

# Effectiveness of climate change adaptation interventions in sub-Saharan Africa and the impact of funding modalities

A mixed methods systematic review protocol

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## Abstract

**Background.** International climate finance plays a key role in enabling the implementation of adaptation measures. However, while there is a common metric for gauging the effectiveness of finance for mitigation – greenhouse gas emission reduction per unit of funding – no corresponding metric exists for adaptation. Instead, assessments of what works best in adaptation finance focus either on procedural aspects of funding modalities, such as equity in the allocation of funding, or on the extent to which specific adaptation activities produce the desired results. This mixed methods systematic review aims to assess the effectiveness of adaptation finance and bridge the gap between those two approaches. It involves a transparent and comprehensive synthesis of the academic and grey literature on how different characteristics of adaptation projects in sub-Saharan Africa – and finance for those projects – affect adaptation outcomes, particularly in terms of risk and vulnerability to climate change impacts. Finalised adaptation projects funded by a set of the multilateral climate funds and two bilateral donors (United Kingdom and Sweden) are the focus of this review. The findings can help inform the future design and implementation of adaptation activities as well as funding decisions.

**Methods.** Funding characteristics that affect project design will be sourced from funders' documentation. Design and implementation characteristics of adaptation projects and their finance will be sourced from project documents, including evaluations. Information about what works will be sourced from impact evaluations, and qualitative and mixed methods research will provide information on how adaptation projects are believed to be associated with specific outcomes. Relevant academic and grey literature published after 2010 will also be considered. Organisational websites and Google Scholar will be searched in English, French and Spanish (depending on availability of information in these languages), while bibliographic databases will be searched in English. Eligibility screening (with consistency checking) will be conducted at two levels: title and abstract, and full text. We will critically appraise study validity and extract and code mixed method, qualitative and quantitative data from relevant studies, including bibliographic details, study location and design, details about the intervention, participants and implementation context, financing and study findings. We will synthesise findings through a combination of quantitative synthesis, framework synthesis and qualitative comparative analysis and/or meta-regression methods to answer what works and how.

**Keywords:** adaptation finance, climate finance, climate resilience, development assistance, international aid

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**Note: The funding for this review has been discontinued, and as a result, the review will not be completed as described in this paper. The protocol developed for the review is presented here so that it may inform other future work.**

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# 1. Background

## 1.1 The problem

Climate change impacts and extreme weather events often compound existing stresses in low- and middle-income countries, such as poverty and inequality (Denton et al. 2014). In sub-Saharan Africa, climate change impacts include higher risks of flooding in East Africa, drought in South Africa, and sea-level rise in coastal cities, among others. Addressing these impacts across different sectors, such as health and agriculture, as well as climate change-driven migration is a major challenge, given the social, demographic, and economic profile of the region (Serdeczny et al. 2017).

The Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have committed to jointly mobilising funding to support proactive measures to adapt to climate change – here referred to as “adaptation finance” (UNEP 2019; UNFCCC 2018). This finance is important for developing countries, as without adaptation, they are likely to experience large and long-lasting negative economic, environmental and social impacts. Climate change also has a compounding effect on other vulnerabilities, such as hunger and poverty (Micale et al. 2018). Therefore, there is broad international consensus to address climate change and other development challenges holistically, under the Sustainable Development Goals (SDGs).

However, recognition of the importance of adaptation finance is relatively recent. The UNFCCC’s original stated objective (2020) was to stabilise greenhouse gas concentrations in the atmosphere (i.e. mitigation), while the need for adaptation received less emphasis (UNFCCC 2013). Only after the publication of the Intergovernmental Panel on Climate Change (IPCC) *Third Assessment Report* in 2001 did countries collectively agree on the need to prioritise both adaptation and mitigation (UNFCCC 2013). This lag in recognising the importance of adaptation, combined with other factors, generated an *adaptation finance gap*, with most funding channelled to support mitigation efforts. Estimates of adaptation costs globally range from US\$140 billion to US\$300 billion per year by 2030 and from US\$280 billion to US\$500 billion per year by 2050 (UNEP 2018), but public finance for adaptation was estimated at only US\$24.7 billion in 2017 and US\$35.4 billion in 2018 (Macquarie et al. 2020).

For Africa, estimates of adaptation costs are in the range of US\$7–15 billion per year by 2020, increasing to US\$50 billion per year by 2050, but actual flows from different sources have been only US\$1–2 billion per year (UNEP 2015). Aid Atlas (2020), a tool that records all donors contributing to the OECD Development Assistance Committee (OECD/DAC) Creditor Reporting System, shows that all funders disbursed US\$5.7 billion to sub-Saharan Africa for adaptation between 2010 and 2018.

Another key challenge in adaptation finance is determining the effectiveness of adaptation, and thus of adaptation finance, which has been hindered by the complex institutional architecture of climate finance. This architecture involves different sources, instruments and implementing actors. Within international public climate finance, the main providers of adaptation finance are bilateral donors (29% of their total climate finance portfolio in 2015–2016), followed by multilateral climate funds (25%), and multilateral development banks (21%) (UNFCCC 2018).

Multilateral climate funds, although modest in size, have been crucial for spearheading adaptation action in developing countries ever since the establishment of the first funds in 2001 (Nakhoda et al. 2014). North–South bilateral finance (i.e. development finance for developing countries) for adaptation, meanwhile, has increased since 2010, the year when the Rio marker for adaptation was introduced. The Rio markers are a scoring system to help donor countries identify activities within their development cooperation portfolios that support the Rio Conventions’ objectives. The Rio marker for adaptation enables funders to indicate whether their finance is targeting adaptation in a principal or significant way (OECD 2016).

According to the OECD/DAC Creditor Reporting System, the UK disbursed US\$2.73 billion for climate adaptation (principal objective) between 2010 and 2018 (out of US\$90.2 billion of total development finance), and Sweden, US\$805 million (out of US\$2.9 billion total development finance). Both the UK and Sweden have targeted large shares of their adaptation finance to sub-Saharan African countries (Atteridge et al. 2019).

In order to increase adaptation finance flows to required levels, it is crucial to understand the conditions that lead to the success or failure of adaptation projects. Funders want to know *what* has worked so far in the field of adaptation, and *why*. Two main approaches have been taken so far to try to answer those questions: one assessing adaptation implementation, the other assessing adaptation finance.

Approaches for assessing adaptation *implementation* effectiveness so far have concentrated on developing tailored indicators to measure adaptation outcomes and impacts at different scales (e.g. individual, community, national), or in different sectors (e.g. agriculture, tourism, coastal areas, food security) (Rogers 2009; Bours and UKCIP 2014). Approaches for assessing adaptation *finance* effectiveness, meanwhile, are derived from the development finance practices. They are based on the following principles: ownership by developing countries, alignment of donor country priorities with developing country priorities and systems, harmonisation among donor countries, focus on development results and measurements, and mutual accountability for results (OECD 2005; 2008; 2011). In practice, however, the main way in which the effectiveness of development finance has been measured is the extent to which an intervention achieved, or is expected to achieve, its objectives and differential results across groups (OECD/DAC Network on Development Evaluation 2019).

Perspectives on adaptation finance have also been influenced by political debates about whether to consider adaptation finance as a form of compensation from historical high emitters of greenhouse gases to those countries less responsible for climate change, but most affected by it. This idea has influenced how adaptation finance has been evaluated and led to the consideration of several additional principles beyond those used in development finance. These include *the polluter pays principle* (Khan 2015), whereby countries with a historical responsibility and high CO<sub>2</sub> emissions should be the funding providers; *the adequacy principle* (Schalatek and Bird 2011), to assure an adequate amount of finance available; and the *new and additional principle* (Stadelmann et al. 2011), to assure that adaptation finance does not divert current development finance flows.

Other principles that have been proposed include that funds be delivered in a *predictable*, *sustainable* and *timely* manner (Klein and Müller 2009; Ciplet et al. 2013); that the allocation of funding prioritise the most vulnerable to climate change and their needs (Klein and Müller 2009; Barrett 2012; Barrett 2013); *equal representation* of countries in decision-making on what gets funded (Wilkinson et al. 2014; Schalatek and Bird 2011); and the *no-harm principle*, preventing harm to the environment or to human rights (Johl and Lador 2012; Schalatek and Bird 2011). An assumption behind these principles is that effective processes will lead to effective outcomes (Ellis et al. 2013). This explains why, historically, studies on the effectiveness of adaptation finance have focused on assessing deployment procedures and access to climate finance, with less coverage of the on-the-ground results and impacts related to adaptation (e.g. increase in adaptation capacity or resilience, decrease in risks to climate change), though this is improving (UNFCCC 2018).

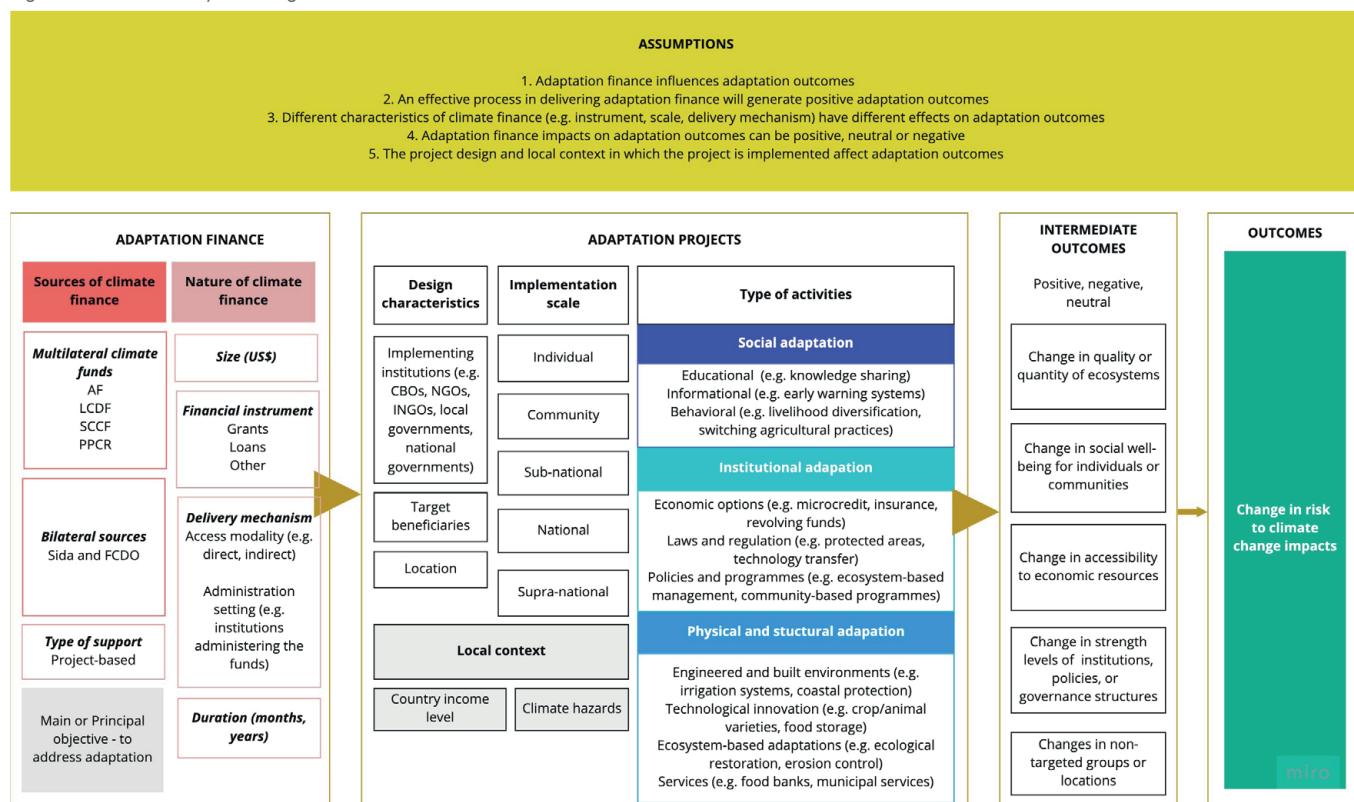
This review aims to bridge the gap between these two types of approaches by examining how adaptation finance influences the effectiveness of adaptation measures on the ground. We will analyse adaptation projects in sub-Saharan Africa funded by 1) multilateral climate funds – specifically, the Least Developed Countries Fund (LDCF), the Special Climate Change Fund (SCCF), the Adaptation Fund (AF) and the Pilot Program for Climate Resilience (PPCR) – and 2) two bilateral donors: the UK, through its Foreign Commonwealth and Development Office (FCDO),

and Sweden, through the Swedish International Development Cooperation Agency (Sida). The multilateral climate funds listed above have been selected because they provide financial support for adaptation projects, and information on the project documentation and evaluations they approved is publicly available to some extent. The two bilateral donors were selected because their investment in adaptation activities is substantial, and project documentation is available through public websites (i.e. [d-portal.org](http://d-portal.org)) or upon request. Hereinafter we refer to the full set of selected funds and bilateral donors as “funders”. Following a systematic review methodology, we will collect and synthesise evidence on the finance and the implementation of adaptation projects supported by these funders. This information will be retrieved from evaluations of funders, project design and evaluation documents, impact evaluations and qualitative research about perceived impacts.

### 1.2 From adaptation interventions to outcomes

Based on the current theory and literature on climate change adaptation and adaptation finance, we developed a draft theory of change (ToC) that explains how the financial characteristics of the interventions considered in this review might lead to changes in adaptation outcomes. Below we provide a description of different ToC elements that are visualised in Figure 1. This ToC focuses on introducing and defining the elements that will be included in this review. Our team has also developed a causal-process-tracing theory of change (pToC), in line with Cartwright et al. (2020), which details our assumptions on how the different elements of the intervention and context interact with one another, and how these interactions affect the final outcome (see here: [https://miro.com/app/board/o9J\\_ktJXbZQ=?moveToWidget=3074457355309039365&cot=14](https://miro.com/app/board/o9J_ktJXbZQ=?moveToWidget=3074457355309039365&cot=14)). The (p) ToC will be used as a tool for extracting, synthesising and representing our findings. The (p)ToC in this protocol is not final, but will be expanded and adjusted as new discoveries are made (see section 3.14 on data synthesis).

Figure 1: A draft theory of change



Source: Authors. (Also available from [https://miro.com/app/board/o9J\\_ktJXbZQ=?moveToWidget=3074457355308798349&cot=14](https://miro.com/app/board/o9J_ktJXbZQ=?moveToWidget=3074457355308798349&cot=14))

Below we define each of the ToC elements.

### Adaptation

**Adaptation:** There are several definitions of adaptation. The most widely used, which we follow in this report, is the one in the IPCC *Fifth Assessment Report (AR5)* glossary: “*the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects*” (Noble et al. 2014). This definition also differentiates between *incremental adaptation* (focusing on maintaining existing states of a system) and *transformational adaptation* (as changes in fundamental attributes of a system).

**Adaptation finance:** The UNFCCC text describes the need to mobilise financial resources for the implementation of the Convention, not only through one or more entities operating the financial mechanism of the Convention, but also through bilateral, regional and other multilateral channels (United Nations 1992). Therefore, different types of sources of funding and different financial instruments (e.g. loans, grants, guarantees) can be considered as climate finance, as long as the purpose is to support climate change action. Climate finance supporting adaptation is also called adaptation finance, and that is the focus of this review.

### Inputs: Adaptation finance sources (funders) and characteristics

Recognised sources of adaptation finance for developing countries include public international sources (e.g. bilateral North–South, multilateral development banks, multilateral climate funds and multilateral funded programmes), private international sources, public domestic sources, and private domestic sources. These sources can act in isolation or together, which means that a single intervention or project can be funded by one or more of these sources. Our review only focuses on the multilateral climate funds and bilateral donors listed above. As noted, hereinafter these sources of finance are referred to as “funders”.

The adaptation finance these funders provide to sub-Saharan Africa has different modalities or characteristics. Such characteristics include the type of support, which can be project-based and non-project-based (e.g. budget support, payments for results); the size of the support; the duration of the funding; the financial instrument (e.g. grants, loans, other); and the delivery mechanism used, which can include access modality (e.g. direct, indirect) and the administration setting (e.g. institutions administering the funds). This review only includes project-type financial support, since it is commonly used by both the multilateral and bilateral funders included in this review and considers all other characteristics presented above.

### The intervention: Definition, scope, design and context

In the context of this review and theory of change, interventions are *adaptation projects*, defined as projects with a main objective to address climate change adaptation, and funded by project-type finance from the selected funders. In this review, we consider that a project’s main objective is to address climate change adaptation if:

- (a) The funder is a multilateral climate fund, and the funder identifies the project as an adaptation project; or
- (b) The funder is a bilateral donor, and the funder has assigned or tagged the Rio marker for adaptation with a Score 2, identifying adaptation as the project’s main or principal objective.

However, a considerable number of projects might be wrongly tagged (Weikmans et al. 2017). Therefore, a preliminary list of projects will be obtained following (a) and (b). Then, these projects’ objectives will be assessed to verify that their main aim is to address adaptation and that they

respond to a climate hazard or risk. Funders can suggest additional projects to include on the list, and our team will assess those projects' objectives as well. Funders can also provide project-type finance to programmes, which are a collection of single adaptation projects. In these cases, the intervention remains the adaptation project.

Adaptation projects are composed of a set of activities designed to achieve the projects' adaptation objectives. *Adaptation activities* can be classified according to adaptation categories identified by Noble et al. (2014) in Chapter 14 of the Working Group II contribution to the IPCC *Fifth Assessment Report*. These include structural and physical adaptation (i.e. engineering and built environment, technological, ecosystem-based and services); social adaptation (i.e. educational, informational, behavioural); and institutional adaptation (i.e. economic, laws and regulations, government policies and programme). These activities might include, for example, improvement of availability and accuracy of climate forecasts and services, promoting the uptake of new crops and land management practices, and provision of technologies and training in climate-smart agriculture. For a complete list, including examples of adaptation activities, see Noble et al. (2014). These activities can be implemented within a single adaptation project at different levels, including individual, community, sub-national, national and supranational.

**Design characteristics:** Before it is implemented, a project is designed. Planned objectives and activities are part of an adaptation project design. Other elements of the design include the choice of institutions (e.g. CBOs, NGOs, INGOs, local governments, national governments) in charge of implementing the project, the location(s) where the activities will be implemented, and the intended beneficiaries. This list is not exhaustive and could be extended to include other elements that characterise the design of an adaptation project.

**Local context.** We recognise that there are several factors determined by the location where the activity is implemented that can affect the outcomes of an intervention. The most important for our review is the type of climate change or climate variability impact in the area of implementation, or climate hazard addressed by the adaptation project.

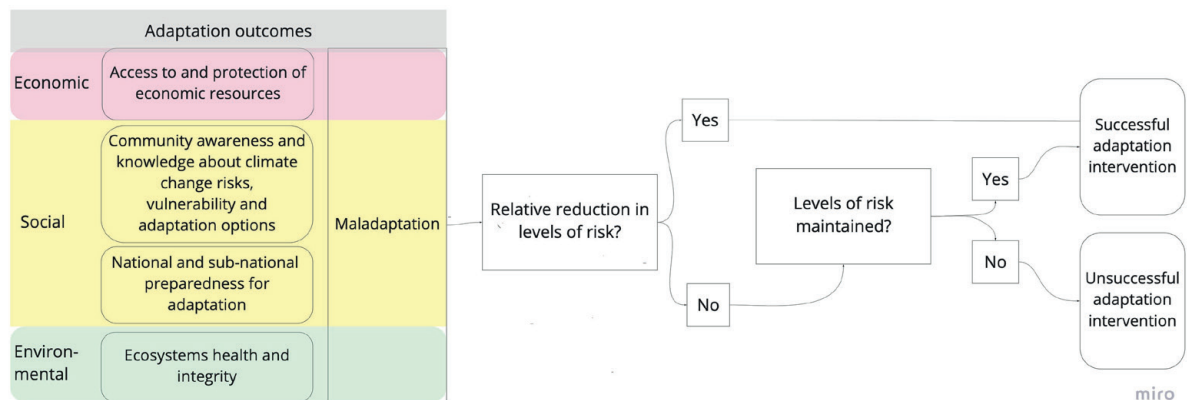
### **Impacts and outcomes: Understanding the effects of adaptation projects**

Our review seeks to understand what works for adaptation. Therefore, we define the main adaptation outcome as “any adjustment that reduces the risks associated with climate change, or vulnerability to climate change impacts, to a predetermined level, without compromising economic, social, and environmental sustainability” (Doria et al. 2009). According to this definition, an intervention or adaptation project is effective if there is evidence of the reduction of climate change risks (see Figure 2). We follow the definition of climate risk provided by Working Group II in the IPCC *Fifth Assessment Report*: “*the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard.*” We also use the IPCC definitions of vulnerability and exposure. Vulnerability is defined as “*the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.*” Exposure is defined as “*the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected*” (IPCC 2014).

In this review, the term risk is used primarily to refer to the risks of climate change impacts. These changes in levels of risks can be achieved through changes in intermediate outcomes connected to economic, social and environmental sustainability, such as: (a) access to and protection of economic resources; (b) community awareness and knowledge of climate change risks, vulnerability and adaptation options; (c) national and sub-national preparedness for adaptation;

and (d) health and integrity of ecosystems (Adger et al. 2005; Brooks et al. 2011; Owen 2020). We hypothesise that these intermediate outcomes affect either the levels of vulnerability of targeted population or their exposure to climate hazards. In addition, we also consider maladaptation as an unexpected or unintended increase in climate risk or vulnerability in non-target groups or locations (Eriksen et al. 2011; Atteridge and Remling 2017; Juhola et al. 2016). All outcomes can be characterised as positive, neutral or negative, depending on how they affect the reduction in levels of climate risk.

Figure 2. A decision tree for understanding effectiveness of adaptation projects.



Source: Authors based on Owen (2020)

### Assumptions

Our theory of change is based on several assumptions. First, we assume that adaptation finance influences adaptation outcomes. Second, an effective process in delivering adaptation finance will contribute to generating positive adaptation outcomes. We also make the assumption that different characteristics of climate finance, such as the instrument used, the scale of the funding or its delivery mechanism can have different effects on adaptation outcomes. We assume that adaptation finance impacts on adaptation outcomes can be positive, neutral or negative. We also assume that the design of the project has considered local context elements, such as political agenda of local authorities, the income level in the targeted region, and non-climate related vulnerabilities such as political instability or gender-based discrimination. Finally, we assume that project design elements and the local context in which the project is implemented have an effect on the adaptation outcomes.

### 1.3 Why it is important to do this review?

In addition to informing climate policy, this review also aims to fill a synthesis gap. A recent map of evidence related to sustainable development in the Global South (Phillips et al. 2017) showed a clear synthesis gap related to SDG13 (climate action), with only two reviews related to mitigation and adaptation, none of which are relevant to the subject of this review. Some existing syntheses focus on the impact of adaptation activities, but without analysis of the impact of financial flows (Owen 2020; Doswald et al. 2014; Piggott-McKellar et al. 2019). Others look into adaptation finance decision-making and evaluate whether finance is allocated to the most vulnerable countries (Betzold and Weiler 2017; Mori et al. 2019; Michaelowa et al. 2020; Persson and Remling 2014; Remling and Persson 2015), but do not focus on adaptation outcomes on the ground. Other studies on adaptation finance have focused mainly on the gap between adaptation finance and adaptation needs, without evaluating evidence on effectiveness that links finance with a specific set of adaptation outcomes (UNEP 2014; UNEP 2016; UNEP 2017; UNEP 2018).

A limited number of studies have focused on the activities of specific donors. Examples include a review of UK government's ICF funding through FCDO (previously known as DFID) and the Department for Business, Energy and Industrial Strategy (BEIS) (House of Commons International Development Committee 2019), an analysis of UNFCCC funding for food systems (Conevska et al. 2019), an evaluation of the Swedish Climate Change Initiative for the period 2009–2012 (Colvin et al. 2020), and an evaluation of the Danish International Development Agency (DANIDA) on climate adaptation (Ministry of Foreign Affairs of Denmark 2019). Nevertheless, none of these is comparing a variety of adaptation projects with different financial sources from different contexts (most focus on entire funds or donor portfolios). This review will fill this synthesis gap by collating the best available evidence for adaptation effectiveness, highlighting the role of finance in this sector and providing advice, based on the results, on what works for adaptation finance.

## 2. Objectives of the review

The aim of this mixed methods systematic review is to answer how different characteristics of adaptation projects and adaptation finance affect adaptation outcomes. We will limit our scope to adaptation projects located in sub-Saharan Africa that were implemented after 2010. The goal is to generate valuable guidance for the effectiveness of climate adaptation and finance. We will focus on the following questions:

Q1: What are the design differences between adaptation projects funded by different funders?

Q2: What is the effect of these projects on the risks to climate change?

Q3: How do these projects lead to a change in specific adaptation outcomes?

Q4: Which financial conditions (such as type of financial instrument, size of funding and delivery mechanisms employed at the country level) are associated with adaptation outcomes?

Q5: Which other (implementation) conditions are associated with adaptation outcomes?

Each question will be answered using specific literature sources (including project design documents and evaluations, impact evaluations, and funder-level evaluations and documentation) and synthesis approaches (including framework synthesis, meta-analysis, qualitative comparative analysis and/or meta-regression), as detailed in Table 1.

Table 1. Review questions and related source documents, types of relevant findings and synthesis approaches.

Review question	Source	Type of relevant findings	Synthesis approach
<b>1. What are the design differences between adaptation projects funded by different funders?</b>	Funder-level operational guidelines Funder-level evaluations	Narrative textual accounts including funding requirements affecting project design, location(s), types of activities, size of funding, type of financial instrument, and outcomes	Narrative
<b>2. What is the effect of these projects on the risks to climate change?</b>	Impact evaluations Qualitative and mixed methods research on perceptions and experiences about impacts, including the views of project beneficiaries, implementation officers, local authorities, and populations that are not targeted, but are still affected	Quantitative research findings, including measures of changes in levels of climate change risks Qualitative research findings, including perceived impact and experiences	Quantitative and framework synthesis
<b>3. How do these projects lead to a change in specific adaptation outcomes?</b>	Project-level documentation Impact evaluations Qualitative and mixed methods research	Narrative textual accounts, including description of implementation context and processes (following our theory of change), summarised using content analysis where needed Qualitative research findings describing the processes and linkages believed to lead to change (following our theory of change)	Framework synthesis
<b>4. Which financial conditions are associated with adaptation outcomes?</b>	Project-level documentation Funder-level documentation Impact evaluations Qualitative and mixed methods research	Narrative textual accounts, including descriptions of the financial conditions within other project reports (following our theory of change) Qualitative research findings describing which types of finance models seem to work and why (following our theory of change)	Qualitative comparative analysis
<b>5. Which other (implementation) conditions are associated with adaptation outcomes?</b>	Project-level documentation Impact evaluations Qualitative and mixed methods research	Narrative textual accounts including description of implementation context and processes (following our theory of change) Qualitative research findings describing the processes and linkages believed to lead to change (following our theory of change)	Qualitative comparative analysis

### 3. Methodology

This mixed methods systematic review will follow the Campbell Collaboration (2019) policies and guidelines.

#### 3.1 Stakeholder engagement

This protocol was co-designed with input from various stakeholders, aiming to improve the relevance of the review findings for different stakeholders and the perceived legitimacy of the review process, as well as to support stronger science–policy connections (Land et al. 2017). Networks with stakeholders built in the early stages of the review process and during co-design stage will also help facilitate the communication of review findings and improve the likelihood of policy impact (Haddaway and Crowe 2018).

Stakeholder engagement for this review was conducted via three main processes: an online workshop, a public consultation process, and a direct engagement with specific experts and funding agencies. First, an online workshop was held in June 2020 with stakeholders from East Africa (including Kenya, Tanzania, Uganda and Rwanda) to understand their knowledge needs. The participants included 16 representatives of national governments, academia, non-governmental and civil society organisations, and funding institutions in the region. Participants were asked to identify sources of finance, type of activities and expected results associated with adaptation projects (with a focus on agriculture). The participants cited multilateral climate funds and bilateral North–South cooperation as the most common sources of finance for adaptation projects in the region. They characterised effective adaptation outcomes as those that increase resilience and/or improve levels of income, quality of life and health. Conversations also stressed the importance of procedural elements in delivering effective adaptation, including fair disbursement, tailored policies and structures, and local ownership. In addition, they highlighted the potential for adaptation interventions to have negative outcomes. All these elements were later included in the review.

Second, we broadened the engagement by inviting global stakeholders, including Sida and FCDO, to comment on the review protocol, as posted on the Stockholm Environment Institute website and shared via climate finance networks (e.g. the Climate-L mailing list). Finally, an international advisory board that includes subject experts on climate finance, climate policy, development aid effectiveness and related areas was constituted, and its members were invited to comment on the draft protocol.

#### 3.2 Criteria for inclusion and exclusion of studies in the review

In this review, we will consider the following criteria for inclusion of relevant studies:

##### For Q1:

**Types of participants:** Set of funders included in this review: LDCF, SCCF, AF, PPCR, Sida and FCDO.

**Types of measured outcomes:** All requirements from funders that affect project design, including location(s), types of activities, size of funding, type of access, type of financial instrument, and outcome areas.

**Types of studies:** We will consider narrative information from funder-level documentation, including funder-level evaluations (see “Types of participants” above).

**Time limitation:** Funder documentation applicable for projects started after 2010.

**Languages:** English, Spanish, French.

**For Q2, Q3, Q4 and Q5:**

**Types of settings:** Any type of settings (both rural and urban) in sub-Saharan Africa including Angola, Benin, Botswana, Burundi, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, the Democratic Republic of Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, the Republic of the Congo, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

**Types of participants:** All types of participants – that is, intervention recipients. These can be national and regional governments, local communities, non-governmental organisations and similar.

**Types of interventions:** We consider an intervention as a project if it receives project-type funding and its main objective is to address climate change adaptation. There are two ways to demonstrate that a project's main objective is adaptation: (a) for multilateral climate funds, if the funder identifies the project as an adaptation project, and (b) for bilateral donors, if the funder has assigned or tagged a Rio marker for adaptation with a Score 2. The eligible multilateral climate funds are the LDCF, SCCF, AF and PPCR, and eligible bilateral donors are Sweden and United Kingdom (as for Q10). Only finalised projects are included in this review, as we want to connect financial characteristics with outcomes. Adaptation projects are included regardless of implementation scale (individual, household, community, sub-national, national and supra-national level, or a combination of these). Often different financial sources are combined in a single project; projects with combined finance sources will also be included if one of the sources is part of our set of funders. Project with all types of financial instruments, delivery mechanisms, size of funding, and administration of funding characteristics are included. Projects that are funded through non-project-type funding, and those that do not explicitly address a climate risk (droughts, floods, heat wave, sea-level rise, etc.), will not be considered.

**Types of outcome measures:** The quantitative outcome measures are changes in the level of climate change risk. These can be achieved through intermediate outcomes connected to economic, social and environmental sustainability, such as a) access to and protection of economic resources, (b) community awareness and knowledge of climate change risks, vulnerability and adaptation options, (c) national and sub-national preparedness for adaptation, and (d) the health and integrity of ecosystems (Adger et al. 2005; Brooks et al. 2011; Owen 2020). In addition, we also consider maladaptation as an unexpected or unintended increase in climate risk or vulnerability in groups or locations that were not targeted (Eriksen et al. 2011; Atteridge and Remling 2017; Juhola et al. 2016).

We will also include qualitative research findings related to perceptions of change in these outcomes or experiences about project impacts.

**Types of studies and study designs to be included**

To answer Q2, we will consider the following quantitative research designs:

- Randomised controlled trials;
- Quasi-experimental designs with non-random assignment, using methods such as naïve and statistical matching on baseline data, and double-difference analysis of data pre-test and post-test data;
- Natural experiments using methods such as regression discontinuity design to construct comparison groups, where assignment is determined at pre-test by a cut-off on an ordinal or continuous variable (White & Sabarwal, 2014);

- Designs where individuals or groups are followed over time and compared with others who are eligible for interventions at a later date; and
- Pre–post studies, which compare measured outcomes before and after an intervention (without matching), will be avoided (unless this is the only available study design).

All qualitative and mixed methods research designs (including ethnography, phenomenology, grounded theory, case studies and mixed methods studies with convergent and sequential designs) will also be considered. Quantitative descriptive studies that include open-ended questions in surveys, and studies that analyse qualitative data quantitatively, will be considered as well (see Table 1 for details).

To answer Q2, Q3 and Q4, we will consider narrative information from project design documents and evaluations of finalised adaptation projects. We will also consider qualitative research findings from any type of qualitative and mixed methods study designs.

No commentary papers or theoretical or modelling studies will be included. Studies will be included regardless of their publication status and their electronic availability. Evaluation documents of ongoing projects will not be considered.

**Languages:** Studies in English, Spanish and French languages will be considered in this review (reflecting the skill set of the review team).

**Time frame:** We will focus on the literature published after 2010 and we only include projects with implementation phases that began after 2010, the year when the Rio marker for adaptation started to be applied to financial flows (OECD 2016) and when expansion of funds dedicated to adaptation finance started (Buchner et al. 2011).

### 3.3 Search methods for identification of studies

We will use a multi-pronged search strategy, with 1) separate but linked searches to locate adaptation projects, project documentation and funder-level documentation, including funder-level evaluations; qualitative and mixed methods research to answer Q1, Q3, Q4 and Q5; and 2) quantitative research evaluating intervention impact (i.e. impact evaluations) to answer Q2.

First, our search for adaptation projects and programmes funded by multilateral sources of adaptation finance will be conducted on the websites of climate funds:

1. Least Developed Countries Fund (LDCF) and Special Climate Change Fund (SCCF) – both trust funds under the Global Environment Facility (GEF): <https://www.thegef.org>
2. Adaptation Fund (AF): <https://www.adaptation-fund.org/projects-programmes/>
3. Pilot Program for Climate Resilience (PPCR): <https://www.climateinvestmentfunds.org/projects>

We will filter out ongoing projects.

Adaptation projects information from the two bilateral donors included in this review will be retrieved from:

1. International Aid Transparency Initiative: <http://d-portal.org/ctrack.html#view=search>
2. UK Development Tracker: <https://devtracker.fcdo.gov.uk>
3. Sweden Openaid: <https://openaid.se>
4. Sida's publication database: <https://publikationer.sida.se>

To obtain a list of relevant projects, we will search on the International Aid Transparency Initiative (IATI) website and filter by the donor (Sida or FCDO), by the policy marker (adaptation as a principal objective) and by country. Contribution to IATI is voluntary, but both FCDO and Sida comply with IATI standards. FCDO publishes information on aid spending and effectiveness quarterly via IATI's d-portal and UK Development Tracker (FCDO 2018). Similarly, Sida has been reporting to IATI on its aid since 2012 (Sida 2020).

Ongoing projects and projects starting before 2010 will be filtered out. Given that only project-type funding is considered, in case of Sida-funded projects, we will filter entries by aid type as follows: Default Aid Type = "Project-type intervention" or "Contribution to specific-purpose programmes and funds managed by implementing partners" (for other funders, this filtering function is not available). In addition to their core-funded operations, international organisations, NGOs, PPPs and networks, both in provider and in third countries, set up programmes and funds with a specific sectoral, thematic or geographical focus. Donors' bilateral contributions to such programmes and funds are recorded as "Contributions to specific-purpose programmes and funds managed by implementing partners" (OECD 2021).

The resulting list of projects will then be briefly inspected to ensure that only projects tagged with a Rio marker for adaptation Score 2 are included. In the case of programmes, we will add individual adaptation projects to the project list. Once the list is completed, the UK Development Tracker and Sweden Openaid websites will be used to search for the necessary project documentation (project design, logical framework, mid-term evaluations, final evaluations and similar). Additional information will be obtained from funders and implementing agencies (e.g. the United Nations Development Programme, United Nations World Food Programme, and others) or from projects websites (where available).

For documentation about multilateral sources of funding, we will search in the following organisational websites:

1. Technical Evaluation Reference Group of the Adaptation Fund (AF-TERG): <https://www.adaptation-fund.org/about/evaluation/publications/>
2. Independent Evaluation Office (IEO) of the Global Environment Facility: <http://www.gefief.org/evaluations/all>
3. Scientific and Technical Advisory Panel (STAP): <https://www.stapgef.org/publications>
4. United Nations Framework Convention on Climate Change (UNFCCC) and Standing Committee on Finance (SCF): <https://unfccc.int>
5. Overseas Development Institute (ODI): <https://www.odi.org>
6. International Federation of Red Cross and Red Crescent Societies: <https://media.ifrc.org/ifrc/>
7. International Institute for Environment and Development (IIED): <https://www.iied.org>
8. Stockholm Environment Institute: <https://www.sei.org>
9. UN Document depository: <https://wedocs.unep.org/handle/20.500.11822/3>

We will search for any funder-level evaluations using the following terms: "fund evaluation", "portfolio evaluation", results, "global environment facility", GEF, "adaptation fund", AF, "Least Developed Countries Fund", LDCF, "Special Climate Change Fund", SCCF, "Pilot Programme for Climate Resilience", PPCR, synthesis, portfolio, monitoring, evaluation, financing, operations, adaptation and "climate change".

For the bilateral sources of funding, we will search for funder-level information on the following websites:

1. UK Independent Commission for Aid Impact (ICAI): <https://icai.independent.gov.uk>
2. The Swedish Expert Group for Aid Studies: <https://eba.se>
3. Sida's publication database: <https://publikationer.sida.se>

We will search for any portfolio evaluations using following terms: "portfolio evaluation", Sida, "Swedish development aid", "Swedish International Development Cooperation Agency", "Styrelsen för internationellt utvecklingssamarbete", FCDO, "Foreign Commonwealth and Development office", DFID, "Department for International Development", "UK aid", ICF, "International Climate Finance", synthesis, portfolio, monitoring, evaluation, "financing, operations", adaptation and "climate change".

All the searches will be performed in English, except for the websites of implementing agencies, which will be searched in English, Spanish and/or French (depending on the availability of information in different languages).

The second step is to search for impact evaluations and relevant qualitative and mixed methods research. This will include academic and grey literature, which will be gathered through searches of bibliographic databases, organisational websites and search engines.

#### **Bibliographic databases**

We will search in following databases and platforms:

1. Web of Science (WoS) Core Collections (consisting of the following indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, and ESCI)
2. 3ei Development Evidence Portal: <https://developmentevidence.3ieimpact.org>
3. EconLit: <https://www.aeaweb.org/econlit/>
4. EconPapers: <https://econpapers.repec.org>
5. RePEc/IDEAS Economics and Finance Research: <https://ideas.repec.org>
6. Networked Digital Library of Theses and Dissertations (NDLTD): <http://www.ndltd.org>
7. ProQuest: Dissertations and Theses: <https://about.proquest.com/en/dissertations/>
8. Sociological abstracts
9. International Bibliography of the Social Sciences
10. OpenGrey: <http://www.opengrey.eu>

We will use existing subscriptions from Stockholm University to access databases that do not have open access. We will search for names of the projects (including exact names and variations), funder names and specific project outcomes of interest. These searches will be restricted to articles published after 2010.

### Additional searches

Searches will also be performed in **Google Scholar**, in English, Spanish and French, for the names of the relevant projects (including abbreviations), funder names and specific project outcomes of interest. These searches will also be restricted to articles published after 2010. The first 1000 search results will be extracted as citations using Publish or Perish software (Harzing 2020) and introduced into the duplication removal and screening workflow alongside records from bibliographic databases.

Searches will be performed across a suite of relevant **organisational websites**. These searches will be particularly important for capturing grey literature on the evidence of impact. Each website will be hand-searched for relevant publications, and the list of websites may be expanded during the review process and based on the list of eligible projects. These searches will also use terms related to adaptation and finance and will be restricted to articles published after 2010. Searches will be performed in English, Spanish and French.

Table 2 provides a summary of the websites to be consulted in the review.

In addition to the sources described above, we will search for eligible literature in the bibliographies of reviews identified during the scoping stage and review process.

The results of the searches in bibliographic databases and Google Scholar will be combined, and duplicates will be removed prior to screening. A library of search results will be assembled in EPPI reviewer (Thomas et al. 2020). Literature from organisational websites and funding agencies will be screened separately before being combined with other records.

## 3.4 Description of methods used in primary research

Based on the scoping process, we anticipate that our evidence base will include narrative accounts and quantitative, qualitative and mixed methods studies, including process and impact evaluations.

## 3.5 Criteria for determination of independent findings

Multiple intervention groups will be carefully assessed to avoid double-counting or omissions of relevant groups (e.g. by using multiple treatments meta-analysis and producing separate forest plots for different comparisons in case of quantitative research). The dependency of findings will be assessed at the data, publication and within-publication levels. Sources of dependency at the data level include publications by different authors using the same data. We will endeavour to group any studies based on the same dataset under a single study. Similarly, we will group multiple publications of the same analysis (e.g. working paper versus journal article) under a single study. Dependency at the within-publication level, such as reporting of multiple outcomes, will be addressed by not including multiple findings in any single analysis, so as to not weight the dependent findings more heavily in comparison with studies reporting only single findings. Thus, for example, where multiple follow-ups are reported, cross-study meta-analysis will include a "synthetic effect", calculated as the sample-weighted average across follow-ups (as in Waddington and Snilstveit 2009). However, within-study analysis may still draw on the multiple follow-ups using time-series analysis.

Table 2. A list of organisational websites

Website name	Address
The United Nations Development Programme (UNDP) - Adaptation site	<a href="https://www.adaptation-undp.org">https://www.adaptation-undp.org</a>
The United Nations Development Programme (UNDP) - Evaluation Resources Centre (UNDP)	<a href="https://erc.undp.org">https://erc.undp.org</a>
The United Nations Environment Programme (UNEP)	<a href="https://www.unep.org/resources">https://www.unep.org/resources</a>
The United Nations Environment Programme (UNEP) - Evaluation Office	<a href="https://www.unep.org/about-un-environment/evaluation">https://www.unep.org/about-un-environment/evaluation</a>
The Global Environment Facility Independent Evaluation Office	<a href="https://www.gefio.org">https://www.gefio.org</a>
The World Bank - Projects database	<a href="https://projects.worldbank.org/en/projects-operations/projects-home">https://projects.worldbank.org/en/projects-operations/projects-home</a>
The World Bank – Documents website	<a href="https://documents.worldbank.org/en/publication/documents-reports">https://documents.worldbank.org/en/publication/documents-reports</a>
African Development Bank – Projects database	<a href="https://projectsportal.afdb.org">https://projectsportal.afdb.org</a>
African Development Bank – Documents website	<a href="https://www.afdb.org/en/documents/publications">https://www.afdb.org/en/documents/publications</a>
International Fund for Agricultural Development (IFAD) – Climate and environment website	<a href="https://www.ifad.org/en/climate-and-environment">https://www.ifad.org/en/climate-and-environment</a>
International Finance Corporation (IFC) - Projects and documents website	<a href="https://disclosures.ifc.org">https://disclosures.ifc.org</a>
Climate Investment Funds (CIFs) – Knowledge Centre website (for PPCR)	<a href="https://www.climateinvestmentfunds.org/knowledge-center">https://www.climateinvestmentfunds.org/knowledge-center</a>
Overseas Development Institute (ODI)	<a href="https://www.odi.org">https://www.odi.org</a>
Oxfam International	<a href="https://policy-practice.oxfam.org.uk/our-work/climate-change">https://policy-practice.oxfam.org.uk/our-work/climate-change</a>
CARE International – Climate Change & Resilience Information Centre	<a href="https://careclimatechange.org">https://careclimatechange.org</a>
International Federation of Red Cross and Red Crescent Societies – Climate Centre	<a href="https://www.climatecentre.org">https://www.climatecentre.org</a>
ActionAid International	<a href="https://www.actionaid.org.uk/our-work/policy-and-research/research-and-policy-publications">https://www.actionaid.org.uk/our-work/policy-and-research/research-and-policy-publications</a>
International Institute for Environment and Development (IIED)	<a href="https://pubs.iied.org/theme/climate-change">https://pubs.iied.org/theme/climate-change</a>
United Nations university (UNU) – Institute for Environment and Human Security	<a href="http://collections.unu.edu/community/UNU:1882">http://collections.unu.edu/community/UNU:1882</a>
Stockholm Environment Institute	<a href="https://www.sei.org">https://www.sei.org</a>
Africa Adapt	<a href="http://www.africa-adapt.net/en-us/">http://www.africa-adapt.net/en-us/</a>
Research and Communication on Foreign Aid (ReCom)	<a href="http://recom.wider.unu.edu">http://recom.wider.unu.edu</a>
Climate Policy Initiative	<a href="http://www.climatepolicyinitiative.org">www.climatepolicyinitiative.org</a>
WeAdapt	<a href="https://www.weadapt.org">https://www.weadapt.org</a>
World Vision International	<a href="http://www.wvi.org">http://www.wvi.org</a>
Sida's publication database	<a href="https://publikationer.sida.se">https://publikationer.sida.se</a>
FCDO – Evaluations collection website	<a href="https://www.gov.uk/government/collections/evaluations-completed-april-2017-to-march-2018--2">https://www.gov.uk/government/collections/evaluations-completed-april-2017-to-march-2018--2</a>
FCDO – Research for development outputs website	<a href="https://www.gov.uk/research-for-development-outputs">https://www.gov.uk/research-for-development-outputs</a>

### 3.6 Selection of studies

The selection of the studies will be twofold. After the process of obtaining a list of relevant projects (including pre-screening of related project documentation), described in section 3.3, is completed, we will collate project documentation. Each document will be screened for eligibility at full text.

Screening for qualitative research and impact evaluations will be conducted at two levels: at the title and abstract level (conducted together for efficiency), and at full-text level. Where abstracts are not available (e.g. reports), we will screen titles only. The full texts will be retrieved (we will track full texts that cannot be located or accessed). Retrieved records will then be screened at full text.

Prior to commencing screening, consistency checking will be performed on a subset of articles (10%) at both the title and abstract level and through full-text level screening. A subset of title and abstract records and full texts will be independently screened by three reviewers. The results of the consistency checking will then be compared between reviewers, and all disagreements will be discussed in detail. Where the level of agreement is low (below about 80% agreement), further consistency checking will be performed on an additional set of articles and then discussed. Following consistency checking (i.e. when agreement is above 80%), records will be screened by one experienced reviewer (and on the same set of records to avoid errors in screening).

The EPPI reviewer's machine learning-assisted classifier function will be used to increase the efficiency of the screening process. The training set for this exercise will be prepared from the records that were screened by at least two reviewers.

### 3.7 Data extraction and management

From the impact evaluations, we will extract data and meta-data following ToC components, including bibliographic information; study aims and design, including location, data collection method, sample size and analytic approach; critical appraisal, details about intervention and implementation context; population details; outcomes and study findings (the outcome means and measures of variation, or first- and second-order constructs, descriptive researcher themes and researcher interpretations). This list will be expanded during the review process.

From qualitative and qualitative parts of mixed methods research, we will code perceived impacts and experiences about impacts, including the views of project beneficiaries, implementation officers, local authorities and non-targeted but affected populations. The coding will be based on the ToC, which will be expanded to account for new discoveries during the coding process (see section 3.14).

From funder-level evaluations, we will extract textual accounts (following the ToC), including funding requirements affecting project design, location(s), types of activities, size of funding, type of financial instrument, and outcomes.

From project design documents and evaluations, we will extract project activities related to adaptation, description of participants (selection procedures, etc.) as well as characteristics of implementation context, such as adaptation finance delivery mechanism and type of administration of funds.

Given that the unit of analysis is a project, all data relating to a single project will be consolidated into a single entry (and all duplications will be removed). We will carefully record all the different literature sources for each type of information collected for the project. This will be done to retain the replicability and repeatability of the data coding and extraction process. A draft coding scheme can be found in the supplementary material.

Prior to starting with coding and data extraction, and to assure the repeatability of the data extraction and coding process, consistency checking exercise will be performed on a subset of different types of records (up to 10%) independently extracted by all reviewers. All disagreements will be discussed among reviewers, and the coding scheme will be clarified if needed.

### **3.8 Assessment of risk of bias in included studies and quality appraisal**

Eligible studies will be subject to quality appraisal (and quantitative studies will be assessed for risk of bias). We will use existing and validated tools for this exercise, such as the Mixed Methods Appraisal Tool (MMAT). MMAT enables the appraisal of qualitative research, randomised controlled trials, non-randomised studies, quantitative descriptive studies and mixed methods studies (Hong et al. 2018). We will also adapt principles from the Template for Intervention Description and Replication (TIDieR) checklist and guide for evaluation of interventions (Hoffmann et al. 2014).

Prior to starting with this stage, appraisal tools will be tested on a subset of records (up to 10%) with different study designs independently assessed by all reviewers. All disagreements will be discussed among the team, and assessment criteria will be clarified if needed. All the studies will be appraised by at least two reviewers.

### **3.9 Measures of treatment effect**

For quantitative data, given the expected differences in outcome reporting (scale, data type), we may use the standardised mean difference (SMD) to compare the results of continuous measures, and the odds ratio (OR) for binary measures.

### **3.10 Unit of analysis issues**

Each article and each study will be assigned a unique ID. In case of multi-arm studies, only intervention and control groups that meet eligibility criteria will be included, and related relevant outcome data will be extracted.

### **3.11 Dealing with missing data**

The authors of the original studies will be contacted for any missing information (if correspondence details are valid and available). For quantitative studies, where information is not available on standard deviations, appropriate methods will be used to derive effect sizes from reported information such as t-statistics (Borenstein, Hedges, Higgins, & Rothstein, 2009).

### **3.12 Assessment of heterogeneity**

For quantitative data (if there is a sufficient number of studies with sufficiently large sample sizes), forest plots will be inspected visually to see the overlap in the confidence intervals for outcome data.  $I^2$  statistic will be calculated to quantify relative heterogeneity across studies (recognising that this statistic produces uncertain assessment of heterogeneity in cases where a number of studies is low (von Hippel, 2015)).  $\tau^2$  will be calculated as a measure of absolute heterogeneity.

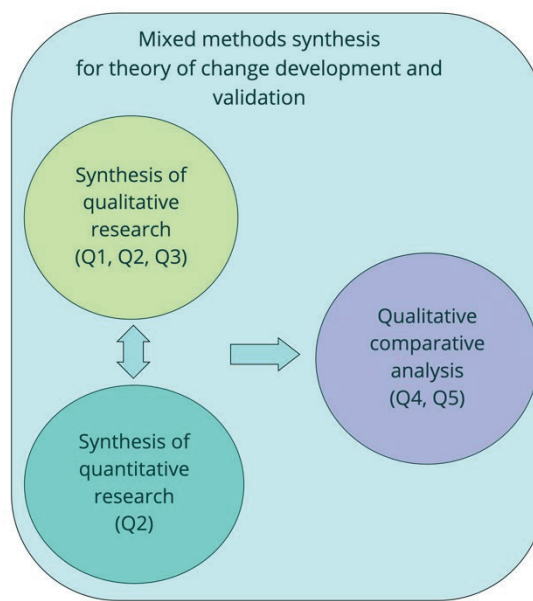
### **3.13 Assessment of reporting biases**

To assess the risk of reporting bias in quantitative research findings, the funnel plots will be inspected visually, and Egger's test will be performed on quantitative data. Explicit assessment of reporting bias for qualitative research findings will not be done. To minimise the risk of reporting bias, we are conducting extensive searches of both academic and grey literature.

### 3.14 Data synthesis

We will conduct a mixed methods evidence synthesis (Heyvaert et al. 2017) with a combination of a parallel and sequential design (Hong et al. 2017), where theory built in the first stage will be tested in the second stage of the review process (Figure 3). For each of the synthesis stages, we will use different approaches linked to each review question, as detailed below (and initially summarised in Table 1).

Figure 3. A diagram representing sequence of different synthesis stages



To answer **Q2** and in a scenario where enough quantitative impact evaluation studies report similar types of quantitative outcomes, we may perform a meta-analysis, where effect sizes will be calculated and weighted appropriately to summarise the impact of the intervention. In other words, we will test whether any observed differences in the outcomes might be associated with an adaptation project (intervention). Given that we expect differences (in the scale and type of data) in outcome reporting, in order to compare the results of continuous measures, we may use standardised mean difference, and odds ratios for binary measures. Qualitative research findings including perceived impact and experiences will be synthesised using framework synthesis, as detailed below.

Concurrently, to answer **Q1 and Q3 and for qualitative research findings pertinent to Q2**, we will apply a framework synthesis, using the ToC as the initial framework (Brunton et al. 2015; Brunton et al. 2020; Macura et al. 2019), to qualitative research as well as to the qualitative parts of mixed methods research, including evaluations of projects or funding sources, process evaluations and research studies.

Framework synthesis is a method for organising and synthesising diverse types of evidence and studying complex interventions (Kneale et al. 2018). It will be used for three purposes: 1) to understand implementation differences between projects funded by multilateral and bilateral funders (**Q1**) by comparing how projects are being executed, including their objectives, expected outcomes, priority countries or regions, types of beneficiaries, types of financial instruments and other characteristics that can affect project design; 2) to synthesise perceptions about the impact (**Q2**); and 3) to expand the hypothesised programme ToC (see Figure 1) with new understandings about the links between intervention (design), financial and other implementation context, and outcomes (**Q3**).

These objectives will be accomplished following six stages: 1) familiarisation with the data; 2) framework creation; 3) indexing of data according to a framework; 4) charting or rearranging the data according to the framework and framework modifications; 5) mapping and 6) interpretation. The *familiarisation* and *framework creation* stages were completed during the protocol drafting process. In the *indexing* stage, the review team will perform searches, screening, data extraction (informed by the draft ToC and as described in the previous sections of this protocol) and identify main characteristics of relevant studies. In the charting stage, characterised studies will be further grouped into categories, and themes will be derived from the data. At the *mapping* stage, derived themes will be considered in light of the original research question, and we will investigate how derived themes relate to one another and to the ToC that can be expanded with new themes at this stage. At the *interpretation* stage, derived themes will be considered in the light of the wider research literature. Compiled effect modifiers during the framework synthesis process will be added to the ToC and later used for exploring the heterogeneity among studies. In the event that considerable differences are found in causal pathways, we will produce separate ToCs for each outcome.

Subsequently, and to answer Q4 and Q5, we will test the links from the (now adjusted and/or expanded) ToC and explore heterogeneity among studies using qualitative comparative analysis (QCA) and/or meta-regression. In the context of this review, QCA will be used to examine the complexity and identify or test links between interventions and their context that may be associated with or trigger a successful outcome (Kahwati et al. 2016; Kneale et al. 2018; Thomas et al. 2014). Conditions or configurations of, for instance, intervention and contextual characteristics, are the units of analysis during this review stage. Different sets of configurations or conditions will be sourced from the primary studies and during the indexing and mapping stage of the framework synthesis. Any identified condition will be reformulated into a hypothesis that can be tested. For example, a condition for reducing vulnerability to climate change could be that direct access to funding (a delivery mechanism) might lead to a reduction of vulnerability. A question to be tested could be: Does the direct access to funding (=condition) increase the likelihood of vulnerability reduction (=outcome)?

Similarly, and in a scenario where enough studies report similar types of quantitative outcomes, meta-regression could be performed to explore the heterogeneity. The moderators for this analysis will be sourced from the ToC, as amended and/or expanded during the framework synthesis stage.

The final report will include refined ToCs (for each outcome or type of intervention) and a description of how interventions contribute to or result in a change in specific outcomes, an overview of implementation differences between projects funded by multilateral funds and the two bilateral donors, insights on how finance and other contextual factors may modify the adaptation outcomes, a description of the strength of the evidence, an assessment of possible knowledge gaps (that may constitute priority topics for primary research), and a discussion of the policy and practice implications of the review findings, including lessons learnt from evaluation of (adaptation) effectiveness. The synthesis will be disaggregated by FCDO and Sida priority countries.

### 3.15 Sensitivity analysis

A sensitivity analysis will be performed on both the qualitative and quantitative findings during the synthesis stage to understand whether the results of the synthesis depend on the methodological rigour and susceptibility to bias of the included studies, and which review findings are based on studies with lower methodological rigour (and quality). If there are sufficient data, we will run separate meta-analyses for randomised controlled trials and quasi-experimental studies. These two types of studies can be later combined into one meta-analysis, and the results of these two analyses will be compared.

### 3.16 Subgroup analysis and investigation of heterogeneity

Heterogeneity will be analysed using sub-group analysis. We will explore differential effects in terms of gender and vulnerable groups. For qualitative findings, and to account for systematic differences in population and interventions, we will conduct a synthesis of findings within similar types of populations and interventions, after which we will compare across different groups (see also section 3.12). The study will also investigate heterogeneity in integrated synthesis using QCA.

### 3.17 Treatment of qualitative research

As described above, qualitative and mixed methods research will be incorporated to answer review questions 1, 3, 4 and 5.

## Declarations

### Funding

This review project was funded by the UK Centre of Excellence for Development Impact and Learning and co-funded by the Stockholm Environment Institute. In March 2021, The Centre of Excellence for Development Impact and Learning subsequently suspended its funding. As a result, the review will not be completed as described in this paper. The protocol developed for the review is presented here so that it may inform other future work.

### Conflict of interest

The authors declare no conflict of interest. Reviewers will be prevented from taking part in inclusion decisions or validity assessment of articles they authored.

### Authors' contributions

BM and NC wrote the protocol with IB and RT. BM led the writing of the methodological sections, and NC led the writing of subject-related sections. NC and IB designed the theory of change and the effectiveness framework. RT, RK and FV helped with the writing of the background section. All authors edited and commented on previous versions of the protocol and approved the final version.

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