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Measuring what matters: tracking climate adaptation processes and outcomes for smallholder producers in the agriculture sector

Deliverable 2: A Systematic Map Protocol

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1. Background

A growing number of climate adaptation actions and initiatives (interventions) are being deployed across the agriculture sector to strengthen adaptation—defined by the IPCC as the adjustments in natural or human systems in response to actual or expected climatic stimuli and their effects (McCarthy, J. J., Canziani, O. F., Leary, N. A., Dokken, D. J., & White, K. S. (Eds.)., 2001). Yet, a central challenge persists: how to measure the impacts of these adaptation interventions (IPCC, 2007; Pörtner *et al.*, 2022). Fundamental disagreements remain over how to define and assess adaptation, and without robust, consistent, and context-sensitive evaluation methods, policymakers, and practitioners struggle to allocate resources, make informed decisions, or demonstrate impact (O'Neill *et al.*, 2022; Pörtner *et al.*, 2022).

Monitoring and Evaluation (M&E) in this space is particularly complex due to long timeframes, evolving climate baselines, terminological differences, and attribution challenges (Hinkel et al., 2013, Birkmann et al., 2022, O'Neill et al., 2022). While a variety of frameworks are in use—including process (Hinkel *et al.*, 2013; New *et al.*, 2022) and results-based evaluations (Hinkel *et al.*, 2013; Green Climate Fund (GCF), 2014; Green Climate Fund Independent Evaluation Unit, 2022), resilience assessments[1] (New *et al.*, 2022; Schipper *et al.*, 2022), economic analyses (Hinkel *et al.*, 2013; New *et al.*, 2022; Rexer and Sharma, 2024), and participatory approaches (Faulkner, Ayers and Huq, 2015)—the field remains fragmented. Many methods are difficult to compare or apply in smallholder contexts due to questions around their relevance, cost, and scalability. This review responds to these challenges by systematically identifying, comparing, and appraising methods used to assess climate adaptation interventions in the agriculture sector, with a focus on smallholder producers in low- and middle-income countries (LMICs). The goal is to generate a strong, policy-relevant evidence base to inform the selection, design, and scaling of credible, inclusive, and cost-effective measurement frameworks—especially as global efforts accelerate toward finalizing adaptation indicators under the Global Goal on Adaptation (Lamhauge and Duluk, 2025) and as the IPCC's Technical Group on Impact and Adaptation (TGIA) works to refine adaptation metrics, evidence standards, and methodological frameworks in the ongoing assessment cycle (van den Hurk, Chow and Wong, 2025).

1.1 Theory of change or causal model

Agricultural systems around the world are being impacted by climate stressors and hazards (Bezner Kerr *et al.*, 2022). These shocks are felt disproportionately by the agricultural producers in LMICs due to existing socio-economic and associated vulnerabilities. In this context of existing vulnerabilities, and exposure to climate induced hazards, climate adaptation interventions often seek to catalyze adaptation processes and outcomes to help agricultural producers in LMICs manage the impacts of climate change and reduce climate induced risks to their livelihoods. These adaptation interventions and their effectiveness in reducing climate impacts and risks are assessed through measurement in a variety of different ways, including output and outcomes indicators as a part of M&E systems, qualitative measures of coping capacity, and quantitative

[1] Resilience assessments will be considered when they are used to measure or estimate processes or outcomes related to climate shocks or stressors. Further details on how this distinction is applied are provided in the eligibility criteria.

resilience indices. Collectively, these diverse concepts can all be considered aspects of measurement, which is the focus of this review.

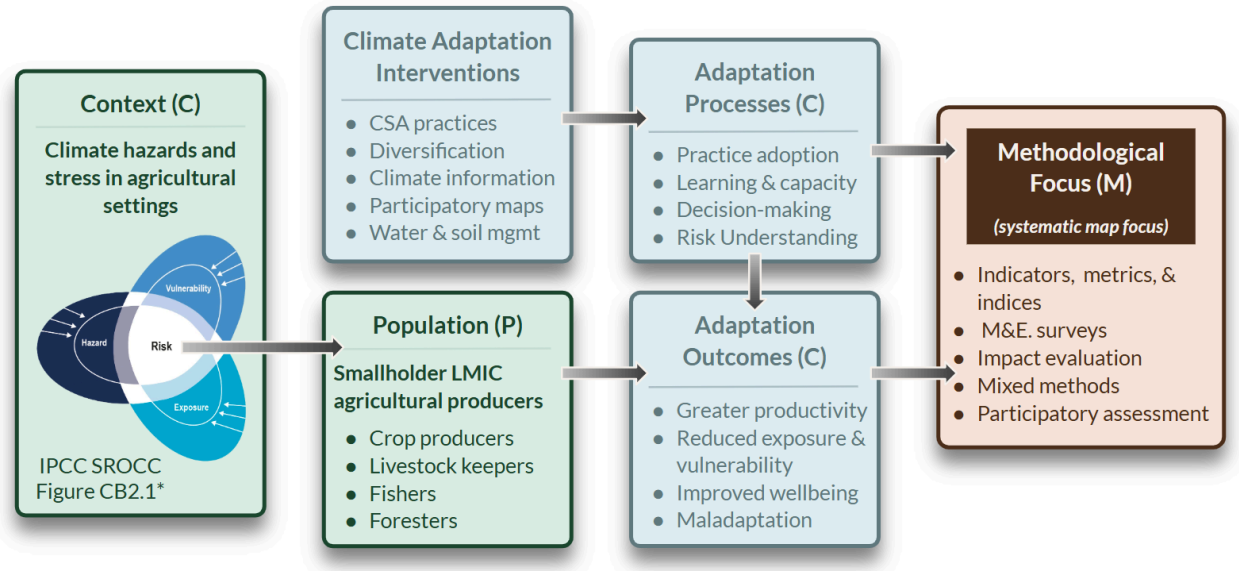

Figure 1: Systematic Map Conceptual Framework[2]

1.2 Stakeholder Engagement

Stakeholder engagement is an integral part of this systematic mapping process and ensures that the review remains relevant, credible, and useful for decision-makers working in climate adaptation and the agriculture sector. Stakeholders contribute expertise on policy priorities, methodological considerations, contextual knowledge, and sources of evidence. Their involvement strengthens the review's rigor and enhances the likelihood that its findings will be taken up by practitioners, funders, and researchers.

Stakeholders have been invited to engage at key points throughout the project, including during the development of this systematic map protocol, and also 1) for the (subsequent) systematic review protocol and 2) for review and dissemination of the final systematic review. Specifically on the systematic map protocol, to date stakeholders have:

- Had the opportunity to provide input on the draft research questions, ensuring they reflect pressing policy needs and are appropriately focused.
- Provided feedback on specific sections of the draft protocol (this document), including review questions, scope, boundaries, definitions, and methodological considerations.
- Suggested or helped to identify key sources of evidence, especially seminal studies, gray literature, and ongoing initiatives that may not be captured through database searches.
- Highlighted gaps, missing data, or blind spots in the emerging evidence base.
- Reviewed and commented on the systematic map protocol prior to its finalization.

[2] Figure CB2.1 (*) cropped from (Abram *et al.*, 2019)

This structured, multi-stage engagement helps ensure the review answers the most important questions for stakeholders working to advance effective, equitable climate adaptation for smallholder producers in agriculture.

2 Objectives and Review Question

This project aims to systematically identify, characterize, and compare the methods used to track and measure adaptation processes and outcomes associated with climate adaptation actions targeting smallholder agricultural producers in the LMICs. Because the evidence base consists of diverse methodological approaches rather than causal-effect studies, the project is structured around a ***Population–Concept–Context–Methodological Focus (PCCM)*** framework.

The project proceeds in two stages:

1. A systematic map to catalogue the full range of adaptation processes, outcomes, and associated measurement approaches used in the agriculture sector.
2. A systematic review of methods focusing on methodological strengths, limitations, and suitability for different users and contexts.

The primary research question guides the first stage.

2.1 Primary Research Question

RQ1. What adaptation processes and outcomes have been measured for smallholder producers in the agriculture sector in the LMICs, and what methods have been used to track, evaluate, or quantify these processes and outcomes?

This question focuses on identifying both:

- the types of adaptation processes (e.g., climate-smart practices, participatory planning & decision-making, adaptation learning and education, climate information systems) and outcomes (e.g., productivity, reduced climate losses, reduced climate risks, reduced exposure to climate shocks, reduced vulnerability to climate shocks, improved well-being), and
- the methods used to measure the processes and outcomes (frameworks, indicators, M&E systems, analytical approaches, participatory tools, digital/data-driven methods, impact evaluations).

2.2 Scope and Boundaries (PCCM Framework)

Search terms were developed using the PCCM (Population–Concept–Context–Methodological Focus) framework to ensure full conceptual coverage while keeping each element discrete and non-overlapping. Each PCCM component maps to a distinct block of the Boolean search string used in Scopus and other bibliographic databases. Synonyms and related terminology were refined through benchmarking, feedback from a Methods Advisor, and targeted review of terms used in recent systematic reviews in agriculture and climate adaptation. These will be further refined following the stakeholder engagement process

Population (P): Smallholder producers and related agricultural production systems - This element captures the actors for whom adaptation processes and outcomes are measured. It includes individuals or households engaged in small-scale agricultural production, consistent with FAO categories (crop, livestock, fisheries/aquaculture, and forestry). These terms map to the first block of the search string. Large-scale commercial or industrial agricultural producers and non-agricultural rural livelihoods are out of scope.

Individuals or households engaged in small-scale agricultural production::
- ➔ crop production
- ➔ livestock and pastoral systems
- ➔ fisheries and aquaculture
- ➔ agroforestry and tree-based systems

Marginalized or underrepresented producer groups, where relevant:
- ➔ women and youth
- ➔ landless or tenant producers
- ➔ Indigenous Peoples and ethnic minorities
- ➔ migrant, seasonal, or agricultural laborers

Concept (C): Adaptation Processes and Outcomes - This element reflects what is being measured, the adaptation processes or outcomes, with synonyms for processes, outcomes, capacities, or changes relevant to climate adaptation. These terms correspond to the second block of the search string. Studies addressing disasters or resilience without a link to climate risk are out of scope, as are sources focused only on climate change mitigation.

Adaptation processes:
- ➔ learning, knowledge generation, or awareness
- ➔ decision-making, planning, or governance processes
- ➔ adoption or uptake of adaptive practices
- ➔ participation, co-production, or behavioral change

Adaptation outcomes:
- ➔ changes in resilience or adaptive capacity
- ➔ livelihood, income, or wellbeing outcomes
- ➔ productivity or yield stability
- ➔ risk reduction or loss avoidance
- ➔ identification of maladaptive outcomes

Context (C): Climate hazards, climate-stress conditions, and agricultural settings - Context is divided into (1) climate-related stressors and adaptation framing, and (2) the agriculture sector domain. These terms correspond to the third and fourth blocks of the search string. Non-agricultural sectors or value-chain studies and those without a climate-related stressor are out of scope.

Climate and hazard context:
- ➔ Climate variability and change
- ➔ Climate-related hazards and shocks (e.g., droughts, floods, heat stress)
- ➔ Exposure and risk conditions relevant to agricultural producers

Agricultural context:
- ➔ Crop, livestock, fisheries/aquaculture, forestry, and mixed farming systems
- ➔ Rainfed and irrigated production systems
- ➔ Agroecological and integrated farming systems

Methodological Focus (M): Measurement, indicators, monitoring, and evaluation approaches - The Methodological Focus block captures how adaptation processes and outcomes are assessed. It includes monitoring, indicators, evaluation methods, data collection, and analytical approaches. These align with the final block of the search string.

Methodological Focus:
- ➔ Methods, tools, or frameworks used to assess adaptation processes or outcomes
- ➔ Monitoring, evaluation, or learning approaches
- ➔ Quantitative, qualitative, mixed-methods, participatory, or modeling approaches
- ➔ Indicator-based, index-based, or narrative assessment methods*

2.3 Key Definitions

Adaptation outcomes: The results of adjustments in ecological, social, or economic systems to moderate potential damages and benefit from opportunities from climate change.

Adaptation processes: The processes of adjustments in ecological, social, or economic systems to moderate potential damages and benefit from opportunities from climate change.

Agricultural production: Primary crop, livestock, fisheries and forestry production.

Climate Adaptation Intervention: A purposeful action or initiative intended to adjust ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects .

Low- and Middle-Income Countries (LMICs): Low Income, Lower Middle-Income, and Upper Middle-Income countries as classified by the World Bank using the Atlas method (World Bank Data Help Desk). High Income countries are not considered LMICs.

Measurement method: Any framework, tool, indicator set, monitoring approach, data source, analytical technique including impact evaluations, or participatory process used to track or evaluate adaptation processes or outcomes and impacts of adaptation.

Smallholder producers: Individuals or households engaged in small-scale agricultural production, typically operating with limited land, labor, or capital.

3 Search strategy

The search strategy is designed to identify all available empirical and methodological literature relevant to the methods used to track and measure the impacts of climate adaptation interventions for smallholder producers in the agriculture sector. The strategy follows recognized standards for evidence synthesis (Collaboration for Environmental Evidence, 2018) and draws on multiple sources: (1) large bibliographic databases, (2) web-based search engines, (3) organizational and institutional gray literature repositories, and (4) citation chasing.

Searches will be conducted using combinations of structured Boolean search strings tailored to each database's syntax. Search terms will reflect the PCCM framework (Population—Concept—Context—Methodological focus), including synonyms and variant terminology for smallholder producers, climate adaptation interventions, agricultural systems, and adaptation measurement methods.

Search terms for major sources will be fully documented with precise search strings to enable replication. Searches of organizational websites and gray literature sources will be conducted using flexible combinations of keywords appropriate to each site's search capacity.

Searches will be restricted to literature published from 2005 onward, reflecting the period in which adaptation metrics and outcome-oriented evaluation frameworks began to consolidate following major developments in IPCC and UNFCCC processes. Contemporary adaptation evaluation methods emerged largely after IPCC AR4 (2007), which elevated adaptation as a mainstream pillar of climate policy and highlighted methodological gaps, especially in assessing outcomes. The subsequent rollout of National Adaptation Programmes of Action (NAPAs), and later National Adaptation Plans (NAPs), generated sustained demand for structured monitoring,

evaluation, and learning systems. Key methodological frameworks—including those from the GEF, OECD, Climate-ADAPT, UNDP, and the NAP Global Network—developed from 2010 onward, alongside the formalization of adaptation reporting under the Paris Agreement and the Global Goal on Adaptation. This cutoff does not limit the evidence base—preliminary testing showed no relevant methodological literature would be excluded by starting in 2005. Screening will be limited to languages for which the review team has capacity—English, French, and Spanish. This reflects both feasibility and the distribution of relevant literature: preliminary searches found that non-English languages collectively accounted for a very small proportion of publications, with Chinese-language studies representing ~1% of results and rarely addressing methodological aspects of adaptation measurement. Given the global nature of adaptation M&E research and its concentration in English-language outlets, the risk of excluding relevant methodological work is low. Translations may be sought for exceptional cases where a non-English study appears highly relevant.

3.1 Bibliographic databases

We will search the following bibliographic databases, chosen for their coverage of environmental science, climate adaptation, agricultural research, development studies, and evaluation methodologies:

Primary Databases

Scopus (Elsevier): Broad coverage of interdisciplinary climate and agricultural sciences.

- Search fields: Title, abstract, keywords
- Access: Cornell University subscription

Web of Science Core Collection (Clarivate): Includes Science Citation Index Expanded (SCIE, 1900 to present), Social Sciences Citation Index (SSCI, 1900 to present), and Emerging Sources Citation Index (ESCI, coverage varies by journal).

- Search fields: Title OR Abstract OR keyword
- Access: Cornell University subscription

CAB Abstracts (CABI): Core database for agriculture, smallholder producers, and rural development.

- Search fields: Title, abstract, and index terms
- Access: Cornell institutional subscription through EBSCOhost

AGRIS (FAO): Agriculture and rural development, including gray literature.

- Search fields: Keyword
- Access: Open access

Academic Search Premier (EBSCO): Development studies and evaluation methodologies.

- Search fields: Title, abstract, subject terms
- Access: Institutional subscription

Decomposition of Search String by Substring

Database used for testing: Scopus

Search fields: TITLE-ABS-KEY(

Date tested: January 06, 2026

Substring (PCCM element)	Search terms (grouped for readability)	Records returned (Scopus)
Population (P): Smallholder producers and marginalized subpopulations	**Smallholder and small-scale producers** smallholder* OR "small holder*" OR "small-scale farmer*" OR "small-scale producer*" OR "subsistence farmer*" OR "farmers in low-income countr*" OR "marginal farmer*" OR "resource-poor farmer*" OR **Households and poverty-linked producer categories** "rural household*" OR "farm household*" OR "agricultural household*" OR "family farmer*" OR "low-income household*" OR "poor household*" OR "female-headed household*" OR "women-headed household*" OR **Livestock- and pastoral-based producers** pastoralist* OR "agro-pastoralist*" OR "agro pastoralist*" OR herder* OR "livestock keeper*" OR "livestock farmer*" OR "livestock producer*" OR "dairy farmer*" OR "crop-livestock farmer*" OR **Fisheries and aquaculture producers** fisher* OR "small-scale fisher*" OR "small scale fisher*" OR fisherfolk OR "artisanal fisher*" OR "aquaculture producer*" OR "fish farmer*" OR "shrimp farmer*" OR **Agroforestry and tree-based systems** "agroforestry farmer*" OR "agroforestry producer*" OR "tree crop farmer*" OR "fruit grower*" OR "forest farmer*" OR silvopastoral OR "silvo-pastoral" OR "tree-livestock farmer*" OR **Marginalized and underrepresented subpopulations** women OR female* OR "women farmer*" OR "female farmer*" OR youth OR "rural youth" OR "young farmer*" OR "young producer*" OR adolescent* OR "landless farmer*" OR "tenant farmer*" OR sharecropper* OR "contract farmer*" OR "Indigenous Peoples" OR "indigenous communit*" OR "tribal communit*" OR "ethnic minorit*" OR "agricultural laborer*" OR "farm worker*" OR "seasonal worker*" OR "migrant farmworker*"	15,203,933
Concept (C): Adaptation processes and outcomes	**Adaptation actions and processes** adapt* W/5 (practice* OR behav* OR decision* OR strateg* OR adjust* OR chang*) OR uptake OR adoption OR participat* OR "participatory process*" OR "adaptive management" OR learning* OR "learning process*" OR "feedback loop*" OR "feedback mechanism*" OR (governance W/5 (adapt* OR climate)) OR **Capacities, knowledge, and governance**	2,276,669

	"adaptive capacity" OR (capacity W/3 (build* OR strengthen* OR expand* OR improv*)) OR (knowledge W/3 (adapt* OR climate OR resilience)) OR **Resilience, risk reduction, and well-being outcomes** (resilien* W/5 (outcome* OR capacity OR livelihood* OR improv* OR effect*)) OR (adapt* W/5 (outcome* OR impact* OR effect* OR capacity OR livelihood*)) OR (reduc* W/5 (risk OR "climate risk*" OR vulnerabilit* OR exposure*)) OR wellbeing OR "well-being" OR **Livelihood and productivity outcomes** livelihood* OR "coping strateg*" OR "coping capacit*" OR (income W/5 (stability OR variability OR loss*)) OR (yield W/5 (stability OR improved OR increased OR variability OR loss*)) OR **Maladaptation** maladapt* OR "maladaptive outcome*" OR "maladaptive adaptation"	
Context (C): Climate stressors and hazards	**Climate adaptation framing** (climate W/3 (change OR adapt* OR resilien* OR risk OR hazard* OR variability OR exposure* OR shock*)) OR "climate-resilient*" OR "climate-smart agriculture" OR CSA OR **Extreme events and climate hazards** (extreme* W/3 (climate OR heat OR weather OR rainfall OR aridity)) OR heatwave* OR "heat wave*" OR "heat stress" OR frost OR "cold spell" OR "heavy rainfall" OR "intense rainfall" OR drought* OR "water scarcity" OR "water stress" OR "aridity events" OR "dry spell" OR flood* OR "storm surge" OR "coastal erosion" OR "salinity intrusion" OR "saline intrusion" OR cyclone* OR hurricane* OR typhoon* OR (wind W/3 (storm OR gust* OR intens*)) OR "weather shock*" OR disaster*	1,642,840
Context (C): Agricultural systems	agricultur* OR farm* OR crop* OR "food production" OR "livestock rearing" OR "animal husbandry" OR rangeland* OR fishery OR fisheries OR aquacultur* OR forestry OR agroforestry OR "tree crop*" OR silvopastoral OR "silvo-pastoral" OR "crop-livestock system" OR "mixed crop-livestock" OR "mixed farming" OR agroecolog* OR "integrated farming system*"	2,526,486
Methodological focus (M): Measurement and evaluation	indicator* OR metric* OR "measurement framework*" OR monitor* OR evaluat* OR assess* OR "impact evaluation" OR "results-based management" OR "results based management" OR "M&E" OR MEL OR effectiv* OR impact* OR (measur* W/5 (adapt* OR resilience OR outcome*)) OR index OR indices OR "data collection" OR survey* OR (participatory W/3 (monitoring OR method* OR assessment)) OR "mixed methods"	35,209,039
Combined Strings	**Combined**	**9,102**

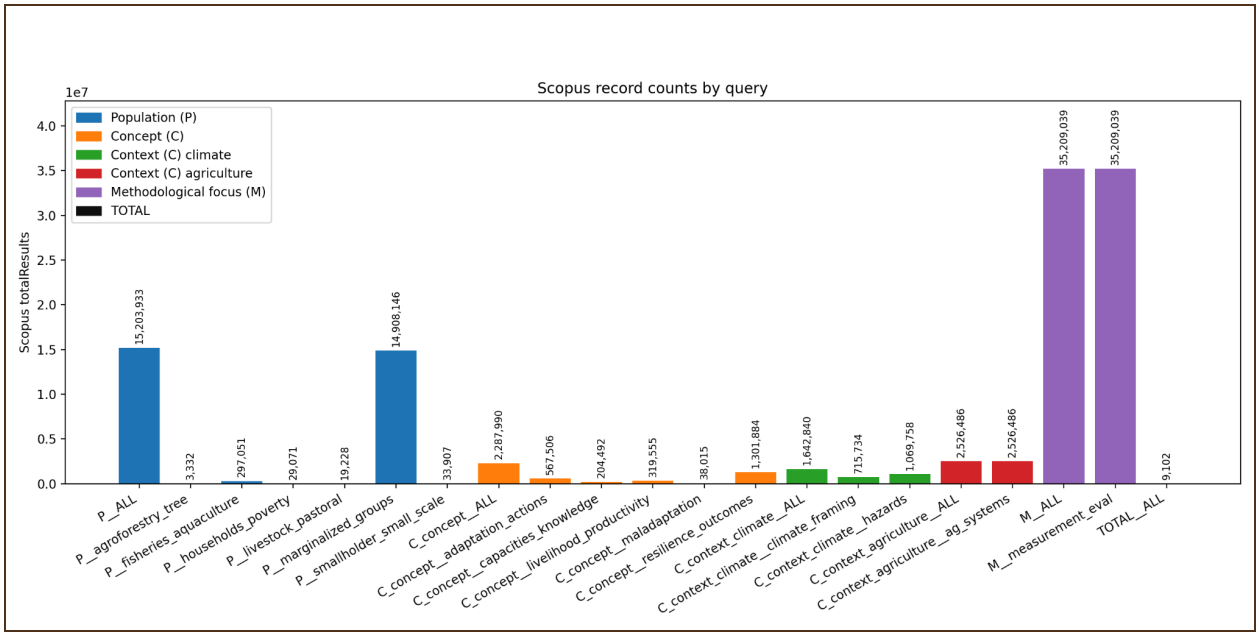

Figure 2: Scopus Search String Results by Query- 06 Jan 2026

Supplementary Sources for Methodological Completeness

In addition to the primary bibliographic databases, a small number of supplementary sources will be searched to identify methodological papers, working papers, and file-drawer studies relevant to adaptation measurement approaches. These sources will be searched using structured and documented search strategies aligned with the PCCM framework, adapted as needed to the syntax and functionality of each platform.

- ***EconLit (American Economic Association):*** Used to identify methodological papers related to impact evaluation, outcome measurement, and quasi-experimental methods relevant to adaptation M&E. Searches will be fully documented (search terms, fields searched, date, and number of records retrieved).
- ***ProQuest Dissertations & Theses Global:*** Used to locate unpublished or doctoral-level methodological work ("file-drawer" studies) that may include novel adaptation process or outcome metrics or monitoring frameworks. Searches will use full Boolean search strings adapted from the core strategy.
- ***Lens.org:*** Used as a cross-disciplinary meta-search platform to identify tools, frameworks, and methods that may not be indexed in the primary databases, particularly in evaluation science and data-driven measurement approaches. It will be searched using full Boolean search logic adapted to its platform-specific syntax. Given the platform's high sensitivity and broad coverage, searches will be restricted by document type (e.g., journal articles, working papers, theses) to improve precision.

Searches in all supplementary sources will be conducted in parallel with the main database searches and will be recorded in full to ensure transparency and replicability. While search strings may differ from those used in the primary databases due to platform constraints, all search strategies and results will be documented and reported alongside the main search process.

3.2 Web-based search engines

Web-based search engines will be used to retrieve academic and gray literature not captured in bibliographic databases.

- Google Scholar
- DuckDuckGo (to reduce personalization bias)

Approach:

- Use extended but simplified Boolean-style search strings aligned with the core PCCM framework, taking advantage of Google Scholar's expanded character limits while remaining within platform constraints.
- Screen first 200 results per string, consistent with CEE guidance.
- Record search date, search terms, and number of hits.

Example Google Scholar String

> "climate adaptation" smallholder
>
> ("adaptation process" OR "adaptation outcome" OR "adaptive capacity" OR "climate resilience" OR livelihoods OR wellbeing)
>
> (indicator OR metric OR measurement OR monitoring OR evaluation OR index)
>
> (agriculture OR farming OR fisheries OR livestock)
>
> (disaster OR shock OR drought OR flood OR "climate risk")

3.3 Organizational websites

We will search organizational repositories relevant to:

- UN agencies and initiatives:
  - FAO: https://openknowledge.fao.org/home
  - International Fund for Agricultural Development (IFAD): https://www.ifad.org/en/research
  - United Nations Development Programme (UNDP): https://www.undp.org/publications
  - United Nations Environment Programme (UNEP): https://wedocs.unep.org/home
  - United Nations Framework Convention on Climate Change (UNFCCC): https://www4.unfccc.int/sites/NWPStaging/Pages/Home.aspx
- World Adaptation Science Programme (WASP): https://wasp-adaptation.org/resources/view-all
- Development agencies:
  - World Bank: https://openknowledge.worldbank.org/home
  - GEF: https://www.thegef.org/newsroom/publications
  - Green Climate Fund (GCF): https://www.greenclimate.fund/publications
  - United States Agency for International Development (USAID): via the partial reconstruction of the Development Experience Clearinghouse (DEC), available through the DEC Document Search at https://usaid.onl/

    - Foreign, Commonwealth & Development Office (FCDO, formerly DFID): https://www.gov.uk/research-for-development-outputs
- International research centers and initiatives:
    - CGIAR centers: searched collectively via https://cgspace.cgiar.org/home
    - International Platform On Adaptation Metrics: https://adaptationmetrics.org/index.php/ (no search available, so all policy papers will be screened)
    - Adaptation Research Alliance: https://www.adaptationresearchalliance.org/resources/
    - Climate and Development Knowledge Network (CDKN): https://cdkn.org/resources (no search available, so all adaptation academic publications and case studies will be screened)
    - Global Center on Adaptation: https://gca.org/reports/ (no search available, so all technical papers will be screened)
    - International Institute for Environment and Development (IIED): https://www.iied.org/publications
    - NAP Global Network: https://napglobalnetwork.org/resources/
    - NDC Partnership Good Practice Database: https://ndcpartnership.org/knowledge-portal/good-practice-database
    - Stockholm Environment Institute: https://www.sei.org/publications/
- Evaluation and M&E networks:
    - 3ie: https://www.3ieimpact.org/research
    - Campbell Collaboration: https://www.campbellcollaboration.org/evidence/
    - Abdul Latif Jameel Poverty Action Lab (J-PAL): https://www.povertyactionlab.org/evaluations

Search terms for these sites will be flexible and tailored to each repository's search features. We will use combinations of keywords related to smallholder producers (e.g., "smallholder," "pastoralist," "small-scale fisher"), adaptation outcomes (e.g., "climate resilience outcome," "adaptive capacity," "food security," "yield stability"), adaptation processes (e.g., "adoption," "livelihood diversification," "institutional strengthening," "participation," "learning"), and methodological approaches (e.g., "indicator," "metric," "measurement," "monitoring," "evaluation," "M&E," "impact assessment," "index," "participatory method"). Contextual terms will also be used, including "agriculture," "climate adaptation," "adaptation intervention," and "climate-smart agriculture."

We will record:

- Site name
- URL
- Search method (internal search engine or manual browsing)
- Results retrieved

3.4 Comprehensiveness of the search

We assess the search comprehensiveness through the following procedure:

1. ***Benchmark List Assembly***

We assembled list of ~20–30 key studies/frameworks known to be eligible, curated through:

- Initial expert identification (author team and CGIAR)
- Stakeholder input
- Prior literature reviews (e.g., PROVIA 2013, IPCC WGII AR6 adaptation chapters, GAMI outputs)

The following steps describe the process of how the benchmark list was identified:

- **Initial Stakeholder Literature List:** 235 Total Items
    - Identified Via: 215 from Stakeholder/Expert Suggestions, 10 from Google Scholar, 10 from IPCC AR6 Chapters 17, 5, 8 Literature
    - Peer-reviewed vs. Grey: 228 were peer-reviewed journal articles and 7 were grey literature, reports, and articles.
- **DOI Enrichment:** 210 DOIs after enrichment.
    - 103 items had DOIs in the initial submissions. 107 were found for missing DOIs. 25 entries remained without DOIs.
- **Abstract Enrichment:** 206 Abstracts were found.
    - DOI links as well as Elsevier, Semantic Scholar, OpenAlex, Crossref, Unpaywall were used to collect abstracts.
- **Eligibility Check:** All 235 items were checked against each eligibility criteria (Figure 3).
    - 32 items passed all checks (13.6%)
    - 104 items were excluded because they failed one or more criteria or did not have an abstract
    - 99 items were marked as uncertain when the reviewer could not decide if one or more eligibility criteria was met or not.

Only items that clearly passed all eligibility criteria were included in the final benchmark list.

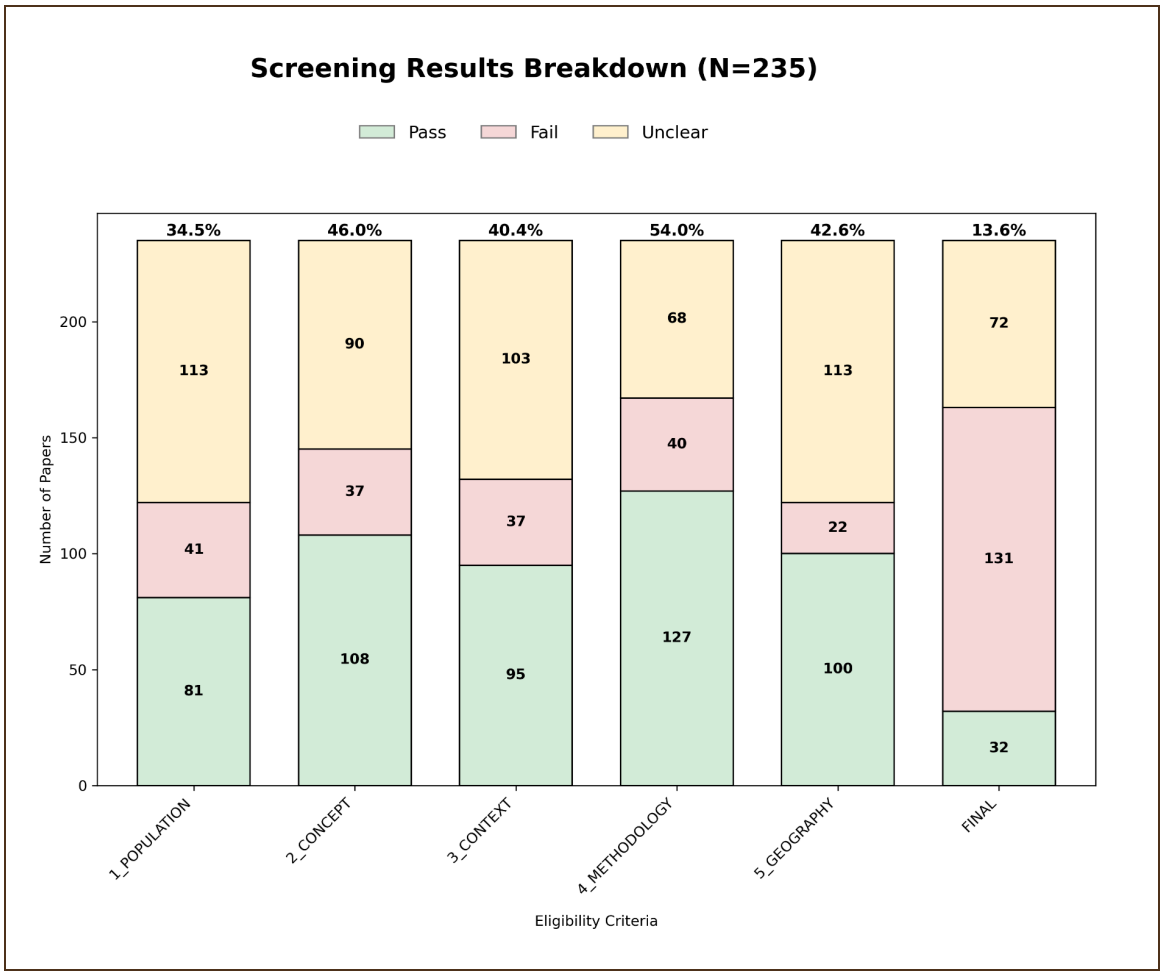

Figure 3: Screening results of benchmark list against eligibility criteria

The final thirty two items that passed all eligibility criteria were:

Benchmark List

This text is very close to being report-ready, but it still has **three specific formatting issues** (artifacts from the raw data) that you should clean up before finalizing it:

1. **HTML Artifacts:** Several journal names still have `&` instead of & (e.g., *Agriculture `&` Food Security*).
2. **Double Titles:** A few items (like *Nam*, *Ullah*, *Budhathoki*, *Gebrehiwot*) have the author names and year repeated **inside** the title string. This makes the citation look messy (e.g., *Nam et al. (2023) 'Nam et al... Assessment...'*).
3. **Capitalization:** Some fetched titles are in sentence case while others are Title Case. It is better to standardize them.

The final thirty-two items that passed all eligibility criteria were:

Benchmark List

1. **Belay, A., Recha, J., Woldeamanuel, T. et al.** (2017) 'Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia'. *Agriculture & Food Security*. https://doi.org/10.1186/s40066-017-0100-1
2. **Below, T., Mutabazi, K., Kirschke, D. et al.** (2012) 'Can farmers' adaptation to climate change be explained by socio-economic household-level variables?'. *Global Environmental Change*. https://doi.org/10.1016/j.gloenvcha.2011.11.012
3. **Azadi, Y., Yazdanpanah, M., Mahmoudi, H.** (2019) 'Understanding smallholder farmers' adaptation behaviors through climate change beliefs, risk perception, trust, and psychological distance: Evidence from wheat growers in Iran'. *Journal of Environmental Management*. https://doi.org/10.1016/j.jenvman.2019.109456
4. **Fahad, S., Wang, J.** (2018) 'Farmers' risk perception, vulnerability, and adaptation to climate change in rural Pakistan'. *Land Use Policy*. https://doi.org/10.1016/j.landusepol.2018.08.018
5. **Amare, A., Simane, B.** (2017) 'Determinants of smallholder farmers' decision to adopt adaptation options to climate change and variability in the Muger Sub basin of the Upper Blue Nile basin of Ethiopia'. *Agriculture & Food Security*. https://doi.org/10.1186/s40066-017-0144-2
6. **Ullah, W., Nafees, M., Khurshid, M. et al.** (2019) 'Assessing farmers' perspectives on climate change for effective farm-level adaptation measures in Khyber Pakhtunkhwa, Pakistan'. *Environmental Monitoring and Assessment*. https://doi.org/10.1007/s10661-019-7651-5
7. **Budhathoki, N., Paton, D., Lassa, J. et al.** (2020) 'Heat, cold, and floods: exploring farmers' motivations to adapt to extreme weather events in the Terai region of Nepal'. *Natural Hazards*. https://doi.org/10.1007/s11069-020-04127-0
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2. Percent Retrieval Check

The stakeholder literature and benchmark retrieval test was conducted using Scopus, given its broad disciplinary coverage and powerful Boolean and proximity-search capabilities. The final search string will be tested to ensure that all benchmark items are retrieved in Scopus before applying it to other databases. Iterations of this process will be recorded in Appendix X.

The initial percent retrieval check of all 235 initial stakeholder literature items against all 9,042 SCOPUS query results gave the following results (Figure 4):

- 62.5% (12 of 32) of academic literature in the benchmark list
- 18.9% (43 of 228) for all academic literature in the stakeholder literature list.

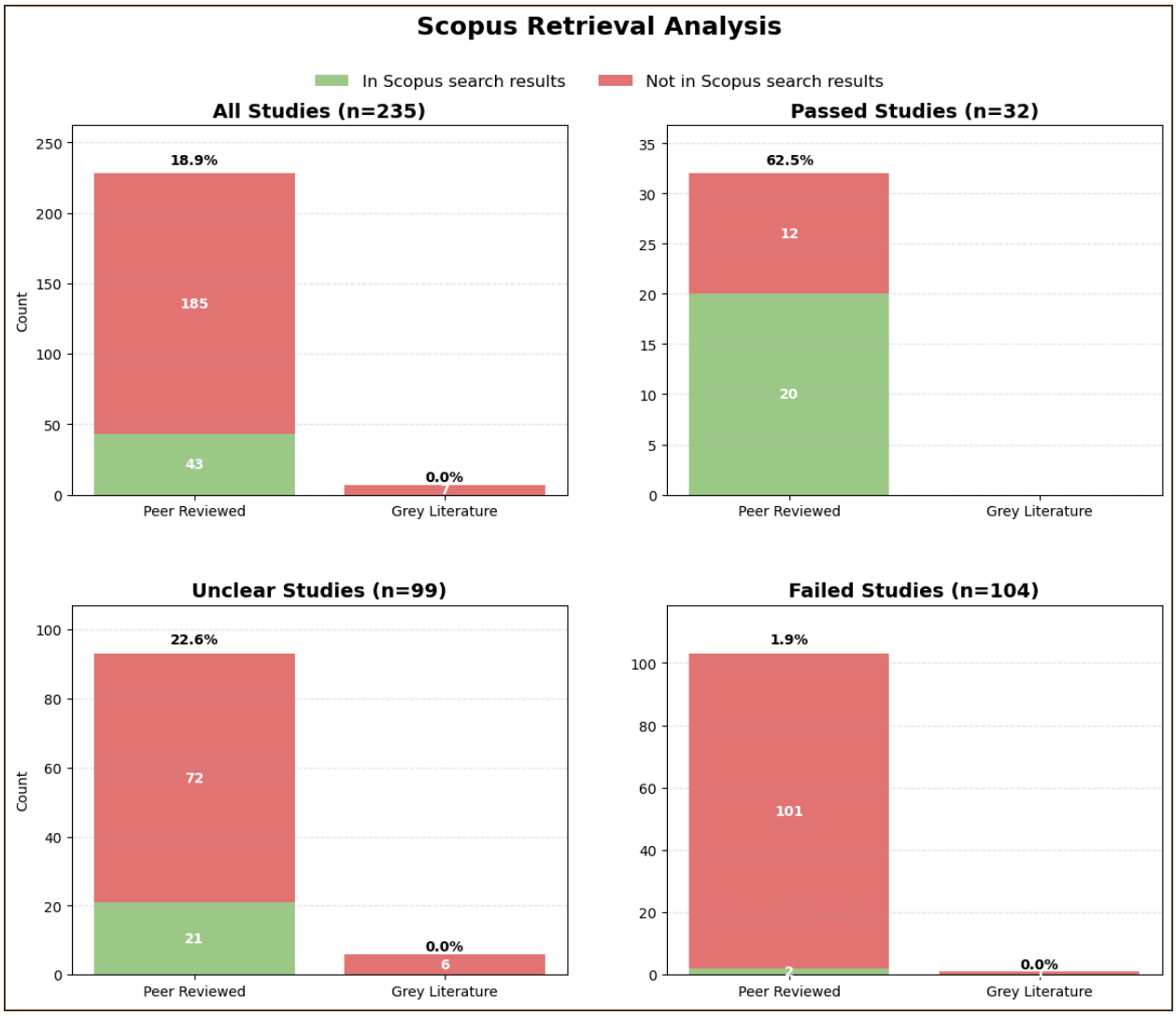

Figure 4: Scopus Retrieval Analysis of items from the full Stakeholder Literature List (235 items) as well as the final Benchmark List (32 items)

Twelve papers in the benchmark list were not retrieved in the SCOPUS search results:

Benchmark List: Not Retrieved in SCOPUS Search Results

1. **Pak-Uthai, S., Faysse, N.** (2018) 'The risk of second-best adaptive measures: Farmers facing drought in Thailand'. *International Journal of Disaster Risk Reduction*. https://doi.org/10.1016/j.ijdrr.2018.01.032
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3. ***Refinement***

For benchmark studies that we missed, we plan to:

- Adjust synonyms and substrings
- Add missing variant terminology
- Recheck until 100% retrieval is achieved or missing items are justified as out of scope.

4. ***Documentation***

All adjustments to the search strings and outcomes of benchmark retrieval tests will be recorded and included in Annex 1 to ensure transparency and replicability.

3.5 Search Update

Given the nine-month project duration, we plan to:

- Conduct the initial full search after stakeholder engagement and protocol finalization.
- Conduct one update search during the systematic map stage (prior to finalizing the map), limited to major databases using the finalized strings.
- Document the update dates and any additional records retrieved.

We do not anticipate major changes in adaptation-method literature within short intervals, however, planned update searches will help ensure completeness and transparency by capturing any newly indexed records prior to finalizing each stage.

4 Screening strategy

All records retrieved through database and supplementary searches will be deduplicated in Zotero by adapting the Bramer et al. method[3] (developed for EndNote). The deduplicated records will be imported into EPPI-Reviewer for screening and data extraction. Screening will proceed in two sequential stages:

1. Title and abstract screening
2. Full-text screening

At each stage, records will be assessed against the pre-specified eligibility criteria (Table 2, below). Screening decisions and reasons for exclusion (at full-text stage) will be recorded within EPPI-Reviewer to ensure transparency and reproducibility. In line with systematic map best practice, screening at the title and abstract stages will be intentionally inclusive, with studies retained for full-text screening wherever relevance is uncertain.

4.1 Eligibility criteria

Table 2. Eligibility Criteria

Category	Inclusion Criteria	Exclusion Criteria
Population	Studies examining climate change adaptation interventions targeting smallholder producers and related agricultural production systems—defined as individuals or households engaged in small-scale production across crops, livestock, fisheries/aquaculture, and forestry.	Studies focusing on populations other than smallholder producers, such as large-scale commercial agriculture, agribusiness value chains without a smallholder focus, or non-agricultural livelihoods.
Concept	Included studies assess or document adaptation processes or outcomes, such as changes in capacities, practices, or resilience. Studies need not explicitly use the term "adaptation," but must describe interventions aligned with adaptation objectives (e.g.,	Studies that address climate change mitigation only or general development objectives without an explicit or implicit focus on climate risk, climate resilience, or adaptive capacity and therefore do

[3] Bramer WM, Giustini D, de Jonge GB, Holland L, Bekhuis T. De-duplication of database search results for systematic reviews in EndNote. J Med Libr Assoc. 2016 Jul;104(3):240-3. doi: 10.3163/1536-5050.104.3.014. Erratum in: J Med Libr Assoc. 2017 Jan;105(1):111. doi: 10.5195/jmla.2017.128. PMID: 27366130; PMCID: PMC4915647.

	reducing climate risks, enhancing climate resilience, or improving coping capacity).	not assess adaptation processes or outcomes.
Context	Studies conducted within agricultural settings in LMICs that are exposed to climate hazards or climate-stress conditions and are framed in relation to climate change, climate variability, or climate risk. Eligible contexts include crop, livestock, fisheries/aquaculture, or forestry systems where climate-related stressors (e.g., drought, flooding, temperature extremes, rainfall variability) are relevant to agricultural production and adaptation decision-making. Studies must situate interventions, outcomes, or analyses within an explicit climate–agriculture context consistent with adaptation framing.	Studies conducted outside agricultural sector domains or without reference to climate hazards, climate-stress conditions, or climate risk framing. This includes studies addressing agricultural systems without a climate dimension, climate impacts or responses unrelated to agriculture, or development or environmental studies that do not explicitly link climate stressors to agricultural production or adaptation processes.
Methodology	Included studies must describe, apply, or evaluate a method, tool, framework, or set of indicators used to assess the impacts of climate change adaptation interventions and must demonstrate an empirical basis through real-world application or scenario-based testing. Eligible study designs include qualitative, quantitative, mixed-methods, modeling studies with empirical validation, and project or program evaluations, and must provide sufficient methodological detail on data collection, sample or population, indicator selection, and analytical approach.	Studies that are purely theoretical or conceptual, lack applied evidence, or do not present adequate methodological information to assess the robustness or relevance of the findings.
Publication Period	Published between 2005–2025, capturing contemporary adaptation evaluation methods post-IPCC AR4 (2007) and emergence of National Adaptation Programmes of Action.	Publications before 2005.
Language	English, French, or Spanish.	Other languages.
Publication Type	Academic and gray literature from reputable sources (multilateral organizations, bilateral donors, international NGOs, national research institutes, recognized evaluation units).	Unclear or non-reputable sources.
Geographic Scope	Single or multi-country studies including at least one LMIC.	Studies exclusively in high-income countries.

4.2 Consistency checking

Screening will be conducted by at least two reviewers, working independently during consistency checks and calibration exercises, and singly once acceptable agreement has been achieved. Consistency checking will be undertaken to assess the replicability and reliability of screening decisions.

- A random subset of 200 records will be screened independently by two reviewers at the abstract stage.
- Agreement will be assessed using Cohen's kappa (or percentage agreement where appropriate).
- A kappa score of ≥ 0.6 (moderate agreement) will be considered acceptable.

Reviewers will discuss all disagreements in the calibration set case-by-case to clarify interpretation of the eligibility criteria. If agreement falls below this threshold, reviewers will:

- Refine guidance notes where needed.
- Re-test agreement on a new random subset of 100 abstracts.

This process may be repeated until acceptable agreement is achieved. Agreement statistics and the number of calibration rounds will be reported in the final review. New team members joining screening will undergo the same calibration process prior to independent screening. Following calibration, AI-assisted tools available within EPPI-Reviewer, trained on human screening decisions, will prioritize remaining records at the title and abstract stage for human reviewer screening. Screening may conclude once reviewers determine that a reasonable stopping point has been reached, based on documented evidence of diminishing returns (e.g., effort curves showing a sustained decline in inclusion rates among lower-priority records). Final inclusion and exclusion decisions will be made by human reviewers, and the use of AI-assisted prioritization tools will be documented to ensure transparency and compliance with established systematic map standards.

4.3 Reporting screening outcomes

Screening outcomes will be reported using a ROSES-style flow diagram, documenting:

- Number of records identified per source
- Number of duplicates removed
- Records screened at title/abstract and full-text stages
- Records excluded at each stage
- Reason for full-text exclusion

In addition, the review will provide:

- An RIS file of included studies
- A table of full-text exclusions with reasons

5 Study validity assessment

As this review is a systematic map, formal risk-of-bias or critical appraisal will not be conducted. Each included study will be coded for basic indicators of methodological robustness, including:

- Study design (e.g., qualitative, quantitative, mixed-methods, modeling with empirical validation)
- Presence and clarity of data collection methods
- Transparency of indicator selection and analytical approach
- Acknowledgement of limitations or sources of bias

Where feasible, additional threats to internal and external validity (e.g., selection bias, lack of comparator, short time horizon) will be noted to inform narrative discussion of strengths and limitations across the evidence base. No aggregate quality score will be calculated.

5.1 Consistency checking

Not applicable.

6 Data coding strategy

A structured data extraction form has been designed and will be implemented within EPPI-Reviewer. Coding will be iterative and piloted on a subset of studies prior to full data extraction to ensure clarity and feasibility. The coding framework may be refined during early extraction to accommodate emerging patterns, with all changes documented and justified.

6.1 Meta-data to be coded

The variables to be extracted for each included study, along with their definitions and data types, are presented in Table 3.

Table 3. Data extraction variables and data types

Variable	Description	Data type	Notes
Study ID	Unique identifier for each included study	System-generated ID	Assigned in EPPI-Reviewer
Publication year	Year of publication	Numeric (year)	If multiple versions, use most recent
Publication type	Type of publication	Categorical (single-select)	Journal article; report; working paper; thesis
Country/region	Country or region(s) covered by the study	Categorical (multi-select)	Enter countries when specified; use a region label only if countries are not provided (separate multiple entries with semicolons).
Geographic scale	Spatial scale of analysis	Categorical (single-select)	Local; sub-national; national; multi-country; regional
Producer type(s)	Type of agricultural producers studied	Categorical (multi-select)	Crop; livestock; fisheries/aquaculture; agroforestry; mixed

Marginalized subpopulations	Whether the study explicitly addresses marginalized groups	Categorical (multi-select)	Women; youth; landless; Indigenous Peoples; ethnic minorities; migrant/seasonal workers
Adaptation focus	Type of adaptation action or intervention assessed	Emergent coding	Developed iteratively during extraction
Methodological approach	Primary methodological design	Categorical (single-select)	Qualitative; quantitative; mixed-methods; participatory; modeling with empirical validation
Purpose of assessment	Primary purpose of the assessment	Categorical (single-select)	Project learning; program evaluation; donor reporting; national reporting; research
Indicators measured	Types of indicators used	Emergent coding	E.g., resilience, vulnerability, exposure, adaptive capacity
Domain type	Whether the study assesses adaptation processes, adaptation outcomes, or both	Categorical (multi-select)	Categories: Adaptation process; Adaptation outcome
Process and outcome domains assessed	Specific domains of adaptation processes and/or outcomes assessed in the study	Categorical (multi-select)	Process domains: Knowledge, awareness, or learning; Decision-making or planning; Uptake or adoption of practices; Behavioral change; Participation or co-production; Institutional or governance processes; Access to information, services, or resources. Outcome domains: Yields or productivity; Income or assets; Livelihoods; Wellbeing; Risk reduction or loss avoidance; Resilience or adaptive capacity
Data sources	Data sources used in the study	Categorical (multi-select)	Surveys; administrative data; remote sensing; participatory methods; secondary data
Temporal coverage	Time horizon of the study	Categorical (single-select)	Cross-sectional; seasonal; longitudinal

Cost data reported	Whether cost or resource requirements are reported	Binary (yes/no)	No cost standardization attempted
Equity and inclusion considerations	Whether equity dimensions are explicitly addressed	Categorical (multi-select)	Gender; youth; land tenure; disability; other
Strengths and limitations	Author-reported strengths and limitations	Free text	Extract verbatim where possible
Lessons learned	Key lessons or recommendations reported	Free text	Used for narrative synthesis
Validity-related notes	Descriptive notes on internal/external validity	Free text	Not a formal critical appraisal

6.2 Consistency checking

At least two reviewers will cross-check data extraction for a subset of included studies prior to full data extraction and coding. Agreement will be assessed qualitatively, and discrepancies will be discussed to refine extraction guidance before proceeding to full data extraction. This process will be repeated as needed to ensure consistency.

7 Type of mapping

The review will produce a systematic map describing the landscape of methods used to assess climate adaptation processes and outcomes. Mapping outputs will include:

- Descriptive metadata tables
- Cross-tabulations of methods by outcomes, populations, and sectors
- Visual representations of evidence density and gaps

7.1 Narrative synthesis methods

A narrative synthesis will accompany the evidence map, focusing on:

- Patterns in methodological approaches
- Commonly used indicators and outcome domains
- Strengths and limitations of different assessment methods
- Differences in methods by context, population, and adaptation type

The synthesis will use descriptive statistics, tables, and figures, and will explicitly avoid vote-counting or effect-size aggregation.

8 Knowledge gap identification strategy

Knowledge gaps will be identified through:

- Areas of low evidence density in the evidence map
- Under-representation of specific populations, regions, adaptation types, or outcomes
- Methodological weaknesses or blind spots across the literature
- Heat maps and cross-tabulations will be used to visualize gaps. Stakeholder input will be used to help interpret which gaps are policy-relevant versus expected.

9 Demonstrating procedural independence

While unlikely, review team members who are authors on potentially eligible studies will not participate in screening, data extraction, or appraisal of their own work. Such studies will be screened and coded by independent team members.

10 Competing interests

Any financial or non-financial competing interests will be declared. Where no competing interests exist, this will be explicitly stated.

11 Funding information

All sources of funding (i.e., CGIAR) for the review will be declared. Funders will have no role in study selection, data extraction, or analysis.

12 Author's contributions

Author contributions will be specified using initials, following standard practice (e.g., "XX and YY designed the review. AA and BB conducted screening…").

13 Acknowledgements

Individuals who contributed to the review, including stakeholders, but do not meet authorship criteria (e.g., training support, technical advice) will be acknowledged with permission.

14 References

References will be managed using Zotero reference management software. All citations and references will be formatted using an author–date (Harvard-style) citation format, consistent with conventions in climate change, environmental studies, and development economics research. Reference lists will be presented in alphabetical order by author and will include full bibliographic details to ensure transparency and reproducibility.

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