

#### Evidence Syntheses to Mitigate and Adapt to the Consequences of Climate Change

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June 2023

American Institutes for Research: Evidence Syntheses to Contribute to a Better, More Equitable World



#### AIR's International Development Division conducts evidence syntheses that align with AIR's mission.

Conducted evidence syntheses on agriculture, education, financial inclusion, food production, health, nutrition, trade, technology, women's economic empowerment, etc.

#### AIR's Methods of Synthesis and Integration Center has implemented over 50 evidence syntheses

Developed evidence synthesis methods for impact, performance, and process evaluations



#### **Evidence syntheses systematically synthesize** the existing knowledge related to a topic

Evidence syntheses capture and consolidate evidence that is voluminous, diverse, and fragmented across disciplines through a synthesis of all the existing high-quality evidence using transparent methods to give the best possible generalized statements about what is known.

- Waddington et al., 2012, p. 360



# Poll: What behavioral interventions are most effective to save energy?







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Mercator Research Institute on Global Commons and Climate Change gGmbH



#### **Evidence-based policy for effective climate solutions in the age of big literature**

Jan C. Minx AIR seminar series 6 June 2023



#### URGENCY Robust scientific policy advice for rapid learning on climate solutions





#### Evidence-based policy depends on well-working evidence pyramid with evidence synthesis at its heart



- Making rapid progress choosing most effective interventions that work
- Using limited financial resources carefully in science (research waste) and policy (wasting money on solutions that do not work well)
- Improving the quality of primary research

Minx et al. (2017), Learning on climate solutions in the IPCC and beyond, Environ. Sci. Policy



#### <u>Successes in international climate diplomacy unthinkable</u> without provision of rigorous scientific evidence



IPCC (2013), <u>Climate Change 2013 – The Physical Science Basis</u>; Rogelj et al. (2018), <u>Scenarios towards limiting global mean</u> <u>temperature increase below 1.5°C</u>, *Nature Clim. Ch.* 



#### A (partially) broken evidence pyramid: little progress in understanding what climate solutions work under what conditions and why



Berrang-Ford et al. (2020), Evidence synthesis for accelerated learning on climate solutions, Campbell Syst. Rev.



# Evidence-based policy takes place in the age of BIG LITERATURE



#### **Evidence-based policy at the brink: the age of BIG LITERATURE**



- Only Web of Science
- Total literature: ~900k
- Vast literature "climate relevant"
- Focus on evidence synthesis: urgent need to make best evidence available for informing climate policy

Callaghan et al. (2020), <u>A topography of climate change research</u>, *Nat. Clim. Change;* Minx et al. (2017), <u>Learning on climate solutions in the IPCC and beyond</u>, *Environ. Sci. Policy* 



# Artificial Intelligence can help to track the evidence and reap the opportunities of vast evidence bases

#### Keeping an overview in the age of big literature: investing in systematic mapping is critical

- It is crucial to keep oversight of the available evidence
  - What are the mature areas of research? Are high quality reviews available?
  - In which areas do we lack (highquality) primary studies?
- Increasingly difficult to manually track evidence
  - Invest into (living) AI-based maps as open-access community resource

Berrang-Ford et al. (2021), <u>Systematic mapping of global research on climate and health: a</u> <u>machine-learning review</u>. Lancet Planet. Health



B Most frequent topics by region and category

	Africa	Asia	Europe	North America	Oceania	Latin America
CCVW Hazards	(Rainfall; general climate change; seasonality)	(Particulates; temperature; meteorological variables)	(Temperature; heatwaves; meteorological variables)	(Hurricanes; extreme weather; particulates)	(Heatwaves; temperature; general climate change)	(Rainfall; meteorology; general climate change)
Health risks and impacts	(Malaria; infectious disease; public health)	(Air pollution; dengue; mortality)	(Mortality; air pollution; heat stress)	(Public health; heat stress; visits to health-care facilities)	(Public health; heat stress; hospital admissions)	(Dengue; mosquito vector dynamics; transmission)
Mediating pathways	(Rural households; age and sex; social vulnerability)	(China; age and sex; urban areas)	(Urban areas; age and sex; social vulnerability)	(Social vulnerability; age and sex; urban areas)	(Social vulnerability; age and sex; urban areas)	(Urban areas; social vulnerability; age and sex)
Options and responses	(DRR; energy policy; GH pathways)	(Energy policy; GH pathways; adaptation)	(GH pathways; energy policy; adaptation)	(Energy policy; community resilience; GH pathways)	(Community resilience; adaptation; energy policy)	(GH pathways; community resilience; adaptation)

# Shaping a new field: AI for new evidence synthesis methods for vast literature bases



Callaghan et al. (2021), Machine-learning-based evidence and attribution mapping of 100,000 climate impact studies, Nat. Clim. Change



# High quality systematic reviews on climate solutions required to understand "what works"



#### Rigorous systematic reviews on climate solutions: Example - can behavioural interventions help to save energy?

#### Comparative assessment of behavioural interventions in residential buildings across the world



#### Rigorous systematic review methodology

Comprehensive, machine learning assissted review of scientific literature (>60k articles)

Meta-regression of results of 122 experimental, quasi experimental primary studies (360 effect sizes)

Sample represents evidence from > 1.1 million households in 25 countries

Assess causes of heterogenity and calculate potential emissions reductions

Khanna et al. (2021), A multi-country meta-analysis on the role of behavioural change in reducing energy consumption and CO2 emissions in residential buildings, Nat.



#### What works? How well do interventions work together?



- Interventions have a small-medium effect on household energy consumption
- The average effect for monetary incentives > social comparison, motivation, *for the incentive sizes studied*

#### First SR to evaluate policy packages



- Certain combination of interventions perform better than their individual parts
- Other evidence synthesis methods required to figure out why some packages work and others do not

Khanna et al. (2021), A multi-country meta-analysis on the role of behavioural change in reducing energy consumption and CO2 emissions in residential buildings, Nat.

Energy

We do not always need new primary evidence! Global policy instrument evaluation for learning and informing national policy instrument choice and design





Khanna et al. (2021), A multi-country meta-analysis on the role of behavioural change in reducing energy consumption and CO2 emissions in residential buildings, Nat.



# Towards living systematic review ecosystems?

# Moving forward: Investing into high-quality systematic review ecosystems

- Problem: 1) Lack of highquality systematic reviews across entire fields; 2) Robust evidence for scientific policy advice requires selectiveness (Simonsohn et al. 2022)
- Solution: "ecosystems of reviews" consisting of interrelated systematic reviews for aggregating various strands of evidence on a particular topic





### Towards a comprehensive assessment of what climate solutions work





- Problem: Robust evidence from systematic reviews and maps is not available when decision makers need it
- Solution: Living evidence (ecosystems) through process innovation, new community organisation and AI



Elliott et al. (2021), <u>Decision makers need 'living' evidence synthesis</u>, *Nature* 

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Starting the age of climate solutions

Evidence

Svnthesis

International

e Evidence-Based Research Network

International

Initiative for

Evaluation

Impact

Collaboration for Environmental

Cochrane

Campbell Collaboration Evidence

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Africa Centre for Evidence



#### Thank you!

Rapid progress in climate policy depends on a sound understanding of what policies work under what conditions and why.

- Filling the evidence synthesis gap in policy evaluation critical to knowledge accumulation and accelerated learning on climate solutions
- Smart use of AI essential to track and synthesize the available evidence efficiently
- Catalyzing (Living) systematic review ecosystems on climate solutions fundamental to real-world progress

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# Qualitative evidence in syntheses of climate change research

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June 6, 2023

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#### Making qualitative evidence synthesis strong and reliable

- Rigorous methodology: Syntheses follow a predefined and transparent methodology which reduces bias and allows for study replication
- Critical appraisal: Syntheses include a critical appraisal of the quality of included studies. This evaluation helps assess the reliability and validity of the evidence
- Qualitative synthesis: Evidence is analyzed and summarized systematically using a qualitative data analysis software (such as NVivo or Dedoose) or consistently extracting relevant data to an excel spreadsheet







Sources: Cochrane training handbook ch. 21; Flemming & Noyes 2021





Advancing Evidence. Improving Lives.

# Why synthesize qualitative evidence for climate change

1. Mechanisms of change

- 2. Under what conditions and why interventions work
- 3. Under what conditions and why changes last

#### **Theory of Change: Synthesis of Climate Adaptation in Food Production**



Source: Mapping and Evidence Synthesis of Process Evaluations of Climate Adaptation in Food Production, The Norwegian Agency for Development Cooperation



#### **1. Understand which** *mechanisms* **determine differences** in effectiveness of behavioral interventions



- Example mechanism: Evaluations of crop production interventions found that smallholders' uptake of climate-adaptive approaches was more consistent when positive results were achieved quickly.
- Implication: Positive results are not always quick; however, communicating expectations may help encourage longer-term behavior change.



# 2. Understand *under what conditions and why* behavioral interventions are more likely to work



- Example moderator: Numerous evaluations found that severe weather, limited water infrastructure, poor roads, and the general inaccessibility of project sites moderated projects' effectiveness.
- Implication: Fundamental failure to consider ways in which an approach can work around practical realities leads farmers to revert to old practices



# 3. Understand under what conditions and why behavioral change is more likely to be sustained



- Example motivation: Evaluations found that programs were unsustainable when participants perceived that activities were not profitable, useful, or a priority for their business.
- Implication: Climate is not always an intrinsic motivator. Understanding the intrinsic motivator for the population encourages long term action.



#### Potential implications for policy decision making

- Importance of a thorough problem analysis, including appropriate climatic and infrastructure conditions
- Behavioral approaches to climate adaptation are reinforced by structural and institutional changes
- Behavioral changes are more likely when aligned with economic incentives because of trade-offs

"Increased financial benefit... proved more meaningful to most farmers than the motivation to achieve other goals associated with organic cotton farming, such as improved sustainability and reducing harm to the environment."







Source: Socio-economic and Environmental Outcomes of Organic Cotton Farmers in Madhya Pradesh, India

