel* OR linkage*) AND PUBYEAR > 2014 AND (LIMIT-TO (SUBJAREA,"ENVI") OR LIMIT-TO (SUBJAREA,"ECON") OR LIMIT-TO (SUBJAREA,"SOCI") OR LIMIT-TO (SUBJAREA,"AGRI")) AND (LIMIT-TO (LANGUAGE,"English"))" = **1,159 records**

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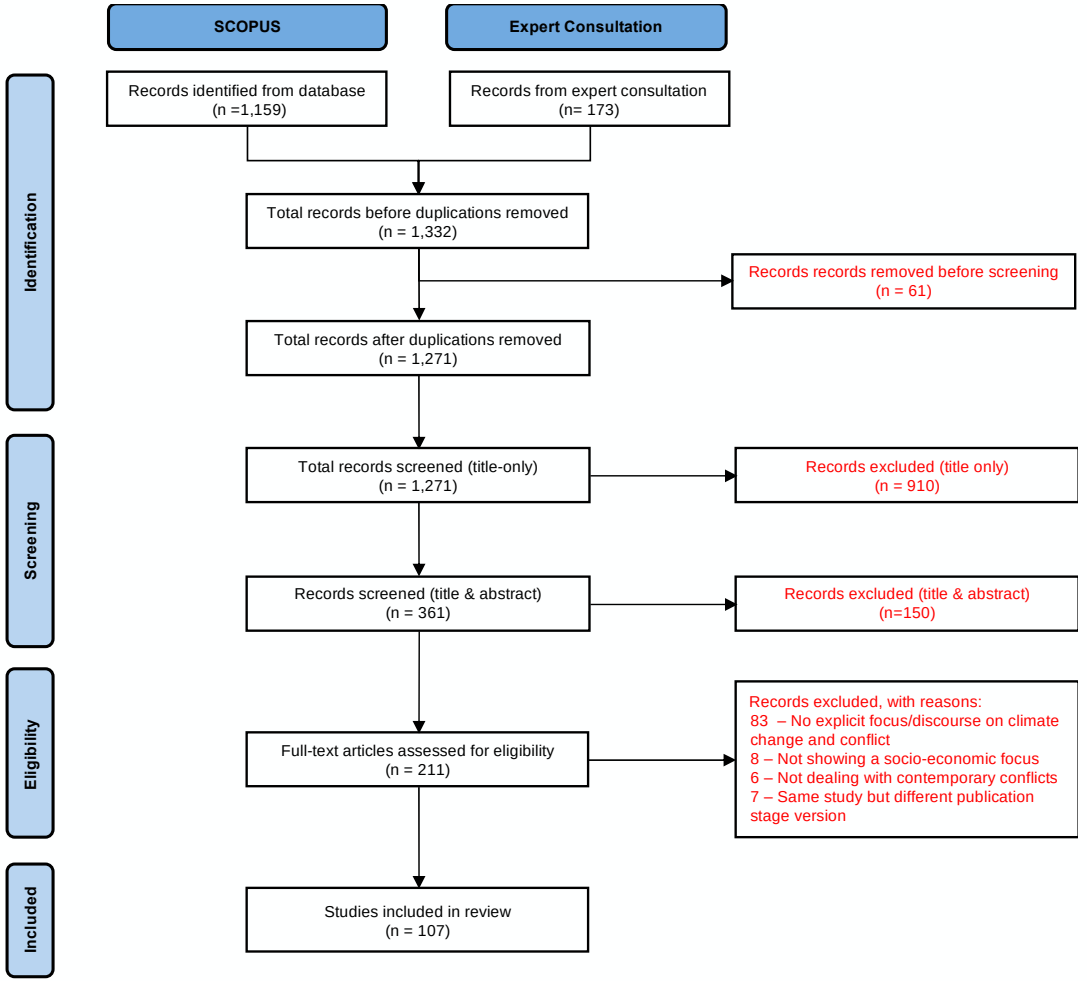
Scoping review



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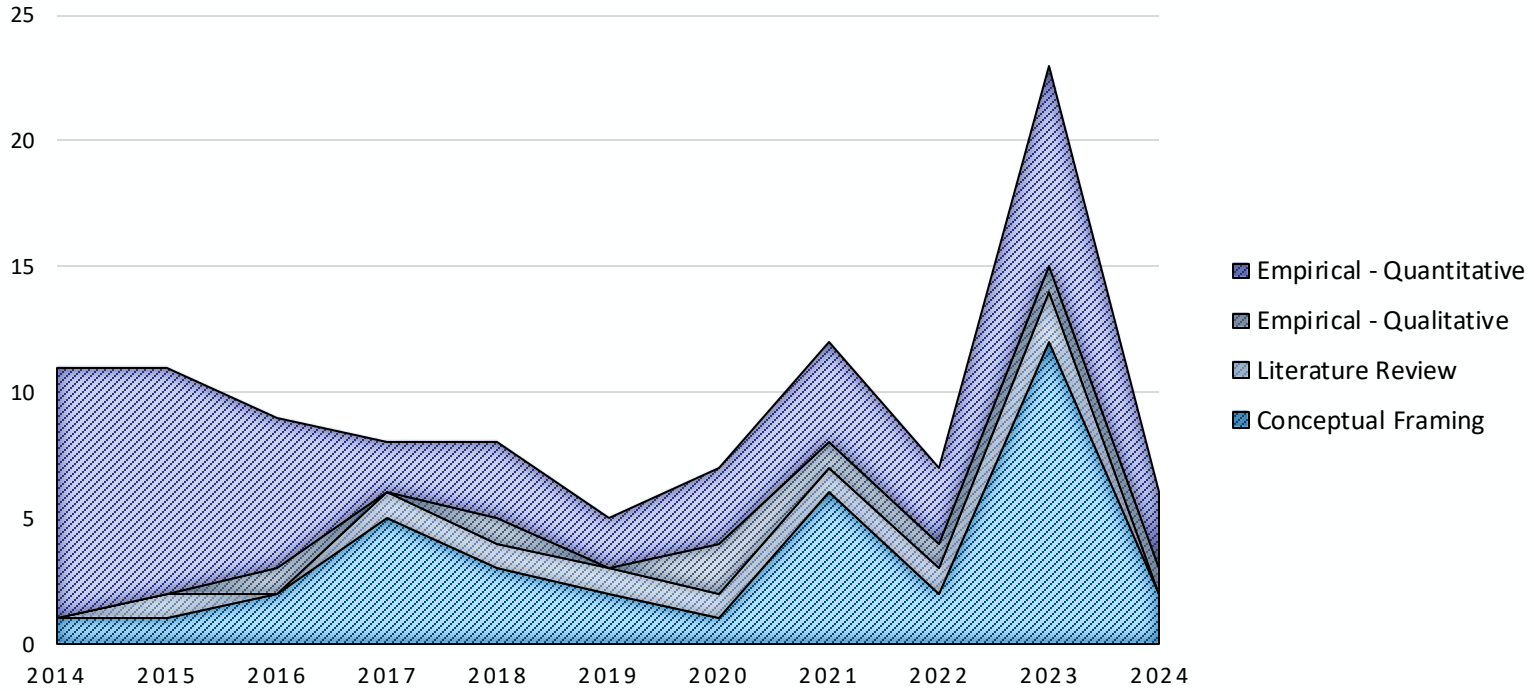
Distribution of studies across years and types



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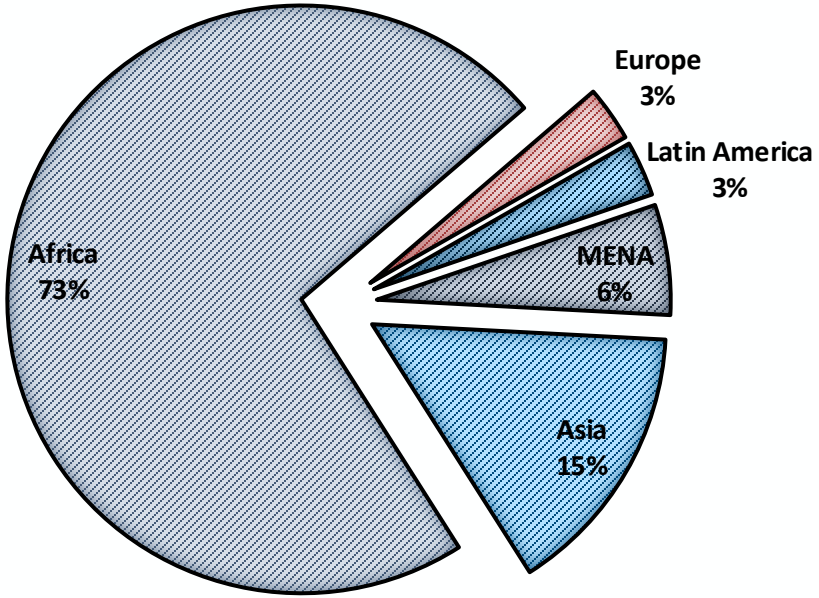
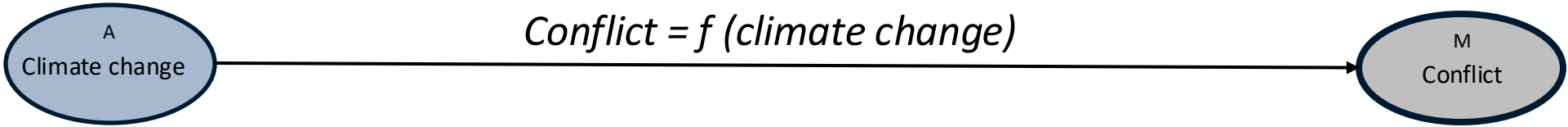
…and what about regional focus?



Pathways – Reduced form



… but what about the mechanisms? And causal inference?

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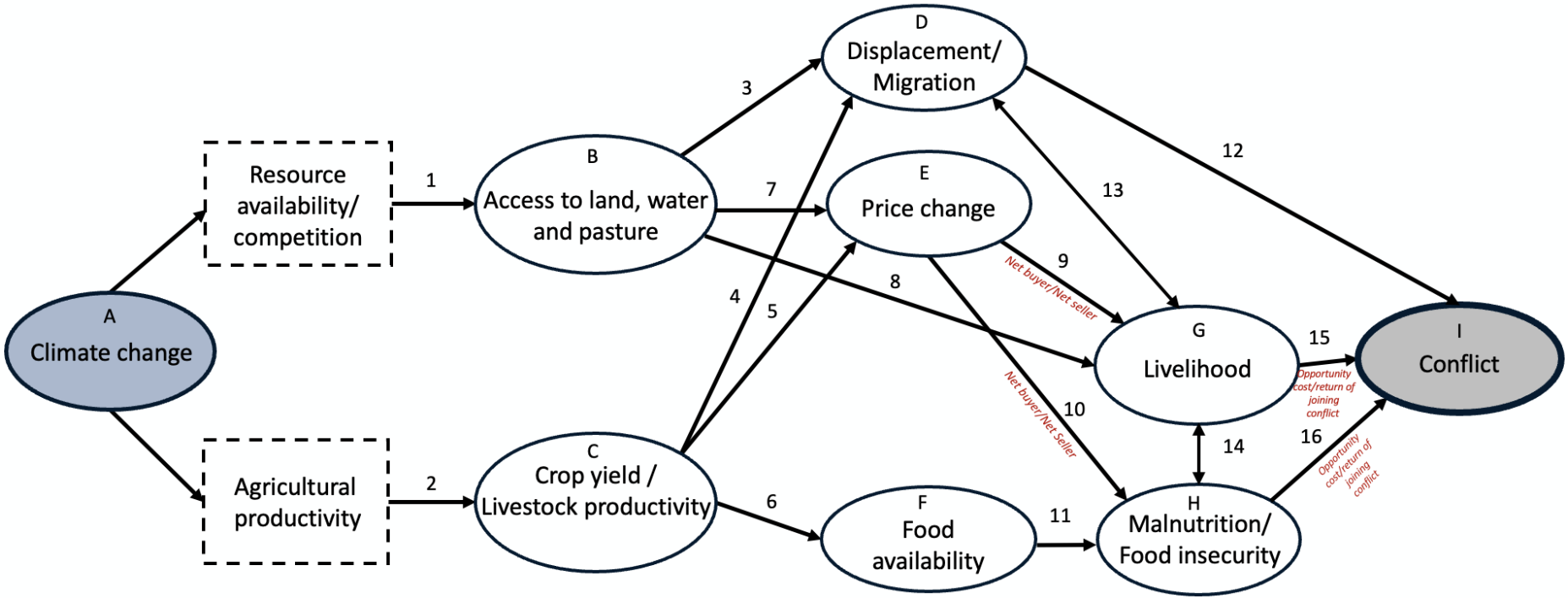
Pathways



Pathways – Conceptual mapping

Nodes	Links	Pathway	Conceptual framing studies	Empirical studies
Resource availabilityCompetition				
A-B-I		Resource availability/competition	Abrahams & Carr, 2017; Berchin et al., 2017; Brzoska & Fröhlich, 2016; Buhaug, 2015; Conca, 2023; Froese & Schilling, 2019; Ibrahim-Olesin et al., 2021; Ikhuoso et al., 2020; Sitati et al., 2021; Thalheimer, 2023; Vargas et al., 2021.	Almer et al., 2017; Ayana et al., 2016; Bohmelt et al., 2014; Cappelli et al., 2023; Cappelli et al., 2024; Couttenier & Soubeyran, 2014; De Juan & Hänze, 2021; Devlin and Hendrix, 2014; Ghimire and Ferreira, 2015; Landis, 2014; Linke et al., 2015; Maystadt & Ecker, 2014; Maystadt et al., 2015; Minale et al., 2024; O'Loughlin et al., 2014; Salehyan & Hendrix, 2014; Tubi and Feitelson, 2016; Vesco et al., 2021; von Uexkull, 2014; Wang et al., 2023
A-B-D-I	1-3-12	Resource availability/competition *via Migration*	Boege, 2023; Clack et al., 2023; Freeman, 2017; Okunade & Kohon, 2023; Olagunju et al., 2021	Ani & Uwizeyimana, 2020; Roy et al., 2022
A-B-E-G-I	1-7-9-15	Resource availability/competition *via Price change - Livelihood*	Buhaug et al., 2023	
A-B-E-H-I	1-8-14-16	*Resource availability/competition via Livelihood - Food insecurity*	Carneiro et al., 2023	

Pathways – Conceptual mapping cont.'d

Nodes	Links	Pathway	Conceptual framing studies	Empirical studies
Agricultural productivity				
A-C-I		Agricultural producitivity	Abrahams & Carr, 2017; Ahmed et al., 2023; Bedasa & Deksisa, 2024; Buhaug, 2015; Buhaug, 2016; Busby, 2018; Homer-Dixon, 2023; Ibrahim-Olesin et al., 2021; Mach et al., 2019; Sitati et al., 2021; Thalheimer, 2023	Ang & Gupta, 2018; Bohmelt et al., 2014; Bollfrass & Shaver, 2015; Breckner & Sunde, 2019; Buhaug et al., 2015; Cappelli et al., 2023; Caruso et al., 2016; George et al., 2020; Koren & Schon, 2023; Mary, 2022; Nardulli et al., 2015; Pacillo et al., 2022; Tubi and Feitelson, 2016; von Uexkull, 2014; Wang et al., 2023
C-E/D-G-I	2-4/5-13/9-14-15	Agricultural productivity *via Migration/Price change - Livelihood - Malnutrition/Food Insecurity*	von Uexkull & Buhaug, 2021	Wischnath & Buhaug, 2014

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Pathways – What about interacting factors?

Nodes	Interacting Factors	Conceptual framing studies	Empirical studies
Direct Association			
A-I	Ethinic divide/Political marginalization/Land disputes	Nyiayaana & Okoh, 2023; Ray & Esteban, 2017	von Uexkull et al., 2016; Schleussner et al., 2016
A-I	Technical solutions/Infrastructure	Phyffer, 2024; Thalheimer, 2023	Abid et al., 2016; Detges, 2016; Harari & La Ferrara, 2018; Petit et al., 2023
A-I	Gender disparity		Munala et al., 2023
A-I	Linguistic diversity		Song et al., 2024

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Datasets

Category	Datasets	Coverage	Resolution
Climate Datasets	Rainfall Only: CHIRPS, CMAP, GPCP, GPCC	Global (focus on tropics)	0.05° – 2.5°
	Temperature Only: MODIS Terra 6, NCEP/NCAR Reanalysis, GSOD	Global	1 km – 2.5°
	Both Rainfall and Temperature: SPEI, CRU TS, ECMWF, AFDM, PDSI, NatCatSERVICE	Global/Africa	0.25° – 2.5°
Conflict Datasets	Global Focus: ACLED, UCDP/PRIO, ICEWS, GDELT	Global	Subnational, georeferenced
	Regional/Local Focus: SCAD, UNSFIR	Africa, Indonesia	Country-level, Province-level
Local Conflict Datasets	Varshney-Wilkinson Dataset, Newspaper Articles and Individual Records	India, Local (e.g., Matour)	City-level, Local-level
Socioeconomic Datasets	World Bank (WDI), IMF, Gridded GDP, Afrobarometer, CIESIN Gridded Population, Household Surveys	Global, Africa	Country-level, subnational
Agricultural Datasets	FAO GAEZ, FAOSTAT, USDA Caloric Content Data, HYDE 3.2	Global	Varies, 5 arc-minutes
Other Datasets	Geo-Referenced Ethnic Groups (GREG), Nightlight Data, SPEED Metadata	Global	Varies

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Conflict Variables

Category	Conflict Types	Description	Frequency	Duration	Fatalities
State-Based Violence	Battles, State-Based Conflict, Explosions	Armed confrontations between state forces, organized armed groups, and bombings or explosions targeting military/civilians.	Daily/Weekly (ACLED); Monthly/Yearly (UCDP)	Days to weeks (ACLED); Months to years (UCDP)	Varies; 25+ deaths (minor conflicts), 1,000+ deaths (major conflicts)
Non-State Violence	Non-State Conflict, Riots	Conflicts between non-state actors (e.g., inter-group clashes) and violent civilian-government clashes (riots).	Weekly/Monthly (ACLED, UCDP)	Hours to days (ACLED); Days to months (UCDP)	Moderate to high, 25+ deaths for significant events
Civilian Targeted Violence	Violence Against Civilians (VAC), One-Sided Violence	Direct attacks, killings, abductions of civilians by armed groups, either state or non-state.	Daily/Weekly (ACLED); Monthly/Yearly (UCDP)	Hours to days (ACLED); Days to months (UCDP)	Can be large, can exceed 1,000 deaths in severe cases
Protests and Social Unrest	Protests, Riots	Non-violent demonstrations and protests against governments, which may escalate into violent riots.	Daily/Weekly (ACLED, ICEWS); Yearly (UCDP if violent)	Hours to days (ACLED, ICEWS); Days to months (UCDP)	No direct fatalities unless escalation to violence

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Climate Variables

Category	Variable Types	Description	Frequency/Trends
Deviations/ Anomalies	Temperature Deviations, Precipitation Deviations	Tracks changes in temperature or precipitation relative to historical baselines, useful for monitoring heat stress, droughts, or rainfall anomalies.	Deviations from long-term averages, gradual trends of temperature/precipitation changes
Extremes	Flood Frequency, Drought Index (SPEI, SPI, PDSI)	Measures the frequency and intensity of floods and droughts using indices such as SPEI (Standardized Precipitation-Evapotranspiration Index), SPI (Standardized Precipitation Index), and PDSI (Palmer Drought Severity Index).	Tracks extreme variations such as recurring floods or multi-year droughts
Events/ Patterns	El Niño/Southern Oscillation (ENSO), Storms and Extreme Weather Events	Large-scale climate patterns like ENSO that cause global temperature and precipitation variability; also tracks storms and other extreme weather events.	Measures cyclical patterns (e.g., ENSO) and long-term trends in storm severity and frequency
Disasters	Natural Disasters (e.g., floods, droughts, hurricanes)	Tracks rapid-onset, climate-related disasters like floods, droughts, and hurricanes, which result in significant economic and social impacts.	Sudden and severe events with increasing trends due to climate change

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Socioeconomic, Agricultural, and Other Variables

Category	Variable Types	Description	Frequency/Trends
Economic Variables	GDP per capita, Government Expenditures, Income from Agriculture, Food Prices, Livestock Prices	Tracks economic indicators such as GDP per capita, public spending, income from agriculture, and price fluctuations of food and livestock.	Annual or periodic data updates reflecting economic activity and market trends
Demographic Variables	Population Density, Migration (internal/external), Ethnic Groups	Measures population distribution, migration patterns, and ethnic group distribution, which affect social and political dynamics.	Updated regularly through censuses and surveys
Well-being Variables	Household Income, Food Insecurity, Child Nutrition (WHZ, MUACZ), Educational Facilities, Access to Urban Centers	Tracks household income, food security, child nutrition, and access to education and infrastructure as indicators of well-being.	Annual surveys and periodic updates reflecting public welfare
Infrastructure & Development	Nighttime Light Emissions, Access to Urban Centers	Nighttime light emissions and access to urban infrastructure as proxies for development and infrastructure access.	Data collected through remote sensing and surveys

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Common Empirical Strategies

Method Group	Specific Methods	Best For	Research Questions	Strengths	Limitations
1. Linear and Panel Models	OLS & Variants, Panel Models	Estimating linear relationships across time and units	How do climate or economic changes affect conflict over time?	Simple, interpretable, controls for time-invariant effects	Assumes linearity, limited in addressing endogeneity
2. Binary and Count Models	Logit/Probit Models, Negative Binomial Models	Predicting binary outcomes (e.g., conflict onset) or event counts	What factors drive conflict onset or frequency?	Suitable for binary outcomes, handles overdispersion in count data	Computationally intensive, sensitive to distributional assumptions
3. Causal Inference Models	Instrumental Variables (IV), Difference-in-Differences (DiD), Structural Equation Models (SEM)	Estimating causal effects and complex pathways	What is the causal impact of climate shocks on conflict? How do indirect effects influence outcomes?	Mitigates endogeneity, captures indirect effects	Requires strong instruments, sensitive to model misspecification
4. Spatial and Non-Linear Models	Spatial Lag Models, Generalized Additive Models (GAMs)	Addressing spatial dependence and non-linear relationships	How do neighboring regions influence conflict? How do climate extremes affect conflict?	Corrects for spatial autocorrelation, captures non-linear effects	Computationally intensive, requires large datasets

Estimating Causal Relationships

Instrumental Variables (IV) Approach

- **Example:** Hsiang et al. (2013) used IV models to estimate the causal effect of climate on conflict.
- **Purpose:** Corrects for endogeneity, identifying causal pathways (e.g., temperature leading to conflict).
- **Critique (Buhaug et al., 2014):** IV assumptions can be unrealistic; results may depend heavily on the choice of instruments.
- **Causal Estimation Techniques:**
  - **2SLS, GMM:** Use these approaches to handle reverse causality and omitted variables.
  - **Structural Equation Models (SEM):** Best for estimating indirect pathways (e.g., how economic factors mediate the climate-conflict relationship).

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Main Estimation Issues

Endogeneity

- **Approach:** Use IV models, 2SLS, or GMM to address potential reverse causality or omitted variable bias.
- **Example:** Understanding how climate shocks directly influence conflict events while accounting for other confounding factors.

Spatial Dependence

- **Approach:** Use spatial models (e.g., Moran's I, Spatial Lag Models) to account for spatial autocorrelation.
- **Example:** Subnational studies on localized conflict where neighboring regions influence each other.

Non-Linearity

- **Approach:** Use Generalized Additive Models (GAMs) or polynomial regressions to model non-linear relationships.
- **Example:** Studying how extreme temperature variations (beyond a certain threshold) lead to higher probabilities of conflict.

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Estimating Multi-Level Relationships

Structural Equation Models (SEM)

- **Best For:** Estimating complex, multi-level relationships, capturing both direct and indirect effects.
- **Use Cases:** Climate-conflict pathways where climate affects economic conditions, which in turn affect conflict.
- **Strengths:** Allows for modeling relationships at different levels (e.g., regional temperature, national conflict).

Combined Approaches

- **Best For:** Studying relationships across multiple levels (e.g., national, subnational, household).
- **Example:** Mixed models + SEM to study how climate impacts conflict at multiple socio-economic levels.

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Combining Quantitative and Qualitative Approaches

Why Combine Methods?

- **Benefits:** Quantitative methods (e.g., statistical models) offer broad patterns; qualitative methods (e.g., case studies) provide deeper contextual understanding.
- **Example:** Ide (2018) emphasizes the value of combining these methods to better understand the complexity of climate-conflict relationships.

How to Combine Approaches:

- **Quantitative Analysis:** Use OLS, spatial models, or SEM to identify patterns in data.
- **Qualitative Insights:** Validate quantitative findings with qualitative methods, such as interviews or case studies, to capture contextual factors.
- **Best For:** Complex, multi-faceted phenomena where quantitative data alone might miss critical insights.

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Conclusions

- **Most studies focus on larger scales**, leaving critical gaps in understanding how local markets and small-scale agricultural changes link to conflict.
- Though the two primary pathways—**agricultural productivity** and **resource competition**—are well-documented, there is a lack of empirical work on **market mechanisms** that link climate change to conflict, particularly how **food prices** and **market access** influence conflict dynamics.
- Existing studies rely on diverse datasets covering climate, conflict, and socio-economic variables, but **inconsistencies in resolution** and **scope** limit comparability. The lack of **high-resolution micro-level data**hinders detailed analysis.
- Significant gaps exist in **causal inference** methods. Challenges such as **endogeneity, spatial dependence, and non-linearity** require more robust approaches, particularly at the micro level. Improvements in methodology and **data availability** are essential for advancing the field.
- **Future Research Directions:** 1) Emphasis on **micro-level analysis** and market mechanisms; 2) Use of **interdisciplinary approaches**, combining insights from agronomy, economics, and peace studies to deepen understanding of climate-conflict links; 3) Application of **causal inference methods**, addressing challenges such as endogeneity, spatial dependence, and non-linearity.

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Many thanks for your attention

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