



POLICY BRIEF

ACDC

Agroecology & the resilience of small-scale farmers to climate change

Evidence to transform food systems in the Dry Corridor of Central America

FEBRUARY 2025

Building Climate Resilience: Agroecology in the Dry Corridor

Lolita Muller, Peter Steward, Todd Rosenstock

KEY MESSAGES

- The integration of agroecological practices stands out as a promising strategy to enhance resilience against climate hazards.
- Agroecological practices such as mulch, crop residues, shaded trees and living barriers increase climate resilience by increasing soil moisture or decreasing soil temperature and erosion.
- While agroecological practices may require initial investments, they are not an economic burden for smallholders.
- This analysis leads to several actionable recommendations for policymakers and stakeholders including investing in farmer education on agroecology and providing financial support for the initial transition period.

Climate hazards, Food and Agroecology in the Dry Corridor

Smallholder farmers, the backbone of agricultural production, are among the most severely impacted by climate change. Their reliance on rain-fed agriculture, coupled with limited resources and access to support, makes them highly vulnerable to the adverse effects of climate variability. Climate change has already unleashed devastating consequences on smallholder farmers, causing drastic reductions in crop yields of crucial staples like maize and beans, severely undermining food security, and exacerbating poverty (Gourdji et al., 2015; Bunn et al., 2015).

The Dry Corridor, extending across Guatemala, Honduras, El Salvador, and Nicaragua, has been a recurring hotspot of climate extremes, including recurrent droughts, erratic rainfall patterns, and heightened temperatures. These climate disruptions have exacerbated existing socio-economic challenges, threatening food security and livelihoods for millions of smallholder farmers who depend on agriculture for their sustenance.

Against this backdrop of climate-induced challenges, agroecology has emerged as a solution offering a comprehensive framework for sustainable agricultural practices that harmonize traditional knowledge with modern scientific insights (Amoak, et al. 2022).

This holistic approach, deeply rooted in ecological principles, seeks to optimize the interactions between plants, animals, humans, and the environment, fostering resilience and adaptation in the face of a changing climate.

While numerous studies have examined the potential of agroecology in addressing climate change, persistent knowledge gaps persist regarding the effectiveness of specific agroecological practices against climate hazards.

This brief delves into the existing quantitative evidence on the impact of agroecology on climate hazard resilience, exploring both the strengths and limitations of this evidence base. It also identifies key gaps in research that need to be addressed to provide a more comprehensive understanding of agroecology's effectiveness in the Central American Dry Corridor.

Resilience against climate hazards

Current evidence

This comprehensive analysis of quantitative evidence demonstrates the inherent resilience-enhancing potential of agroecological practices against climate hazards for various crops, including maize, beans, and coffee (Fig 1a).

Agroecological practices such as living barriers and shaded trees create microclimates that shield crops from the adverse effects of extreme droughts, heat waves, and cyclones by enhancing soil moisture and minimizing erosion.

Furthermore, agroecology's emphasis on soil health through organic farming techniques, including cover cropping and mulching, significantly improves water retention and reduces erosion, further bolstering crop resilience in the face of climate extremes. These findings highlight the practical effectiveness of agroecological approaches in addressing the immediate challenges posed by climate extremes, reaffirming their role as valuable tools for building agricultural resilience.

While agroecology offers promising solutions to climate resilience, it is essential to consider its potential economic impact on farmers. While these practices may reduce the maximum potential farm output in any one year, their ability to minimize crop losses during unfavorable climate conditions suggests that they can be sustainable solutions in the long run.

Economics

This analysis of quantitative evidence indicates that the economic impact of agroecological practices on farmers in the Central American Dry Corridor is generally small or neutral in the short term. While initial implementation costs may be incurred, particularly for practices like agroforestry, shaded trees, and living barriers, these costs are often offset by various economic benefits over time. The introduction of biodiversity, a pillar of agroecology, not only enriches ecosystems but also opens new income streams for farmers. Agroforestry, for example, provides timber, fruits, and medicinal plants, diversifying agricultural production and generating additional revenue.

Moreover, agroecology enhances soil health and water retention, reducing the need for external inputs like fertilizers and pesticides. This can lead to cost savings for farmers, further improving their economic well-being in the long run.

While this analysis indicates a generally neutral economic impact of agroecological practices in the short term, the potential for long-term benefits for smallholder farmers is substantial. As the effects of climate change intensify, agroecology's ability to enhance productivity, reduce input costs, and diversify income streams will become increasingly valuable. However, transitioning to agroecological practices requires time and investment, highlighting the urgency of supporting smallholder farmers in adopting these sustainable practices as soon as possible.

Challenges in quantifying agroecology's impact

Despite the growing recognition of agroecology's potential to enhance climate resilience, there are remaining gaps in quantitative evidence, particularly in the context of the Central American Dry Corridor (Fig 1b).

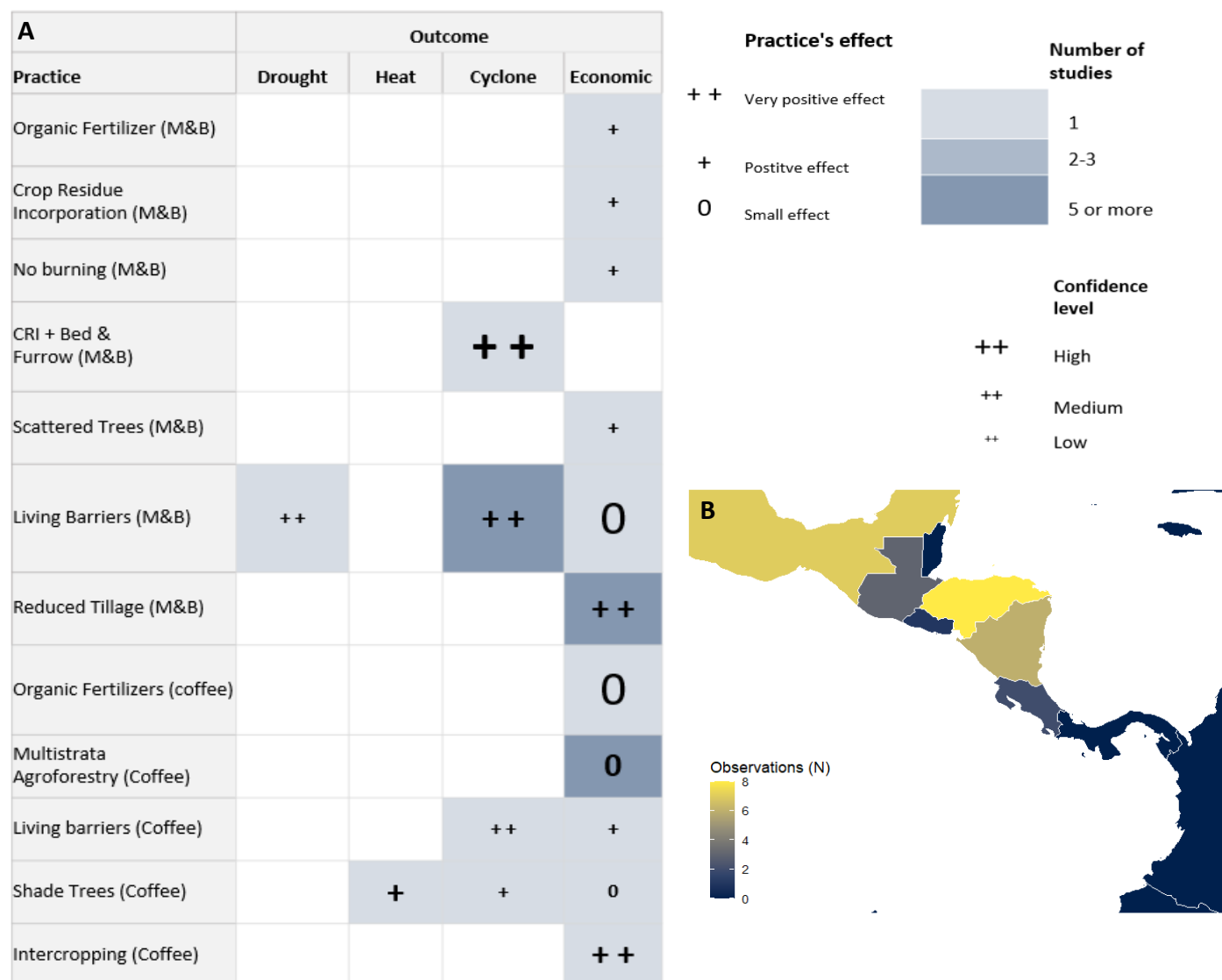
The scarcity of quantitative evidence can be attributed to several factors. First, numerous agroecological practices exert their influence indirectly, enhancing crop health and resilience through nuanced mechanisms that may be challenging to quantify directly. For instance, practices like integrated pest management or weed management



that promote crop vigor and reduce pest damage ultimately bolster plants' ability to withstand climate extremes. Second, certain well-established agroecological practices, despite their widespread adoption and perceived efficacy, may lack dedicated research due to their presumed effectiveness and lack of perceived need for further validation. This can lead to a knowledge gap regarding their precise impact on climate resilience.

Therefore, a more nuanced understanding is needed of agroecology's indirect and context-specific contributions to climate resilience in the Dry Corridor. This requires a combination of rigorous quantitative research, leveraging local knowledge and practices, and integrating diverse datasets to provide a comprehensive assessment of agroecology's effectiveness in this region.

Figure 1: a) Table of the assessment of Agroecological Practices in the Dry Corridor: Impacts on Climate Resilience, Economic Outcomes, and Water Use Efficiency for Maize and Beans. b) Map of the evidence



Conclusions and policy implications

This brief contributes valuable understanding of agroecology's role in enhancing climate hazard resilience and livelihoods in the Central American Dry Corridor. These findings suggest that agroecology has the potential to significantly enhance climate resilience among smallholder farmers in the Dry Corridor. However, more research is needed to fill knowledge gaps and provide comprehensive, quantitative evidence to fully assess its effectiveness.

In addition to its potential benefits for climate resilience, agroecology offers important economic and social advantages for smallholder farmers. By diversifying their income sources, reducing input costs, and improving soil health, agroecological practices can help to boost farmers' livelihoods and foster sustainable food systems.

This brief is the groundwork for a much bigger project, the ACDC project (*Agroecology and the resilience of small-scale farmers to climate change: Evidence to transform food systems in the Dry Corridor of Central America*), which

is an effort to address the gaps in knowledge identified in this brief and provide policymakers and stakeholders with a more robust understanding of agroecology's role in sustainable agriculture and climate adaptation.

Policymakers and stakeholders are encouraged to consider these findings as they develop strategies to adapt to climate change and promote sustainable agriculture in the Dry Corridor. Agroecology should be recognized as a key component of these strategies, and further research should be prioritized to fully harness its potential for resilience, food security, and economic development.

Quantifying climate resilience

Assessing the evidence base for agroecology's role in enhancing climate resilience and livelihoods in the Central American Dry Corridor used a two-stage approach. (Fig 2). Initially, key informant interviews were conducted with stakeholders and actors involved in agriculture and climate change in the Dry Corridor. The goal of these interviews was to identify the agroecological practices that are most relevant to smallholder farmers in the region and to gather insights into their on-the-ground experiences with these practices. Conducting the interviews before the literature review ensured that the research was guided by the perspectives and experiences of local farmers. This participatory approach is essential for understanding the nuances of agroecology in the Dry Corridor and ensuring that the findings are relevant to the region's agricultural context.

Based on the findings of the interviews, a comprehensive search of both scientific and grey literature was conducted to identify quantitative evidence on the impact of these agroecological practices on crop yields, soil health, and economic outcomes. The literature search yielded 206 relevant articles. After careful evaluation of the quality and relevance of each article, 31 articles were selected for in-depth analysis, forming the core dataset for the study.

For each selected article, the relevant quantitative data on crop yields, soil health, and economic outcomes were extracted and analyzed. The quality of the evidence and the confidence in the findings was also assessed. This comprehensive evaluation process ensured that these conclusions were based on the most rigorous and reliable evidence available.

Overall, this methodology ensured a comprehensive and rigorous assessment of the available evidence base for agroecology's role in enhancing climate resilience and livelihoods in the Central American Dry Corridor.

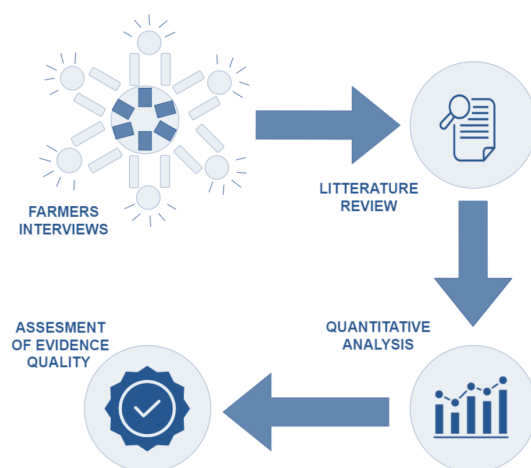


Figure 2: Flowchart of the Methodology for Quantifying Agroecology's Resilience to Climate Hazards.

Further reading

- Altieri, M.A., Nicholls, C.I. n.d. Agroecología y resiliencia al cambio climático: principios y consideraciones metodológicas.
- Amoak, D., Luginaah, I., McBean, G. 2022. [Climate Change, Food Security, and Health. Sustainability, 14\(21\):13954.](#)
- Bunn, C., Läderach, P., Riveira, O.O., Kirschke, D. 2015. A Bitter Cup: climate change profile of global production of Arabica and Robusta coffee. *Climate Change*, 129:89-101.
- Donatti, C.I., Harvey, C.A., Martinez-Rodriguez, M.R., Vignola, R., Rodriguez, C.M. 2019. [Vulnerability of Smallholder Farmers to Climate Change in Central America and Mexico: Current Knowledge and Research Gaps. Climate and Development 11, no. 3: 264–86.](#)
- Eitzinger, A., Schmidt, A., Sain, G., Sonder, K., Hicks, P., Nowak, A.C., Fisher, M., et al. 2013. [Tortillas en el comal: los sistemas de maíz y frijol de América Central y el cambio climático.](#)
- Gourdji, S., Läderach, P., Valle, A.M., Martinez, C.Z., Lobell, D.B. 2015. [Historical Climate Trends, Deforestation, and Maize and Bean Yields in Nicaragua. Agricultural and Forest Methodology, 200:270-281.](#)
- Morris, K.S., Méndez, V.E., van Zonneveld, M., Gerlicz, A., Caswell, M. 2016. Agroecology and Climate Change Resilience in Smallholder Coffee Agroecosystems of Central America. Affiliation: Agroecology and Rural Livelihoods Group (ARLG) Research Brief # 4. Vermont, USA: The University of Vermont.
- Nicholls, C.I., Altieri, M.A. 2019. [Bases agroecológicas para la adaptación de la agricultura al cambio climático. UNED Research Journal 11, no. 1: S55–61.](#)

- Vignola, R., Esquivel, M.J., Harvey, C., Rapidel, B., Bautista-Solis, P., Alpizar, F., Donatti, C., Avelino, J. 2022. [Ecosystem-Based Practices for Smallholders' Adaptation to Climate Extremes: Evidence of Benefits and Knowledge Gaps in Latin America. Agronomy 12, no. 10:2535.](#)

The Agroecology and the resilience of small-scale farmers to climate change: Evidence to transform food systems in the Dry Corridor of Central America (ACDC) project aims to inform decision-makers about the impact of agroecological innovations on women and men farmers' resilience to climate change in the Dry Corridor of Central America. The intended beneficiary of this work is 100,000 vulnerable men and women farmers, including youth.

Lolita Muller is a senior research associate with the Alliance for Biodiversity in Montpellier, France.

Peter Steward is a scientist with The Center For International Agriculture in the Tropics (CIAT) in Nairobi, Kenya.

Todd Rosenstock is a principal scientist with the Alliance for Biodiversity in Montpellier, France.

Please cite: Muller, L., Steward, P., Rosenstock, T. 2025. *Unveiling Agroecology: Climate hazards resilience in the Dry Corridor. Agroecology and the resilience of small-scale farmers to climate change: Evidence to transform food systems in the Dry Corridor of Central America (ACDC).* Cali, Colombia: Alliance of Bioversity & CIAT.

About ACDC

The *Agroecology and the resilience of small-scale farmers to climate change: Evidence to transform food systems in the Dry Corridor of Central America (ACDC)* project is funded by Canada's International Development Research Center (IDRC) and implemented by The Alliance of Bioversity International and CIAT.

This work was carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada, Grant No. 109933-001. The contents and opinions expressed in this publication are not peer reviewed and are the sole responsibility of the authors and are licensed under a Creative Commons Attribution 4.0 International License. The views expressed herein do not necessarily represent those of IDRC or its Board of Governors, Alliance of Bioversity & CIAT, or affiliated organizations.