Global Adaptation Mapping Initiative

Systematic evidence synthesis protocol

1.0 Type of review: systematic map/review

2.0 Authors – list updated on website

3.0 Abstract *(max 350 words)*

The Paris Agreement and Katowice Climate Package articulated a clear mandate to document and assess adaptation progress towards the Global Goal on Adaptation. This includes regularly scheduled stocktaking exercises to summarize and synthesise progress on adaptation. The Intergovernmental Panel on Climate Change (IPCC) Assessment Reports provide an important forum for synthesizing research and evidence to inform the adaptation stocktake. Yet to-date there has been negligible/little robust, systematic synthesis of progress on adaptation or adaptation-relevant responses across the globe. The purpose of this review is thus to ***systematically review human adaptation responses to climate-related changes that have been documented globally since 2013 in the scientific literature***. The broad question underpinning this review is: *Are we adapting to climate change?* More specifically, we ask '*what is the evidence relating to human adaptation-relevant responses that can (or are) directly reducing risk, exposure, and/or vulnerability to climate change*?' We are currently reviewing scientific literature since 2013 that is indexed in Scopus and Web Science Core Collection to identify documents empirically reporting on adaptation-related responses to climate change in human systems. We exclude non-empirical (theoretical & conceptual) literature and autonomous/ evolutionary adaptation in natural systems. We are identifying a subset of these documents that report on *observed* responses that can directly reduce risk/exposure/vulnerability (excluding planning, policies, vulnerability assessment, adaptation strategies). This subset will comprise our included documents for coding across a set of questions focused on: Who is responding? What responses are documented? What is the extent of the adaptation-related response? Are adaptation-related responses reported to reduce risk, exposure and/or vulnerability? We will supplement this systematic mapping with an expert elicitation exercise, undertaken to synthesize insights from included/coded literature for global regions and sectors, with associated synthesis statements and confidence assessments. The primary output will be a series of global maps of adaptation based on our review questions, with key insights and confidence levels.

4.0 Background

The Paris Agreement and Katowice Climate Package articulated a clear mandate to document and assess adaptation progress towards the Global Goal on Adaptation. This includes regularly scheduled stocktaking exercises to summarize and synthesis progress on adaptation. The Global Stocktake (GST) thus underpins the global mandate to track collective progress on how human and natural systems are responding to climatic changes. Despite this, there has to-date been negligible systematic assessment or synthesis of adaptation responses globally. There is, however, a proliferation of documents reporting on adaptation-related efforts and experiences across different sectors, systems, and populations. This review seeks to

systematically synthesis this growing literature to summarize diverse forms of evidence documenting global adaptation progress across sectors, systems, and populations.

5.0 Stakeholder Engagement

This review responds to the mandate of the IPCC's AR6 outline, which highlights the need to document and synthesize observed responses to climate change (http://www.ipcc.ch/site/assets/uploads/2018/03/AR6_WGII_outlines_P46.pdf and http://www.ipcc.ch/site/assets/uploads/2018/09/220520170356-Doc.-2-Chair-Vision-Paper-.pdf).

The IPCC report outlines reflect an extensive consultatory process that includes climate change experts from across disciplines, users of the IPCC reports, and representatives from governments. Throughout this protocol, we draw on the foci, categorization, and priorities outlined in the IPCC AR6 WGII outline as a reflection of stakeholder framing for this review. To maximize potential impact of outputs, the timeline for this review has additionally been aligned with the publication schedule and publication cut-offs to inform the AR6 assessment process (https://www.ipcc.ch/site/assets/uploads/2018/12/Timeline_WGIIAR6.pdf)

6.0 Objective of the Review

Table 2: Review objectives and key components

Review objective	To systematically map and review human adaptation-related responses to climate change that have been documented globally since 2013
Population (P)	Global human or natural systems of importance to humans that are impacted by climate change
Interest (I)	Observed/documented adaptation responses to climate change within human systems (or human-assisted in natural systems)
Context (Co)	Any empirically documented/observed adaptation response by humans
Time & Scope (T/S)	Published between 2013 and 2020

We frame the review using standards for formulating research questions and searches in systematic reviews, using a PICoST approach: population/problem (P), interest (I), context (Co), and Time (T) and Scope (S) (Table 2). The population (P) is global, encompassing all human societies and ecosystems of importance to humans.

The activity of interest (I) is adaptation-related responses. Due to the lack of scientifically-robust literature assessing the potential effectiveness of responses, we use the term 'adaptation-related responses' rather than the more common 'adaptations' to avoid the implication that all responses (or adaptations) are actually adaptive (i.e. reduce vulnerability and/or risk); some responses labelled as 'adaptations' might in fact be maladaptive. To be included, responses must be initiated by humans. This includes human-assisted responses within natural systems, as well as responses within governments, the private sector, civil society, communities, households, and individuals, whether intentional/planned or unintentional/autonomous. While unintentional/autonomous responses are included, these are likely to be under-represented unless labelled as adaptation and documented as a response to climate change due to the infeasibility of capturing potential adaptive activities not identified as adaptations. We exclude responses in natural systems that are not human-assisted; these are sometimes referred to as evolutionary adaptations or autonomous natural systems adaptations. While important, autonomous adaptation in natural systems is distinct from adaptations initiated by humans; this review focuses on responses by humans to observed or projected

climate change risk. We include any human responses to climate change impacts that are, or could, decrease vulnerability or exposure to climate-related hazards, as well as anticipatory measures in response to expected impacts.

This review focuses on adaptation only, and excludes mitigation (responses involving the reduction of greenhouse gas (GHG) concentrations). We consider adaptation responses across contexts (Co) globally, and focus only on adaptation activities that are directly intended to reduce risk, exposure, or vulnerability, even if later identified as maladaptation. To reflect publications since AR5 and prior to the AR6 publication cut-off, we focus on literature published in the time period (T) between 2013 and 2020.

7.0 Methods

7.1 Search Strategy

This protocol follows guidance for systematic review mapping (e.g. James et al. 2016) and general guidelines for evidence synthesis (Cochrane, Campbell, CEE). We follow the ROSES established reporting standards (Haddaway et al. 2018). The review process will follow 7 key phases (Table 3) designed to develop two databases on climate change adaptation in human systems. These databases will provide a resource for a number of subsequent analyses, syntheses, and potential publications. In this protocol, we report on only one of these potential publications (Phase 6).

Table 3: Key phases within the review process

Phase	Description	Lead	Output
Phase 1:	Review and development of protocol	Advisory team	Review protocol Status: complete
Phase 2:	Systematic identification of potentially relevant adaptation literature a) Keyword searches and extractions from databases b) Import into MCC-APSIS platform for screening	Admin team	Status: complete
Phase 3:	Screening of documents a) Training of screeners & piloting platform b) Stage 1 screening: to remove literature not relevant to (adaptation-related) responses to climate change in human systems. c) Stage 2 screening: to identify a sub-set of the above literature that documents empirical observations of responses to reduce risk and/or vulnerability.	Screening team	Database 1: empirical literature on climate change adaptation in human systems Status: screening reaching completion (stages 1 & 2)
Phase 4:	Coding of documents from Stage 2 screening to collect information on adaptation-related response activities globally (coding team). a) Training of coders and consistency checking b) Coding	Coding team	Status: Training completed; coding in progress
Phase 5:	Confirmation of final coding for all documents. a) Identify documents requiring double-coding or needing additional topic coding b) Reconciliation of multiple codes for each document	Admin team Coding team	Database 2: empirical literature on global human adaptation responses
Phase 6:	Synthesize results towards a publication mapping the global human response to climate change.	Admin team Advisory team	

Phase 7:	Article publication	Admin team Advisory team Coding team	Publication 1

To ensure we capture relevant documents, we conducted initial scoping to identify appropriate search terms. A list of 10 *a priori* identified publications were used to construct search terms and refine the search string (Table 2). We did not replicate the search strings of review articles within this list, but rather used the papers to identify potential search terms and better understand the range of terminology used in this field. This informed the development of unique search strings for this protocol.

Table 4: Publications used to develop keywords for search strings

1. Miller et al. (2018) Adaptation strategies to climate change in marine systems. *Global Change Biology.*
2. Araos et al. (2015) Climate change adaptation planning in large cities. *Environmental Science & Policy.*
3. Biesbroek et al. (2018) Data, concepts and methods for large-n comparative climate change adaptation policy research: a systematic literature review. *Wiley Interdisciplinary Reviews – Climate Change.*
4. Runhaar et al. (2018) Mainstreaming climate adaptation: taking stock about "what works" from empirical research worldwide. *REC.*
5. Ford et al. (2015) The status of climate change adaptation in Africa and Asia. *REC.*
6. Lesnikowski et al. (2015) How are we adapting to climate change? A global assessment. *Mitigation and Adaptation Strategies for Global Change.*
7. Lwasa (2015) A systematic review of research on climate change adaptation policy and practice in Africa and South Asia deltas. *REC.*
8. Tanner et al. (2015) Livelihood resilience in the face of climate change. *NCC.*
9. Kafatos et al. (2017) Responses of agroecosystems to climate change: specifics of resilience in the mid-latitude regions. *Sustainability.*
10. Georgeson et al. (2016) Adaptation response to climate change differ between global megacities. *NCC.*

7.2 Search String

Search strings were developed for each bibliographic database as shown below. The searches focus on documents combining two concepts: climate change, and adaptation or response. Given the huge number of publications referring to environment and resilience, we restricted our search string to documents including reference to climate change or global warming in their titles, abstracts, or keywords; articles referring to weather, environmental variability, or meteorological variables without explicit reference to climate change are thus not captured. We included terms such as 'resilience' and 'risk management' to reflect the breadth of literature relevant to climate adaptation that is indexed using these terms. We use natural language terms only since Scopus and Web of Science do not employ controlled vocabulary (e.g. MeSH terms). Experimentation of MeSH terms in PubMed and Medline identified no relevant and sufficiently precise MeSH terms; these databases were thus omitted from the search.

Documents retrieved from searches will be uploaded to a customized platform, MCC-APSIS for management and screening.

Table 5: Search concepts and strings

Database	Concept 1	Concept 2	Date & document type restrictions	Approximate N. documents retrieved
Key concepts & scope	Climate change	Adaptation	Articles, reviews, data papers, and letters only. Date range: 2013-2020	n/a
Web of Science	TS= (climat* or "global warming")	*AND* TS: (adapt* or resilien* or (risk NEAR/3 manag*) or (risk NEAR/3 reduc*))	Refined by: DOCUMENT TYPES: (Article OR Data Paper OR Database Review OR Letter OR Review) Timespan: 2013-2019. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI.	40,129
Scopus	TITLE-ABS-KEY (climat* or "global warming")	AND TITLE-ABS-KEY (adapt* or resilien* or (risk NEAR/3 manag*) or (risk NEAR/3 reduc*))	AND (LIMIT-TO(PUBYEAR, 2019) OR LIMIT-TO(PUBYEAR , 2018) OR LIMIT-TO PUBYEAR, 2017) OR LIMIT-TO(PUBYEAR, 2016) OR LIMIT-TO(PUBYEAR, 2015) OR LIMIT-TO(PUBYEAR, 2014) OR LIMIT-TO(PUBYEAR, 2013)) AND (LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(DOCTYPE, "re") OR LIMIT-TO(DOCTYPE, "dp") OR LIMIT-TO(DOCTYPE, "le"))	37,674

7.3 Languages

Database search — including bibliographic databases, organisational websites, and web-based search engines — will be conducted in English only, but screening will not exclude by language. This means that documents written in any language are eligible for inclusion as long as they are indexed in English within selected databases. Given the global scope of this review, it is not considered feasible to search in all global languages. In addition, the bibliographic databases that we will search typically catalogue records using translated English titles and abstracts: non-English searches are thus not largely necessary for these resources.

7.4 Estimating the comprehensiveness of the search

The search will involve screening a large volume of literature (casting a wide net) to identify a much lower number of relevant documents (<5,000). We anticipate that the major screening restriction will be the requirement that there is *empirical* documentation of activities that are *directly linked to potential risk/vulnerability reduction*. Yet much literature relevant to adaptation remains either unreported, not labelled or tagged as adaptation or climate-related, or reported in forms or platforms inaccessible within a global review.

7.5 Search update

We anticipate that this project will be completed within 12 months of searches being conducted. As such, a search update prior to publication is not as necessary as with projects that take longer to complete. However, we will attempt to produce a web-based platform for this project that will allow searches and screening to be automatically updated on an ongoing basis, to ensure that new research is included to some degree (for example, in an unverified, computer-screened database) as soon as it is catalogued in the databases searched.

8.0 Article Screening and Study Inclusion Criteria

8.1 Screening strategy

Screening will focus on identification of documents that meet our PICoST search criteria. Documents must be published between 2013 and 2020. All retrieved documents will follow a 3-step screening strategy following keyword searches: 1) title screening, 2) abstract, summary, or homepage screening, 3) full text screening. At each stage, documents will be assessed vis-à-vis inclusion and exclusion criteria.

We will provide a list of documents excluded at full text screening, with reasons for exclusion.

8.2 Inclusion & exclusion criteria

Document screening will comprise 2 stages. First, documents will be screened to identify those that are focused on empirical assessment of adaptation to climate change, initiated by humans (Database 1). Secondly, Stage 2 screening will identify a subset of these documents that present empirical documentation of *observed/documented* adaptations that are theoretically aimed at directly reducing vulnerability/risk. This latter set (Database 2) thus excludes adaptation planning, prioritization, and assessment of constraints, and represents a subset of Database 1.

Database 1 will be generated following ***Stage 1 screening*** (Table 7), and will include documents with primary focus on adaptation. Documents focusing on mitigation responses (i.e. reducing greenhouse gas emissions) will be excluded. Documents synthesizing climate change impacts on populations, without explicit and primary emphasis on *adaptation responses* will be excluded. In some cases, climate *responses* may be synonymous with climate *impacts* (e.g. human migration or species shifts). For example, human migration can be considered an impact (climate-induced movement of people) or an adaptation response (people responding to impacts through migration). In these cases, we will include documents only if their synthesis and/or data collection is targeted at presenting the responsive or adaptive aspects of the human or natural system. Documents must present empirical data and analysis. Articles whose contributions are primarily conceptual or theoretical will be excluded. Documents published between 2013 and 2020 will be considered, including documents reporting on adaptations undertaken prior to 2013. Documents will not be excluded from screening based on language as long as they are indexed in English.

The review will focus on articles and documents that consider responses to changes in *climate*. These may include local environmental or weather fluctuations that are attributed (empirically or theoretically) to climate change. Articles summarizing responses to generic environmental change, primarily non-climatic changes, or who present no justification for how the adaptations might be affected by climate change, will be excluded. Empirical evidence of attribution is not necessary. Adaptation responses to perceived climate change impacts will be eligible for inclusion. Documents will not be excluded by geographical region, population, ecosystem, species, or sector.

Table 7: Stage 1 screening criteria (to generate Database 1)

Inclusion criteria	Exclusion criteria	Examples for inclusion/exclusion
Population/ Problem (P)		
Focused on adaptation to actual, projected, or perceived impacts of *climate change*.	Focused on responses to environmental variability that are not conceptually linked to climate change.	*Example of document that would be excluded:* Responses to flooding or heat waves with no justification or mention in full text that variability may be affected by climate change. *Note:* evidence of detection and attribution is not required, but there must be some justification for how climate can, or may in the future, be an important driver of impacts.
Interest (I) and Context (Co)		
Substantive focus on *adaptation* to climate change	Primary focus on *mitigation* to climate change or on *impacts* of climate change that are not framed as potentially adaptive	*Examples of documents that would be excluded:* Energy efficiency programs; planting trees to absorb CO_2; energy conservation; solar power; carbon taxation; agricultural shifts to increase soil carbon storage. *Examples of documents that would be included:* climate legislation or policy to reduce or minimize the impacts of climate change; changing crop types to move to a more climate-resilient crop; changing livelihood strategies to avoid climate risks; migration out of flood-prone areas; improving health systems or surveillance systems to prepare for changing disease incidence.
Presents *empirical* data on adaptation	Primary contributions are conceptual or theoretical	*Examples of documents that would be excluded:* Papers theorizing adaptation opportunities, but results are not based on empirical data collection. *Examples of documents that would be included:* Assessing or proposing potential benefits of adaptation options, adaptation planning, or assessment of constraints to, or opportunities for, adaptation. Must be based on qualitative or quantitative data collection (e.g. interviews, focus groups, policy analysis, field work). Can be secondary analysis, combining multiple empirical studies. Must be evidence in the title or abstract that there is substantial empirical data presented.
Adaptation responses must be *initiated by humans*	Autonomous or evolutionary adaptations in natural systems that are not human-assisted	*Examples of documents that would be excluded:* Changing range of a species with no involvement of humans; evolutionary responses by animals or plants that are not initiated or assisted by humans. *Examples of documents that would be included:* restoration or conservation measures to protect sensitive ecosystems; fishing or hunting policies; changes to coastal management policy.
Time & scope (T/S)		
Published between 2013 and 2020	Published prior to 2013	n/a
Databased/indexed in English, with primary source available in any language	Not databased/indexed in English	n/a

For scientific documents, must be an article, review only. For grey literature, must be a reputable organisation.	Editorials, books, conference proceedings, meetings.	n/a

Stage 2 screening will focus on identification of documents that present *observed/documented* adaptation responses that are directly aimed at reducing risk/vulnerability (Table 8). Documents presenting empirical syntheses of vulnerability or adaptive capacity without primary or substantive focus on tangible adaptation responses (reactive or proactive) will be excluded. Documents will be considered eligible for inclusion if they explicitly document adaptation actions that are directly theorized or conceptually linked to risk or vulnerability reduction. This excluded assessments of *potential* adaptation, *intentions/plans* to adapt, and discussion of adaptation constraints or barriers in the absence of documented actions that might reduce risk, exposure, or vulnerability.

Table 8: Stage 2 screening criteria (to generate Database 2)

Inclusion criteria	Exclusion criteria	Examples for inclusion/exclusion
Presents empirical data on observed/documented adaptation responses	Primary contributions are conceptual or theoretical, or presents *potential* adaptations, adaptation constraints, or adaptation opportunities	*Examples of documents that would be excluded:* Assessing or proposing potential benefits of adaptation options. Adaptation planning (without evidence of actions to directly reduce risk/vulnerability). Assessment of constraints to, or opportunities for, adaptation.
Focuses on actions that are directly aimed at *risk/vulnerability reduction*	Focuses on actions that are aimed at assessing vulnerability or proposing potential actions, with no clear evidence of activity that directly reduces risk	*Examples of documents that would be excluded:* Vulnerability assessments (including consideration of adaptive capacity); adaptation planning that does not involve actions to directly reduce risk/vulnerability; adaptation financing alone (unless funded risk reduction actions are documented). *Examples of documents that would be included:* Advocacy activities to help citizens reduce their risk; provision of climate services to aid decision-making in risk reduction; climate legislation or policy designed to minimize risk; adaptation finance that supports actions that are directly aimed at reducing risk/vulnerability.

9.0 Critical Appraisal

9.1 Critical appraisal strategy

Quality appraisal will be undertaken on all documents/studies meeting inclusion criteria, and will be part of the assessment of confidence in evidence. Critical appraisal will not be used for article inclusion or

exclusion since this review includes literature with a range of methods. Appraisal will be conducted to fulfill the requirements of assessment of confidence in evidence. The appraisal is guided by components of the GRADE-CerQual (https://www.cerqual.org/) approach to evaluating confidence in evidence for qualitative data. We will not appraise or extract quantitative data. The following critical appraisal questions have been included in the data extraction form:

A. **Are there any major methodological limitations?** E.g. Are methods sufficient to answer the research question, and are findings adequately and sufficiently substantiated by empirical data (qualitative or quantitative data)? Are there any major sources of bias in the data collection, analysis, or interpretation of results? Comments on methodological limitations:
B. **Assessing coherence: Did the article provide sufficient information to answer all of your coding questions?** Were there particular questions for which you felt that there was: 1) limited information or unclear evidence provided, 2) divergent results or outliers that made it hard to answer or that the authors seemed to ignore, or 3) the paper/document was not really directly relevant to the questions you were asking? This question will help us assess confidence in findings. Please highlight any of your answers that may be less reliable compared to others.
C. **Assessing adequacy: Please comment on the quantity and quality of data upon which the findings in this article/document are based** (e.g. sample size and/or depth of research). Did the article/document contain sufficient and adequate data (quantity and/or richness) for you to feel confident answering these questions? This question will help us assess confidence in findings. We are less confident about a finding when the underlying data only come from a small number of participants, locations, or settings, or in the case of case-studies do not contain sufficient detail/richness to make a meaningful assessment.
D. **Assessing relevance: Are the results of this study relevant to a particular context only** (e.g. a particular region, population, or context)? If so, describe the context within which these results are valid/relevant.

10.0 Data Extraction

Meta-data extraction and coding strategy

Data extraction will be guided by an adaptation typology designed to characterize *who* is responding, *what* responses are being observed, what is the *extent* of the adaptation-related response, and are adaptation-related responses *reducing vulnerability and/or risk*? Coding of regional and sectoral foci within documents will allow stratified analyses for individual sectors or regions.

Questions will include both closed/restricted answer questions and open-ended narrative answer questions. The former will facilitate quantitative categorical analysis (e.g. descriptive statistics, summarizing studies in ordered tables) and mapping of adaptation (breadth), while the latter will facilitate contextual understanding of adaptation and qualitative analysis.

The data extraction strategy is designed to create a systematic database characterizing adaptation responses that can be used for multiple types of analyses rather than a single objective. Key analytical questions are summarized in Table 9. A detailed codebook for data extraction is included as Appendix I.

Table 9: Summary of research questions guiding typology for analysis

Research themes & questions
1. General
1.1. Description of topic summarized in document (open field)
1.2. Region(s) or geographic focus of adaptive responses documented (restricted options)
1.3. Open field to specify region
1.4. Sectoral focus of adaptive responses documented (restricted options)
1.5. Cross-cutting themes (restricted options)
1.6. Consideration of local knowledge (restricted options)
1.7. Consideration of Indigenous knowledge (restricted options)
2. Who is responding?
2.1. Who is engaging in adaptation responses? (restricted options)
2.2. Open field if answered 'other' to above question
2.3. Is there evidence that particular vulnerable groups are targeted in adaptation responses? (restricted options)
2.4. Open field if answered 'other' to above question
3. What responses are documented?
3.1. What types of responses are reported? (restricted options)
3.2. What types of implementation tools are reported? (open field)
3.3. What climatic hazards are being responded to? (restricted options)
3.4. Open field if answered 'other' to above question
3.5. What aspects of exposure or vulnerability are targeted by adaptation responses? (restricted options)
3.6. Open field if answered 'other' to above question
3.7. What is the stated (or implied/assumed) link to reduction in risk? (open field)
4. What is the extent of the adaptation-related responses?
4.1. What is the *general stage* of response activities? (restricted options)
4.2. Is there any information on who financed the response? (restricted options)
4.3. Is there any information on the costs of adaptation? (restricted options)
4.4. What is the *depth* of response activities? (open field)
4.5. What is the *scope* of response activities? (open field)
4.6. What is the *speed* of response activities? (open field)
5. Are adaptation-related responses reducing risk?
5.1. Is there any evidence that activities successfully reduced risk? (restricted options)
5.2. Open field if 'yes' to the above question.
5.3. Are indicators or measures of 'success' identified? (restricted options)
5.4. Open field if 'yes' to the above question.
5.5. Is there any consideration of risks or maladaptation associated with the adaptation responses? (open field)
5.6. Is there any reference to co-benefits? (open field)
6. Adaptation limits
6.1. Are limits to adaptation described? (restricted options)
6.2. Open field if 'yes' to the above'.
6.3. Are these hard or soft limits? (open field)
6.4. Is there evidence to indicate whether responses approach, challenge, or exceed soft limits? (open field)
7. Assessing confidence in evidence
7.1. Are there any major methodological limitations? (open field)
7.2. Did the document provide sufficient information to answer all of these coding questions? (coherence) (open field)
7.3. Comment on the quantity and quality of data upon which the findings are based (adequacy) (open field)
7.4. Are the results relevant to a particular context only? (relevance) (open field)

Data extraction strategy

Step 1: Initial data extraction by theme. Data will be extracted from the dataset using the data extraction based on the questions listed in Table 9. Given the substantial number of documents expected, data extraction will be undertaken by a team of researchers, each with the responsibility of assessing documents relevant to his/her theme. Data extraction will include a combination of coding (binary or categorical restricted choices) and meta-data extraction of qualitative data and quotes. Adaptation themes have been categorized into 21 thematic areas reflecting the key chapter foci identified within the IPCC WGII AR6 outline, and include: global regions, sectors/systems, and cross-cutting topics. Each thematic area will be assessed by one individual theme lead. Each record will be independently assessed by at least two individuals.

Step 2: Reconciliation of duplicate coding. Finally, the team lead will assign each record a lead coder, who will be responsible for comparing and consolidating the two sets of codes.

The final dataset will comprise a single entry for each document, including relevant coding to allow searching on region, sectoral focus, and extraction of specific questions.

Table 10: Thematic areas used to define coding responsibilities of each coder

Thematic areas
Regions
Africa
Asia
Australasia
Central & South America
North America
Europe
Small Island States
Sectors/systems
Terrestrial & freshwater ecosystems
Ocean & coastal ecosystems
Water quality & sanitation
Food, fibre, and other ecosystem products
Cities, settlements & key infrastructure
Health, well-being, and communities
Poverty, livelihoods, and sustainable development

Missing data and outcome reporting bias

There is likely to be substantial reporting bias given that many activities that reduce vulnerability and risk are not reported or not labelled as adaptations. Given the conceptual complexity of the adaptation literature, there are currently no feasible options to overcome this reporting bias at the global scale. These biases will be declared in all publications.

For individual documents, there may be insufficient information to answer a question in the data extraction form. In this case, all coders will be asked to enter 'no data' to distinguish absence of evidence ('no data') from evidence of absence. Reporting of confidence in evidence and lack of information for key adaptation needs is a key goal of this initiative.

11.0 Data Synthesis and Presentation

We present data cleaning (quality assurance screening and double-coding reconciliation) in a separate protocol.

We present data synthesis in a separate protocol.

We present expert elicitation plans in a separate protocol.

Presentation of results

Results will be presented in 4 key formats for the primary output manuscript:

1. Global maps (potentially interactive) of adaptation demonstrating: who is responding, what responses are being observed, what is the extent of the adaptation-related response, and are adaptation-related responses reducing vulnerability and/or risk?
2. Descriptive statistics characterizing patterns and trends in the data across the five research question variables (e.g. Do adaptation type mixes differ by region or hazard? Are some vulnerabilities more frequently addressed than others? Has there been more procedural progress in some sectors or regions compared to others?)
3. Narrative synthesis will be used to support the above trends, drawing on qualitative free-text responses in the data extraction database.
4. Key results statements with associated confidence in evidence assessment.

Assessment of risk of publication bias

We anticipate substantial publication bias, particularly based on language (dominance of English-language publications via publicly accessible platforms) and region (lower publishing rate in low income regions). In this context, it is typically difficult to distinguish whether absence of adaptation reporting reflects lack of adaptation activities or lack of reporting.

This initiative has been designed to minimize publication bias through the following strategies: 1) systematic searches; 2) expert elicitation to compile synthesis profiles/assessments for each region-sector, thus allowing experts to judge potential reporting bias; 3) inclusion of formal confidence assessment to identify where evidence is strong or weak, and highlight publication gaps and potential bias; 4) presentation of all variables as *relative mixes/profiles* rather than estimating absolute progress/assessment.

We further anticipate biases towards the prioritization of scientific knowledge and evidence. Critiques of previous global assessment processes (IPCC, IPBES) have raised the challenges of integrating diverse knowledges, in particular Indigenous and local ways of knowing, into scientific formats of confidence assessment and knowledge synthesis.

Knowledge gap and cluster identification strategy

This initiative is explicitly targeted at identifying knowledge gaps through inclusion of confidence assessments and synthesis across all regions and sectors of interest. Cluster identification will be based on sector-region stratifications.

Demonstrating procedural independence

This review protocol was initially stimulated by the need for climate research syntheses to inform the IPCC AR6 assessment process. As a result of this, several authors participating in this review are also AR6 Lead Authors. The review, however, is developed independently from the IPCC assessment process, and draws on publicly available documentation of AR6 priorities. While a desire to provide valuable outputs to the AR6 assessment process underpins the methods here, protocol development has been procedurally separate from any influences or biases. To avoid team members from appraising their own research, no screeners or coders will be assigned to review records that they have authored.