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Effectiveness of Forest Conservation Interventions: An Evidence Gap Map

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About this Learning Paper

This paper presents an evidence gap map of forest conservation interventions in low- and middle-income countries, based on evidence published over the period 2016 to mid-2018. It serves as an update to a similar effort by the International Initiative for Impact Evaluation (3ie), with refinements to the framework through the distribution of studies across three tiers based on quality, while also considering environmental and socioeconomic outcomes.

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Abstract

This paper presents an evidence gap map of forest conservation interventions in low- and middle-income countries based on evidence published over the period 2016 to mid-2018. It serves as an update to a similar effort by 3ie, with refinements to the framework that distributes studies across three tiers based on quality and considers environmental and socioeconomic outcomes. Compared to the previous evidence gap map, the evaluation of forest conservation outcomes has clearly accelerated in recent years, but from a modest base: the body of evidence still remains insufficient across most intervention types. Community-based management (especially in South Asia) and protected areas are well represented, though the latter distinguishes few subcategories. In turn, both PES and REDD+ evaluations are less available, and the latter surprisingly features more welfare than forest conservation or carbon impacts. Capacity-building interventions are almost absent in the matrix. It is also notable that policy mixes, often dominant in real-world implementation, have so far received little scrutiny. Among forest types, conservation interventions in mangroves lag behind, despite their environmental importance. Geographically, Asia and Latin America generally publish much more evaluated evidence than Africa. In conclusion, despite the incipient progress we have undoubtedly seen, many important knowledge gaps still remain.

ABBREVIATIONS

3ie	International Initiative for Impact Evaluation
CIF	Climate Investment Funds
CIFOR	Center for International Forestry Research
EGM	Evidence gap map
FAO	Food and Agriculture Organization of the United Nations
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse gas
ICDP	Integrated conservation and development project
IEU	Independent Evaluation Unit
IUCN	International Union for Conservation of Nature
PA	Protected area
PES	Payments for environmental services
PICO	Population, Intervention, Comparator and Outcome
REDD+	Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme

EXECUTIVE SUMMARY

This report updates a previous study by the International Initiative for Impact Evaluation (3ie) that presented an evidence gap map (EGM) of forest conservation interventions. It includes peer-reviewed articles published during the period 1 January 2016 to 31 August 2018, collected via the Scopus and Web of Science databases. It was prepared for the Independent Evaluation Unit (IEU) of the Green Climate Fund (GCF) and aims to provide an overview of the effectiveness of different forest conservation interventions. The GCF aims to support forest and land-use projects that have the potential to reduce greenhouse gas (GHG) emissions in the framework of REDD+. A mapping of the availability of impact evaluations and their assessments of the effectiveness of different types of conservation interventions is critical to supporting the evidence-based decision-making of the GCF and other organizations that invest in forest-based climate change initiatives, such as the UN-REDD Programme, the Climate Investment Funds, the United Nations Environment Programme and the Global Environment Facility.

We used a Population, Intervention, Comparator and Outcome (PICO) framework to define our scope, clarify various categories of interventions to be considered, identify eligible comparators/counterfactuals, and choose outcomes of relevance for this study. Special care was given to the definition of intervention types. In particular, we made sure that overlaps between categories were minimized in order to avoid double counting or miscounting, and we constructed mutually exclusive categorical classifications. We also used subcategories to disaggregate broad categories into smaller homogeneous groups of interventions. The categories were constructed to also consider the policy environment surrounding REDD+ interventions and the types of decisions that policymakers have to make. The classification of interventions is presented in Table 1.

Table 1 Intervention categories for forest conservation measures

BROAD CATEGORIES	EXPLANATION & SUBCATEGORIES
Conditional incentives, such as payments for environmental services (PES)	Private and non-governmental organization interventions such as Coasean agreements ("user-financed PES") Subsidy programmes established by broader public sector institutions or user representatives, often tax financed ("government-financed PES")
Protected areas (PA)	Various categories as defined by the International Union for Conservation of Nature (IUCN), based on the degree of protection/tolerance of human presence and activities within its borders
Locally based conservation	Conservation measures that rely on local sustainable practices, e.g. community-based forest management
Intragovernmental deforestation-curbing regulations and incentives	Transfers from central to local government based on conservation performance (e.g. the Brazilian ecological value added tax [ICMS-Ecológico]) Interventions such as a central government publicly exposing high-deforesting municipalities ("blacklisting") and taking punitive measures
Product-market-based conservation	Environmental certification, with consumer-financed sustainability premiums (for forest products, such as the Forest Stewardship Council for timber, or for crops, such as the Roundtable on Sustainable Palm Oil) Moratorium (barring non-sustainable providers in the value chain) Zero-deforestation commitments (reaping publicity gains for consumer recognition of sustainability)
Indirect conservation based on improved technologies and/or substitution effects	Interventions to increase agricultural yields Improved cooking stoves Plantations with clear conservation purposes (e.g. for fuelwood supplies) Agroforestry with clear conservation purposes
Indirect conservation based on enabling conditions	Environmental education/awareness building Capacity-building Improvements in the rule of law Integrated conservation and development projects
Land tenure reforms	Land tenure reforms that include conservation objectives, such as indigenous/local land demarcation and tenure enforcement processes
Land swaps	Changes in land designation (e.g. moving a concession from a High Conservation Value area to a degraded area or an area without forest cover)

This EGM extends the previous one in several ways. First, the PICO framework led to a slightly different choice of search terms and inclusion/exclusion criteria. We collected 2,500 references and selected 257 articles after screening abstracts and titles. An additional round of screening of the full texts led to our final sample of 120 articles that contained 164 relevant evaluation cases (articles could contain more than one evaluation case). In this update, we recognized the importance of including studies with other methodologies, so as to provide information on the context and the overall theory of change. Consequently, we distributed studies across three tiers based on evaluation methods: Tier 1 category studies used experimental and quasi-experimental methods to understand causal and attributable impact (50 studies); Tier 2 category studies used non-experimental methods (28 studies) but had comparators; and Tier 3 category studies were those without clearly defined comparators or those where conclusions were not logically derived from data and results but provided valuable qualitative context for forestry-related actions and outcomes (86 studies).

As with all EGMs, two types of driving forces, or "biases" behind the results need to be recognized: biases in implementation of programmes and projects on the ground; and biases in producing evidence around these. First, not all forest conservation interventions are implemented to a similar extent. For instance, protected areas have clearly been the most important forest conservation intervention for more than 150 years; hence, we should expect them to be heavily represented in the available assessments of programmes. In contrast, payments for environmental services (PES) have only become popular over the last three decades, and private sector zero-deforestation commitments have only been used over the past couple of years. These differences in implementation track record and popularity, together with other intervention-specific inertia and limitations, are all inevitably reflected in an EGM. In other words, a diversity of programmes and strategies for forest conservation exists, but the evidence available regarding their effectiveness will depend on the extent to which interventions have been implemented worldwide.

The second bias refers to research and evaluation. Scientific analysis and publication of evidence/assessments are focused disproportionally on specific types of interventions, which may reflect the biases of researchers, evaluators and their funders. For instance, some methods are more likely to be published and are also much more suited to examining certain types of interventions. Researchers also often cluster in geographical areas of particular interest or debate, whereas they deliberately avoid other areas (e.g. areas of armed conflict). This bias is likely to run contrary to the implementation bias described first: donors and/or researchers are likely to be more curious and interested in studying "new" and seemingly promising instruments (such as PES) than those already known for many years (such as integrated conservation and development projects [ICDPs]). "Absence of evidence" thus does not necessarily equal "evidence of absence". Additionally, new terms are often coined for similar interventions – for example, ICDPs being rebranded as "landscape approach" interventions. It is worthwhile to keep these challenges in mind when we turn to interpret our results.

Our new and updated EGM builds on the previous iteration, but refines the framework, adopting slightly modified approaches. In addition to its coverage of a subsequent period (2016–2018 versus 1990–2015), the categories of interventions were modified in order to minimize the risk of overlapping (e.g. international policies could translate into local or national PES schemes, but these were two distinct categories in the previous study) and to explicitly refer to some new, prominent intervention types (e.g. zero-deforestation commitments).

In this EGM update, we evaluated multiple environmental and socioeconomic outcomes of forest conservation interventions. These included forest cover, biodiversity, GHG emissions, livelihoods and employment. We also evaluated "leakage" (forest loss occurring outside of the area covered by the intervention) and cost-effectiveness of interventions. Additionally, we kept track of studies that targeted multiple outcomes, so as to document trade-offs or win–win interventions.

Summary of key findings

Geographical distribution: Our EGM only includes studies from low- and middle-income countries. Within these, Asia and Latin America are regions with good availability of evidence; Africa lags far behind. Among countries, India and Nepal exhibit disproportionately high representation, with an abundance of research in social sciences and into the countries' burgeoning programmes centred around community-based management. Unsurprisingly, large forest countries such as Brazil, Indonesia, Mexico, Ecuador and Peru are also well represented in the EGM. Central African countries are arguably underrepresented, despite the fact that they contain the world's second-largest area of tropical forests. Evidence in Africa in general is also underrepresented research-wise, given that many forest conservation programmes have been implemented in this region.

Distribution of interventions: The distribution of intervention types in the EGM is highly uneven: protected areas are well studied, followed to a lesser degree by conservation projects based on management by local communities (e.g. community-based forest management). PES evaluations are less available, despite their high visibility in conservation debates. It is worth noting, especially from the perspective of informing decisions with robust evidence, that Tier 1 category studies cover other intervention categories, such as conservation based on product markets (mostly certification: seven studies), or tenure reforms (e.g. securing land titles for local people: also seven studies). Last, other presumably important interventions that aim to pave the way for conservation, such as capacity-building or improving technologies to reduce the pressure on standing forests (e.g. more efficient cooking stoves) are surprisingly almost absent from the map update. This could also depend on our search criteria and to what extent the related studies explicitly mentioned conservation as their primary objective. However, this is also true for the previous map (1990–2015), and we conclude that no efforts have been made towards reducing this evidence gap in the interim. Considering the importance given to awareness-raising and capacity-building in this programmatic area, this is a critical absence of evidence.

Distribution of outcomes: Unsurprisingly, the majority of Tier 1 and 2 studies evaluate forest-cover impacts. Livelihood outcomes are less well covered. Only four studies deal with both environmental and social outcomes at the same time. We therefore have very limited evidence that investigates potential trade-offs. The relative absence of biodiversity as a measured outcome is also noteworthy, yet might be explained by the difficulty of assessing impacts. Another critical gap is the lack of evidence on cost-effectiveness, which is needed to help support resource allocation decisions. This result is likely due to the fact that data on costs of interventions are often not readily available.

Distribution of outcomes across intervention types: The framework that cross-tabulates outcomes with interventions for all studies in Tiers 1 and 2 triggers a striking observation: empty cells are prominent in the matrix – that is, there is a lack of evidence for a majority of interventions and a majority of outcomes. Specifically, protected areas and community-based forest management, in particular, have been evaluated for most outcome types. For protected areas, this is notably matched by a

huge body of interventions. Shedding light on the efficiency of different subtypes (e.g. strict protected areas versus those that tolerate the presence of certain human activities) may eventually constitute a knowledge-gap filling of higher priority than filling in blank spots for very seldom-used conservation tools. Despite the relatively high number of studies overall in Tiers 1 and 2, when the two dimensions of outcomes and interventions are combined, the body of evidence remains insufficient across most intervention types to cover most aspects of interest.

Some intervention categories lack evidence because they seem to be infrequently implemented in practice. These include, for example, fiscal transfers from central to local governments based on conservation performance, or even "land swaps" (e.g. moving concessions from forested to degraded areas) – an idea that arguably looks good on paper but meets considerable challenges in its operationalization. The absence of other categories that are considered to be promising and already implemented on a reasonable scale is more surprising. In particular, the innovative Brazilian initiative to blacklist high-deforesting municipalities was shown to considerably reduce deforestation (Cisneros et al., 2015) but fell outside the time scope of our EGM update.

REDD+ interventions: A prominent set of interventions are those that aim to explicitly achieve forest-based climate change mitigation, denominated as "REDD+". REDD+ is an umbrella term for spatially specific forest conservation strategies that tend to apply mixes of functionally different interventions. These policy mixes often feature ICDPs, protected areas, direct incentives (such as PES) as well as enabling measures (such as land tenure reform). Somewhat surprisingly, both the carbon and forest-cover outcomes of REDD+ interventions have been less studied than their human well-being aspects (see also Duchelle et al., 2018), thus running counter to the trend in our full sample. For this and the previous EGM, it remains clear that REDD+ interventions are relatively unexamined, and the extent to which they achieve forest-based climate change mitigation is unknown. The focus on well-being outcomes may be due to the pronounced interest in REDD+ social safeguards, but could also be due to the difficulty of tracing REDD+ land-use impacts back to single well-defined interventions.

Other aspects: With respect to ecosystem types, natural forests are addressed in almost all studies, whereas mangroves, for example, are not represented in the map – perhaps because of their smaller area and lesser attention in the media compared to rainforests. Notably, among Tier 1 and Tier 2 studies, interventions implemented by local communities are addressed more frequently than private company interventions. Indeed, with the rapid emergence of a variety of private commitments (zero-deforestation supply chains, certification) and incentive-based approaches (some private sector-led PES), one would expect private sector-led forest conservation interventions to get more attention. One explanation for this underrepresentation, which might prove only temporary, is that access to private sector data may be more difficult than for other sectors, especially when related to supply chains that remain relatively opaque.

Focus on Tier 1 (experimental and quasi-experimental studies): When considering only robust studies classified as Tier 1, which are considered the core of EGMs according to the principles behind the 3ie report, we get similar results: protected areas are by far the most evaluated intervention from a forest-cover outcome perspective. These are followed by community-based management, PES and tenure reforms, although with a quickly declining intensity of evaluation. Conversely, there is a lack of evidence on outcomes such as livelihoods, biodiversity and leakage. Although livelihood impacts are evaluated in slightly more studies than the other two outcomes (and also much more in

the previous 3ie study – see the consolidated heat map in Annex 3), their distribution does not reveal a clear pattern, as they are often secondary objectives of conservation interventions. Notably, environmental and social trade-offs associated with interventions have not been well explored.

As for a quick assessment of the direction of the evaluated impacts, our synthesis suggests the following:

- Protected areas often have positive forest conservation impacts.
- Livelihood outcomes are often numerically small, of mixed direction or ambiguous.
- Leakage is evaluated in only two cases, arguably reflecting insufficient attention to impacts at larger spatial scales.

In sum, among the 120 publications we reviewed, containing 164 evaluation cases, 77 articles (corresponding to 97 cases) used the most rigorous methods (Tiers 1 and 2). Considering these were published in a three-and-a-half-year period, this marks an accelerating interest in the evaluation of conservation outcomes, as compared to the previous EGM exercise. The distribution of evaluated outcomes on instruments in our EGM is as follows: protected areas 49; community-based conservation 15; PES 13; product-market-based conservation 10; tenure reform 10; indirect enabling tools 5; technology-related tools 1; and others 3.

Overall, our findings reinforce those from the previous 3ie report in many ways, including by demonstrating major gaps in evidence for a significant number of interventions, a large representation of studies on protected areas and community-based forest management, the focus on forest cover as the evaluated outcome, and the relatively low representation of studies from Africa.

Summary of key recommendations

The full recommendations emerging from our findings stated in Results, section Chapter IV.

A summary follows:

- Main donors in the field of conservation need information in a format that enables evidence to move from the sphere of science to the world of policy.
- Conversely, better coordination is required between donors and researchers, if only to reduce biases in site and intervention selection, and hence reduce gaps as shown by the EGM.
- Cause-to-effect relationships should be better analysed once evidence of impacts is processed.
- The degree of impacts, and cost-effectiveness as its corollary, should be better measured (all interventions were said to have positive environmental impacts but likely differ much in degree).
- Prominent categories such as protected areas could be further split into subtypes in order to identify the characteristics that determine greater impacts.
- Leakage deserves more attention, to evaluate impacts at a landscape level.
- A subdivision of the dominating protected area category into different protected area types would be recommendable for future work.
- When assessing the desirability of conducting future systematic reviews on specific conservation instruments, this should be guided by the availability of a critical mass of primary case evaluations (see above), as well as by the quantity and quality of previously completed systematic reviews. While assessing the latter goes beyond the scope of this work, it seems obvious that some instruments are fairly saturated (e.g. two systematic PES reviews were performed

within the last five years). Looking at the outcomes for different protected-area categories may be advantageous, as it could also be for the recently very popular product-based conservation instruments, once a critical mass of primary studies has been reached, probably within the next couple of years.

- Special interest exists naturally in the outcomes of the hundreds of local REDD+ projects that have been implemented over the last decade. Nevertheless, we would be hesitant to recommend a systematic review of REDD+ projects, for two reasons. First, for many of these projects, REDD+ primarily represents a funding label, covering a functionally very heterogeneous mix of on-the-ground interventions. Second, surprisingly few REDD+ projects have been evaluated for their forest conservation impacts (Duchelle et al., 2008): primary empirical evidence may be too scarce for a meaningful systematic review.
- Similar to REDD+, evaluations of other applied conservation policy mixes also remain very scarce, constituting a glaring gap of evidence. This is unfortunate, given that most real-world situations are best described by simultaneous, overlapping use of different conservation tools at the same sites. Recent methodological advances in how to conduct such complex evaluations are encouraging (Sims and Alix-Garcia, 2017).
- As for other gaps described in this EGM, conservation donors can play an important role here in encouraging or requiring implementers to prepare early for rigorous impact evaluations, including the gathering of data for this purpose. Essentially, this is what would be most urgently needed to help the conservation community fill important knowledge gaps.

Chapter I. INTRODUCTION

About a third of the world's land area, around 4 billion hectares, is covered with forests. Forests are home to the vast majority of terrestrial species, particularly due to the high biodiversity in the large tracts of tropical forests located in the Congo Basin, the Amazon Basin and South-East Asia. Forests also play a major role in climate change mitigation (Griscom et al., 2017) and the regulation of rainfall and global freshwater cycles (Ellison et al., 2017). Natural forests and wildlands also provide, on average, 28 per cent of total household income in communities in and around forests – nearly as much as agricultural crops (Angelsen et al., 2014). However, the future of forests is under threat, mostly due to commodity-driven deforestation. Most agricultural expansion is now taking place in forested areas of the developing and emerging worlds; the land is being converted on a large scale to meet food-, energy- and fibre-related needs (Curtis et al., 2018).

Reduction of deforestation and forest degradation can be achieved in many ways, and diverse policies and programmes have been tested across the tropics (Angelsen et al., 2018). The case of protected areas represents a multifaceted tool that has been applied on a very large scale with varying degrees of protection. Integrated conservation and development projects (ICDPs) have also been a favoured approach for many donors, due to their alleged capacity to deal with problematic trade-offs by providing lasting solutions of productive change. Market-based approaches and payments for environmental services (PES) have attracted much attention for their focus on agents' self-interests that can be made compatible with conservation purposes. In a similar vein, the private sector has signed zero-deforestation commitments under the threat of boycott campaigns and risks of reputational damage. Briefly, these interventions may be summarized into three main categories: command-and-control/disincentives (e.g. protected areas), incentives (e.g. PES) and enabling measures (e.g. capacity-building).

It is clear, however, that the creativity used to design conservation policies and programmes has not been matched by thorough efforts to evaluate their capacity to deliver impacts (Börner et al., 2016). Any such attempt should preferably be based on the application of scientific methods – ideally, experimental methods where many sources of bias are controlled for. That said, other methods such as descriptive research with case studies may also yield essential information about local contexts and challenges. Whatever the methods used for the evaluation of outcomes, a robust definition of the interventions is required. However, conservation interventions commonly combine elements in "intervention/policy mixes" that make them hybrid across categories, and thus harder to evaluate (e.g. PES implemented inside a protected area, or capacity-building as part of an incentive mechanism). For this reason, we devote special attention to the definition of categories of interventions, which is a first and necessary step towards an assessment of existing evidence of what works and what does not. We subsequently discuss the gaps that we believe remain to be filled.

In 2016, the International Initiative for Impact Evaluation (3ie) published an evidence gap map (EGM) of forest conservation interventions to identify existing and missing evidence of the relationship between given intervention types and their outcomes and impacts on the ground (Puri, Nath, Bhatia, & Glew, 2016). Our current study continues that work, and is supported by the Independent Evaluation Unit (IEU) of the Green Climate Fund (GCF) and the Center for International Forestry Research (CIFOR). The GCF aims to support forest and land-use projects that have the potential to reduce greenhouse gas (GHG) emissions within the framework of REDD+, towards achieving the GCF vision of

paradigm shift/transformational change. This strategy involves a diversity of interventions that go beyond the forest sector to promote conservation and sustainable management in the landscape. Therefore, an assessment of the effectiveness of different types of conservation interventions is critical to help support evidence-based decision-making by the GCF and other organizations that invest in forest-based climate change initiatives, such as the UN-REDD Programme, the Climate Investment Funds (CIF), the United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF).

The present study updates the earlier 3ie report in order to integrate recent references from early 2016 to mid-2018. It goes beyond the original EGM by using a more refined analytical framework and search protocol. Specifically, we revised the original EGM classification of conservation instruments and outcomes categories, as presented in Table 2. In doing so, our rationale was to disaggregate categories to avoid overlaps to the extent possible and to take into consideration the types of policy choices and contexts that decision makers often have to deal with. Therefore, we did not consider the level of application for interventions (e.g. international funding versus local implementation) and did not use a REDD+ category because it does not determine the very nature of the interventions: indeed, as mentioned earlier, all intervention types are eligible under the umbrella term REDD+ in one way or another. Our slightly different approach can be seen as complementary to the 3ie EGM report, as it provides another perspective using a much more limited period of time (2.5 years). We also aim to go one step further by reporting on the direction of outcomes (positive versus negative) for those studies identified as rigorous in our quality assessment.

Using the revised framework, we also integrated results from the previous report. We mapped its references against our own categories of interventions and outcomes and used our eligibility criteria to make sure that both samples were comparable. Integrated results for the entire period (1990–2018) are presented in Annex 3.

The previous report uses intervention categories that refer to either nature (e.g. market versus governance mechanisms) or the objectives/institutional setting (climate policies) of the intervention. While an interesting split in its own right, we believe there is a risk of overlap, with some interventions potentially ending up in more than one category and, conversely, interventions that cannot be unambiguously allocated to a single category. Similarly, the categories of outcomes (environmental, social, behavioural change) may also refer simultaneously to different levels: for instance, impacts on behavioural change would typically translate into impacts on forest cover, so distinguishing between them might be tricky. An overview of the selections we made in our conceptual framework, from the previous report to the new EGM study, is presented in Table 2.

Table 2 Differences in intervention and outcomes categories between the 2016 and 2018 evidence gap maps

THEME	3IE CATEGORY	CATEGORY IN THE CURRENT STUDY WITH JUSTIFICATION AS NEEDED
Interventions		
Capacity-building	Education and awareness campaigns	"Education and awareness campaigns"
	Training communities	"Capacity-building" under the broad category "Indirect conservation based on enabling conditions"

THEME	3IE CATEGORY	CATEGORY IN THE CURRENT STUDY WITH JUSTIFICATION AS NEEDED
	Technology	Covered under categories with specific conservation objectives, e.g. "Conservation based on local sustainable practices involving local communities" or "Indirect conservation based on improved technologies"
Governance	Decentralized forest management	"Conservation based on local sustainable practices involving local communities" to make explicit reference to community-based management. Note that clarification of property rights (as subcategory) is captured under the new category "Land tenure reforms", designed as a stand-alone category because community-based management does not necessarily imply a transfer of rights
	Payment for Environmental Services (PES)	Same, but split into two categories following the PES literature, since these have contrasting institutional implications: "User-financed PES" versus "Government-financed PES"
	Protected areas	"Protected areas"
	Agroforestry	Subcategory of "Indirect conservation", which includes studies that present agroforestry as conservation oriented. According to the Food and Agriculture Organization of the United Nations (FAO), agroforestry as mainly production-oriented land use constitutes agriculture
	Policy regulating mechanisms	Subcategories (e.g. "community self-governance") of "Conservation based on local sustainable practices involving local communities"
	Subsidies and tax concessions	Covered under more specific categories, e.g. "agricultural subsidies for reduction of forest cover", is included in "Indirect conservation" when dealing with increased agricultural yields or improved cooking stoves
	National forest programmes	A broad category that does not specify a line of action but would implicitly be covered in other categories as appropriate
Market mechanisms	Forest enterprises	Category considered too imprecise in its action; covered instead in "Production of artisan wood products" and "Production and sale of natural oils" under "Conservation based on local sustainable practices involving local communities"
	Forest certification and public disclosure	The category that has seen significant diversification, so split into several subcategories under the heading "Conservation based on product markets": "environmental certification", "moratorium" and "zero-deforestation commitments"
	Trade laws and management	Rebranded "moratorium" under the category "Conservation based on product markets"
Climate policies and initiatives	International policies	This broad category was included elsewhere, e.g. under "moratorium"
	International programmes and initiatives	This broad category was included elsewhere, e.g. as ICDPs
-	-	One specific intervention was added without a clear connection to previous 3ie categories – "land swaps" (moving concessions from forested to degraded areas)
Outcomes		

THEME	3IE CATEGORY	CATEGORY IN THE CURRENT STUDY WITH JUSTIFICATION AS NEEDED
Knowledge and behaviour change	Knowledge and behaviour change	Covered implicitly under all interventions aiming to change actors' decisions, and only differs from the previous report in the means for triggering these changes. This can be done through incentives and top-down regulations, or by increasing knowledge (e.g. "environmental education/awareness building" subcategory)
Environmental	Population or species diversity	"Biodiversity"
	Supporting services	Not included in the current study due to the difficulty in dividing the sample along those lines, including for issues with divisibility, measurement and aggregation
	Provisioning services	
	Regulating services	
	Cultural services	
	Forest cover and condition	"Forest cover"
	-	"GHG emissions"
	-	"Leakage" for loss of forest cover outside of the intervention area
Social and economic outcomes	Livelihoods, employment	Same, but split into two subcategories: "livelihoods" and "employment"
	Income and poverty reduction	Merged with livelihoods
	Decision-making	Not included in the current study; one study on "participation" under the "others" category
	Food security	Not included in the current study; did not occur in our sample
	Health	Not included in the current study; did not occur in our sample
	Education	Not included in the current study; did not occur in our sample
	-	"Other types of social outcomes", e.g. equity or participation
Transparency and accountability	Transparency and accountability	Not included in the current study; did not occur in our sample
Cost-effectiveness	Cost-effectiveness	"Cost-effectiveness"

Studies were then scrutinized for varying levels of methodological rigour and reliability. For this we used quality assessment criteria to distribute studies across three tiers: study design (whether experimental, quasi-experimental or others), use (or not) of comparators, the accounting of confounding factors, and whether conclusions were in line with data and results as presented in the articles (see Table 7).

In the present study, we ask the following research question: *What evidence is there to inform environmental and socioeconomic outcomes of different forest conservation interventions in low- or middle-income countries (according to the World Bank's definition*[1]*)*?

The report is structured as follows. In section Chapter II, we present the guiding principles used to answer the main research question. In section Chapter I, we present the EGM method and protocol, which we have applied and which can be replicated. In section Chapter IV, we present the studies analysed and discuss the main results. In the annexes, we provide complete references for all studies included in our sample, and we review the main sources of information about GCF forest and land-use projects in order to identify the scope of eligibility for the forest conservation interventions that were considered in this study.

[1] As of 1 July 2018, the World Bank income classifications by gross national income per capita were as follows: low income, USD 995 or less; lower-middle income, USD 996 to USD 3,895.

Chapter II. GUIDING PRINCIPLES

The previous 3ie EGM report (Puri et al., 2016) provided a base for this study. It also inspired us to rethink several guiding principles for the design of our analytical framework and search protocol.

a) **Umbrella terms:** Special care must be given to forest conservation intervention categories that are potentially overlapping, including avoiding double counting or miscounting. Mutually exclusive categorical classifications are needed for EGMs, and it is important to distinguish between various related interventions that are of a similar nature. For this reason, umbrella terms may not always make for suitable analytical categories. For instance, the term "REDD+ intervention" is arguably not an appropriate label, because REDD+ initiatives generally encompass a diversity of intervention types, including enabling measures, disincentives and incentives (Duchelle et al., 2018). The same comment applies to "enabling conditions" or "governance", because they include a too diverse bundle of policies. Hence, evaluating "REDD+", "enabling conditions" or "governance" as single categories would functionally be too coarse a scale for drawing lessons about individual instruments within the bundle.

b) **Key criteria and categories:** Forestry interventions may be categorized in many ways. They may be based on implementing actors (e.g. government, private sector, local village institutions), intervention type or other modalities of the intervention, such as geographical or administrative boundaries. Since most forest conservation interventions are likely to be multidimensional, no single categorization is likely to solve problems in creating mutually exclusive categories without overlaps. For this study, we distinguished between incentives, disincentives and enabling measures. The economic and institutional characteristics were then used to disaggregate these broad types into (sub)categories: incentives were distinguished by whether these were condition based (i.e. PES, certification or zero-deforestation commitments), which makes a considerable difference in terms of contracts and proximity between forest users and payers/consumers (PES usually entail direct contracts between buyers of services and producers, whereas certification implies a looser but still condition-based "contract" between the consumer of the final product and the producer). Disincentives can take various forms. In the EGM we distinguished, for instance, between "protected areas" and "land swaps" (moving a concession from forested to degraded land). Other types of interventions are those that lie within the overall category of enabling conditions. These include, for instance, environmental awareness campaigns or providing locals with alternative livelihoods or implementing tenure reforms. As our categories might not cover all possible interventions, we also introduced an "others" category that provides room to report on any other case.

c) **Scientific rigour:** While experimental and quasi-experimental methods are good for inferring causal attribution, in this study we also considered non-experimental evaluations, to account for the fact that they were likely to provide us with complementary information about local contexts and dynamics. In this respect, we further disaggregated between non-experimental studies with and without comparators. Indeed, if no clear comparator/counterfactual is used, this weakens a methodology considerably; we have still recorded

these results but at a different tier of pre-assumed reliability. Last, we considered that, whatever the methods used, if conclusions were not logically derived from data and results then the study was of a low quality/reliability.

d) **Spatial delimitation:** Experimental/quasi-experimental techniques favour spatially well-targeted instruments (whether at the forest or landscape level), but we also considered interventions that were more diffuse in space (e.g. a moratorium); to do so we applied the same quality assessment criteria as defined above.

e) **Defining outcomes:** We also focused more on outcome categories than the previous EGM report. For inclusion, a clear a priori focus of the intervention should have been on achieving forest conservation (rather than forest side-effects from other objectives, such as poverty alleviation). We looked at results in terms of environmental and socioeconomic impacts rather than aspects such as transparency, which tend to be related more to enabling conditions for positive outcomes. Additionally, we kept track of those case studies that targeted multiple outcomes in order to document trade-offs or win–win interventions.

Chapter III. FRAMEWORK, SEARCH PROTOCOL AND DATA EXTRACTION

A. THE PICO FRAMEWORK

Several steps were followed to construct the EGM. It is structured with what is commonly labelled the Population, Intervention, Comparator, and Outcome (PICO) framework:

- *Population* refers to the "subject" (including ecosystems) upon whom an intervention is applied or who is ultimately affected by the intervention.
- *Intervention* refers to the action, policy, programme or project to which the subject is exposed.
- *Comparator* refers to control groups that have not been exposed to the same intervention.
- *Outcome* refers to all relevant outcomes that result from the relevant population being exposed to a relevant intervention based on a causal chain (in theory).

A tentatively exhaustive set of categories and subcategories is provided in the PICO framework. Building off the previous EGM report and guidance from GCF documents (see Annex 2), but also relying on our experience in the field, we present a broad set of categories for forest conservation interventions in Table 3.

Based on the PICO framework, we define inclusion/exclusion criteria as presented in Table 4. These criteria are intended to guide our decisions to keep or reject references when doing the title and abstract screening.

Table 3 PICO framework

Population	Population contains two components: • Local households, communities and companies directly targeted by a forest conservation intervention • Forest ecosystems targeted by a forest conservation intervention in a low- or middle-income country (using the World Bank definition). Included are terrestrial forest ecosystems, mangroves, and agroforests
Intervention	Interventions are policies, programmes or projects, that include the following: 1. Incentives: PES-like with clear conditionalities 1.1. Private and non-governmental organization interventions such as Coasean agreements ("user-financed PES") 1.2. Subsidy programmes established by broader public sector institutions or user representatives, and often tax financed ("government-financed PES") 2. Protected areas, broadly speaking: various categories as defined by the International Union for Conservation of Nature (IUCN), based on the degree of protection/tolerance of human presence and activities within their borders 3. Conservation based on local sustainable practices involving local communities: promotion of non-timber forest product production under conditions such as "extractive reserves"; community management generally speaking (community-based, co-management…) 4. Intragovernmental deforestation-curbing regulations and incentives: 4.1. Transfers from central to local government based on conservation performance (e.g. the Brazilian ecological value added tax [ICMS-Ecológico]) 4.2. Central government publicly exposing high-deforesting municipalities ("blacklisting") and cutting their access to credits and subsidies while listed 5. Conservation based on product markets:

	5.1. Environmental certification, with consumer-financed sustainability premiums (for forest products, such as the Forest Stewardship Council for timber, or crops, such as the Roundtable on Sustainable Palm Oil for palm oil) 5.2. Moratorium (barring non-sustainable providers in the value chain) 5.3. Zero-deforestation commitments (reaping publicity gains for consumer recognition of sustainability) 6. Indirect conservation based on improved technologies and/or substitution effects: 6.1. Increased agricultural yields, Borlaug hypothesis of "land sparing" 6.2. Improved cooking stoves 6.3. Plantations with clear conservation purposes (e.g. for fuelwood supplies) 6.4. Agroforestry with clear conservation purposes 7. Indirect conservation based on enabling conditions: 7.1. Environmental education/awareness building 7.2. Capacity-building 7.3. Improving the rule of law 7.4. ICDPs 8. Land tenure reforms that include conservation objectives (including indigenous/local land demarcation, titling enforcement processes [e.g. the Brazilian CAR – Environmental Rural Register]) 9. Land swaps such as moving a concession from a High Conservation Value area to a degraded area or an area without forest cover
Comparator	Comparable populations (forest ecosystems or human populations or companies – see above) at sites without the implementation of a forest conservation intervention as defined above
Outcome	Relevant environmental and socioeconomic outcomes (or impacts) may include those that are faced by the population (as defined above) directly as a result of the implementation of a forest conservation intervention (as defined above), including maintenance or improvement of forest ecosystems, reduced GHG emissions, livelihoods and employment. In addition, we consider related characteristics that define the quality of the impacts: cost-effectiveness (how much positive outcome against the cost of the intervention) and leakage (outcomes taking place outside of the boundaries of the intervention). The list is not closed and other outcomes such as participation, equity and others might also be considered

Table 4 Summary of PICO framework and inclusion/exclusion criteria

	INCLUDE	EXCLUDE
Population	All population categories listed in **Error! Not a valid result for table.**	Areas not targeted by a forest conservation intervention High-income countries (World Bank definition)
Interventions	All interventions listed in **Error! Not a valid result for table.**	Conservation outcomes as a side effect of the intervention rather than primary aim; for instance, ICDPs when conservation is not stated as the primary objective No clear boundaries for the population affected by the intervention Biodiversity aspects per se, including wildlife trade, poaching
Comparators	Comparable populations (forest ecosystems, local households, communities, and companies) at sites without the implementation of forest conservation interventions Same populations at sites prior to the implementation of forest conservation interventions (before/after comparators) Comparable populations subject to other forest conservation interventions	Different ecosystems or human populations
Outcomes	Forest cover Biodiversity GHG emissions Livelihoods indicators Employment Cost-effectiveness of the intervention (level of impact against the level of related expenses) Leakage (vis-à-vis all previously listed outcomes happening outside of the boundaries of the intervention) Other social outcomes (participation, equity, etc.)	All outcomes happening outside of targeted areas, and not causally being related to the intervention Outcomes transcending measurable socio-environmental indicators

B. SEARCH PROTOCOL

Based on the PICO framework, we produced a group of search terms that cover three of the framework's four elements, as displayed in Table 5.

Table 5 Search terms

Intervention
Conservation; protection; protected area; national park; community-based management; payment(s) for environmental services; payment(s) for ecosystem services; direct payment(s); incentive(s)-based conservation; subsidies; subsidy program; subsidy programme; extractive reserve(s); indigenous land demarcation; local land demarcation; Rural Environmental Registry; certification; agricultural yield(s); sustainable agriculture; capacity-building; cooking stoves; fuelwood substitution; land-use zoning; non-timber forest product(s); land tenure; titling; law enforcement; rule of law; deforestation-free supply chain; zero-deforestation supply chain; zero-deforestation commitment; decentralized forest management; tax concession; land swap; moratorium; environmental awareness; capacity building; ICDP
Population
Forest; mangrove; (we argue that population terms for the search should be limited to forests and mangroves as they would ensure that accessed articles relate to our field; other components of the population such as communities, companies or households would automatically be covered whenever relevant so they do not provide an added value to the search)
Outcomes
greenhouse gases emissions; GHG emissions; forest condition; forest conservation; forest protection; forest cover; reduced deforestation; livelihoods; employment; cost-effectiveness

Note that we deliberately avoided the search term "REDD+", as it would come to include a huge number of references of dubious relevance, as shown in another recent systematic study (Duchelle et al., 2018). However, those of relevance that it would have retrieved are assumed to be covered through other search terms that are directly related to the nature of forest conservation interventions. We also purposefully decided not to include the term "agroforestry", because according to the FAO land-use classifications, agroforestry is classified as an agricultural rather than a forest land use. Including it would lead us to a whole different field of research about maximizing agricultural yields, which are already covered by "conservation/protection", provided the article deals with our scope of interventions.

We also avoided the term "agri-environmental measures", because it typically refers to policies in high-income countries (in other countries, other terms from the PES family dominate). We avoided the term "debt-for-nature swap" because it is an umbrella for specific conservation measures being implemented as a result of the swap ("land swap" was included in the search terms).

In turn, the search terms were translated into specific search strings for each of the databases that were used to collect the references (Table 6). These references were collected from the main scientific databases, and we focused our effort on peer-reviewed literature as an additional criterion for quality and robustness of results.

Table 6 Search strings

Web of Science
Databases: to be defined but expect to refine by excluding many categories
Truncation: * allows for alternative beginnings and endings
Wild cards: "$" stands for zero or one character
Search in TS (topic).
Use of Boolean search approach: OR for all terms within one PICO element (Population, Intervention, Outcomes) AND to combine the PICO elements. For instance: ("conservation" OR "protected area" OR …) AND ("forest" OR "mangrove" OR…) AND ("GHG emissions" OR "livelihoods" OR…)
One concrete example of search: TS=("conservation" OR "protection" OR "protected area*" OR "national park*" OR "community-based management" OR "Payment* for Environmental Service*" OR "Payment* for Ecosystem Service*" OR "Direct payment*" OR "incentive*-based conservation" OR "subsidies" OR "subsidy program*" OR "subsidy programme*" OR "extractive reserve*" OR "Indigenous land demarcation" OR "local land demarcation" OR "Environmental Rural Register" OR "certification" OR "agricultural yield*" OR "sustainable agriculture" OR "capacity-building" OR "cooking stove*" OR "fuelwood substitution" OR "land-use zoning" OR "non-timber forest product*" OR "land tenure" OR "titling" OR "law enforcement" OR "rule of law" OR "deforestation-free supply chain*" OR "zero-deforestation supply chain*" OR "zero-deforestation commitment*" OR "decentralized forest management" OR "tax concession*" OR "land swap*" OR "moratorium" OR "environmental awareness" OR "capacity-building" OR "ICDP" AND TS=("forest*" OR "mangrove*") AND TS=("greenhouse gas* emissions" OR "GHG emissions" OR "forest condition" OR "forest conservation" OR "forest protection" OR "forest cover" OR "reduced deforestation" OR "livelihoods" OR "employment" OR "job*" OR "cost-effectiveness"
Scopus
Databases: to be defined but expect to refine by excluding many subject areas
Truncation: * allows for alternative beginnings and endings
Search in TITLE-ABS-KEY (titles, abstracts and keywords).
Use of Boolean search approach: OR for all terms within one PICO element (Population, Intervention, Outcomes) AND to combine the PICO elements. For instance: TITLE-ABS-KEY("forest" OR "protected area" OR …) AND TITLE-ABS-KEY("forest" OR "mangrove" OR…) AND TITLE-ABS-KEY("GHG emissions" OR "livelihoods" OR…)
One concrete example of search: TITLE-ABS-KEY("conservation" OR "protection" OR "protected area*" OR "national park*" OR "community-based management" OR "Payment* for Environmental Service*" OR "Payment* for Ecosystem Service*" OR "Direct payment*" OR "incentive*-based conservation" OR "subsidies" OR "subsidy program*" OR "subsidy programme*" OR "extractive reserve*" OR "Indigenous land demarcation" OR "local land demarcation" OR "Environmental Rural Register" OR "certification" OR "agricultural yield*" OR "sustainable agriculture" OR "capacity-building" OR "cooking stove*" OR "fuelwood substitution" OR "land-use zoning" OR "non-timber forest product*" OR "land tenure" OR "titling" OR "law enforcement" OR "rule of law" OR "deforestation-free supply chain*" OR "zero-deforestation supply chain*" OR "zero-deforestation commitment*" OR "decentralized forest management" OR "tax concession*" OR "land swap*" OR "moratorium" OR "environmental awareness" OR "capacity-building" OR "ICDP" AND TITLE-ABS-KEY("forest*" OR "mangrove*") AND TITLE-ABS-KEY("greenhouse gas* emissions" OR "GHG emissions" OR "forest condition" OR "forest conservation" OR "forest protection" OR "forest cover" OR "reduced deforestation" OR "livelihoods" OR "employment" OR "job*" OR "cost-effectiveness"

C. STUDY SCREENING AND THREE-TIER QUALITY ASSESSMENT

Once the search was launched and references collected, we exported titles and abstracts into an online software called Abstrackr. This freely available online tool enabled us to collectively undertake the screening of all collected references based on the inclusion/exclusion criteria (only literature written in English will be considered). Articles whose title or abstract suggested the occurrence of at least one exclusion criterion for at least one of the four components of the PICO were rejected (e.g. intervention in areas without forest cover or in high-income countries; or projects without clear priority provided to conservation; see Table 4). A two-day training workshop was organized with reviewers in September 2018 to ensure consistency in decisions during the title/abstract screening based on the inclusion/exclusion criteria derived from the PICO framework. The acceptance rates by all reviewers were also monitored to make sure they were similar and that consistency prevailed in decisions.

Once the title and abstract screening were completed, the accepted references were downloaded, and the full articles were further screened along the same lines as the abstracts: articles with at least one exclusion criterion for at least one of the four components of the PICO were rejected. Then all accepted articles were given an ID number to be used for the data extraction in an Excel file.

Once the screening of full articles was completed, we proceeded with the data extraction as explained in detail in the next section. We made a quality assessment of the evaluation methods, in order to mark studies providing solid evidence. Even though we limited the review to peer-reviewed publications in journals – the previous 3ie report already provides insights from some grey literature, and we believe peer-reviewed articles for this complex topic provide a stronger minimum assurance of quality – we complemented this reference collection with our own specific assessment. Here, we paid attention to three main characteristics:

- Use of explicit comparators
- Attention paid to confounding factors
- Conclusions clearly derived from data and results

Although a wide range of study designs were accepted, we took note of the evaluation methods in order to be able to use this information if ever necessary to distinguish between experimental and non-experimental designs. All of these criteria are recapitulated in Table 7 below.

Table 7 Quality assessment procedure

Use of a comparator	Use of a comparator No comparator mentioned in the study
Eligible study design	Relevant types of study design include those using quantitative and qualitative methods for an ex-post evaluation, by decreasing order of scientific robustness: • Experimental design with randomized participants assigned to the intervention and control groups • Quasi-experimental designs with selected control groups (selected by either the researcher or other agents involved in the intervention, such as project managers or government representatives) where strong justifications are provided, such as matching methods (participants and non-participants have similar characteristics) • Surveys of participant and non-participant populations (cross-sectional, without strong justifications on the selection criteria) • Surveys of populations prior to and after the intervention (longitudinal)
Quality control criteria	Key results are logically derived and supported by the data and methods. Confounding factors that could have influenced the results are considered and explained

Based on the quality assessment of collected references, we were able to distribute studies and results into three different tiers based on their assessed quality and hence the credibility of conclusions:

- *Tier 1:* studies using experimental or quasi-experimental methods, hence with control groups, and whose conclusions are logically derived from results and data.
- *Tier 2*: studies not using experimental or quasi-experimental methods, with comparators but not control groups – e.g. using before/after data or surveys where the selection of comparison groups is not supported by strong enough justifications such as matching methods – and whose conclusions are logically derived from results and data. This Tier 2 basically enabled us to capture studies that did not use the best methods of evaluation but for which there was a comparator; it thus goes beyond the scope of the previous 3ie report. We made the judgment that despite their lower quality from the perspective of evaluation methods, these studies still held the potential to provide us with useful information to inform the EGM (interventions and outcomes covered by the peer-reviewed literature).
- *Tier 3:* studies without a comparator, or studies with a comparator but the conclusions of which are not logically derived from results and data (whatever the methods used). Because we acknowledge the much lower quality of these studies from the perspective of evaluation methods, only basic data were extracted from this sample.

We decided not to base tier categories on the consideration of confounding factors in the articles because reviewers might make somewhat arbitrary decisions on such a difficult criterion to assess. However, this information remains available in our exhaustive data extraction files.

D. Data Extraction

The critical data extraction phase is when all strategic information from the articles is identified; it provides the basis for the EGM, as well as for the synthesis of results from the targeted literature. It leaves room for some interpretation by the analysts involved in this step. The training was thus critical to ensure consistency among the reviewers, all the more

so as extracted data – which can be viewed as a radical summary of the collected articles – have to be put into pre-defined result boxes. In order to improve consistency among ourselves, the lead author provided training, double-checked extracted data on a daily basis, asked for clarifications whenever needed, and provided advice throughout. The process was thus closely monitored, and consistency was ensured whenever possible.

The data extraction Excel files are provided as supplementary material, and Table 8 below lists the fields that had to be filled in by the analysts.

Note that we report cases separately when there was more than one case described in any one article. Therefore, we use the term "cases" to refer to all evaluations of cases that are provided (number of cases > number of articles).

Only studies with a comparator were submitted to full data extraction, as they provide the strongest results to report. Studies without a comparator (Tier 3) were submitted to a minimal data extraction process, whereby only a few fields were filled in order to substantiate the EGM: bibliographical information, type of study, country, type of intervention, general notes.

Table 8 Data extracted

Bibliography	Study ID
	Case
	Reviewer initials
	Authors
	Publication year
	Title
	Journal
	Type (1. Case study; 2. Review)
Use of a comparator	Use of a comparator (1. Before/after; 2. Control group (usually using matching methods); 3. Other; 4. No comparator) [if "other" then please complete the following column]
	Elaborate on the comparator if deemed useful
	Not clear whether out of scope, typically because the conservation objective of the intervention is not stated clearly (type "X" if indeed the case)
Data and methods	Year(s) that the data cover (use "" for multiple separate years and " - " for continuous years)
	Data sources (1. Self-reported/surveys among participants; 2. Remote sensing/mapping; 3. Direct observations; 4. Others)
	Type of study (1. Experimental; 2. Quasi-experimental; 3. Non-experimental: surveys, case studies, econometrics…; 4. Not available)
Intervention	Country
	Type of intervention (consider the main intervention only – list available in **Error! Not a valid result for table.**)
	Additional information characterizing the main intervention

	Mention other secondary interventions involved when relevant (provide reference numbers based on the numbering provided in **Error! Not a valid result for table.** of the "framework and protocol" document)
Population	Forest ecosystem (1. Natural forest; 2. Mangrove; 3. Agroforestry; 4. Forest restoration; 5. Others)
	Human populations (1. Local communities; 2. Companies)
Outcomes relative to comparator	Forest cover (1. Positive impact - increased or maintained (depending on counterfactual); 2. Negative impact – decreased; 3. Neutral impact; 4. Mixed; 0. Undefined)
	Forest cover: elaborate
	Biodiversity (1. Positive impact - improved or maintained; 2. Negative impact – reduced; 3. Neutral impact; 4. Mixed; 0. Undefined)
	Biodiversity: elaborate
	GHG emissions (1. Positive impact – reduced; 2. Negative impact – increased; 3. Neutral impact; 4. Mixed; 0. Undefined)
	GHG emissions: elaborate
	Livelihoods (1. Positive impact – improved; 2. Negative impact – worsened; 3. Neutral impact; 4. Mixed; 0. Undefined)
	Livelihoods: elaborate
	Employment (1. Positive impact – new opportunities; 2. Negative impact – fewer jobs; 3. Neutral impact; 4. Mixed; 0. Undefined)
	Employment: elaborate
	Leakage caused by the intervention based on the authors' statement (1. Reported leakage; 2. No leakage reported)
	Leakage caused by the intervention based on the authors' statement: elaborate
	Cost-effectiveness of the intervention based on the authors' statement (1. Positive impact - high; 2. Negative impact - low; 0. Undefined)
	Cost-effectiveness of the intervention based on the authors' statement: elaborate
	Others: please elaborate (e.g. participation, equity…)
Frequency (automated)	Positive impacts
	Negative impacts
	Neutral impact
	Mixed impacts
	Undefined
Critical criteria	Key results and conclusions are logically derived and supported by the data and methods (Yes, No)
	Confounding factors that could have influenced the results are considered and explained (Yes, No)

Chapter IV. RESULTS

A. GENERAL STATISTICS

After removing duplicates, we collected 2,500 articles to screen, based on a combined Scopus and Web of Science search.

After the screening of titles/abstracts, we accepted 257 articles out of the initial sample of 2,500 articles: an acceptance rate of 10.2 per cent (before checking for further duplicates as the screening software Abstrackr had some glitches).

Out of these 257 articles, we selected 142 based on full-paper screening (110 were out of scope, 5 were duplicates). Within this sample, 22 articles were kept separately as they presented reviews.

Out of the 164 cases presented in these 120 articles, data extraction resulted in the following distribution among tiers: 50 cases in Tier 1, 28 in Tier 2, and 86 in Tier 3 (of which 80 did not have a comparator; another 6 cases had a comparator, but their conclusions were not found to be logically derived from results and data).

This strict quality assessment enabled us to gather a significant number of studies with robust methods and conclusions that represent an important source of information to conduct data analysis. We focused our efforts on Tier 1 and 2 studies to present interesting and credible trends in terms of an impact evaluation of forest conservation interventions over the years 2016 to 2018 (midyear).

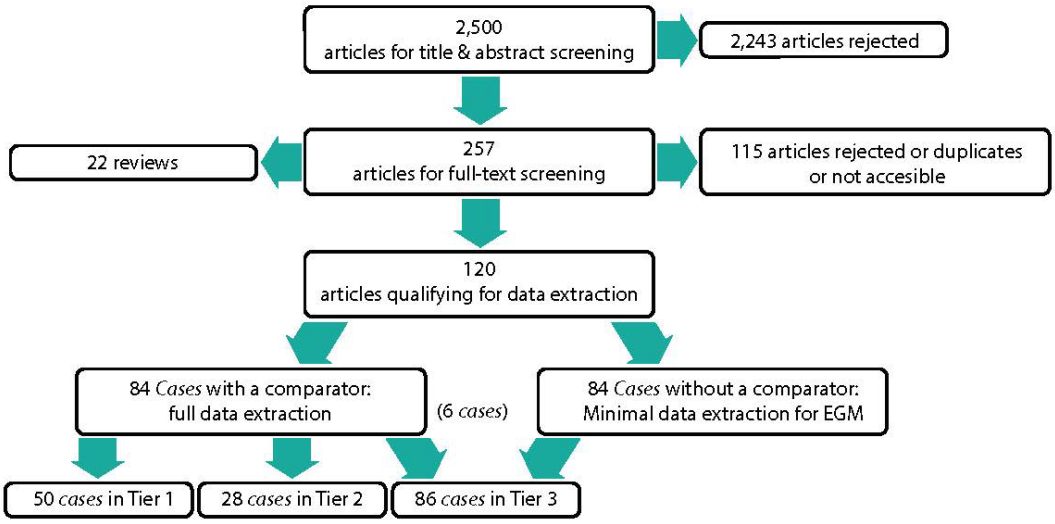

Figure 1 Literature searches and screening results

Note: One article may contain more than one evaluation case, hence the terminology "case" for each evaluation we found in any given article, and the higher number of cases than articles.

B. UNDERLYING DRIVERS OF EVIDENCE GAPS

What kind of distribution of conservation instruments should we expect to see? What creates the gaps that we are observing in the EGM? Observed evidence will always be a composite overlaid result of two different sets of distributions:

a) *Implementation bias:* How many conservation interventions of a certain type have been carried out, and where?

b) *Research and evaluation bias:* Given the distribution of globally implemented interventions, how many of these have been taken up by researchers for analysis, and where?

Part of the implementation bias is, for instance, that the world has been using protected areas as conservation instruments over the last century and a half, whereas PES has been used on a large scale over the last three decades, and zero-deforestation commitments have only been used over the last couple of years. These orders of magnitude of difference in implementation time, together with other tool-specific inertia and limitations, are naturally reflected in a widely differing scope of application (hectares of forest targeted, number of sites of implementation/projects, number of people participating). Below we reproduce a simple comparison of protected areas versus PES enrolled areas in three Latin American countries (Table 9). Two of these countries (Costa Rica and Mexico) have been front riders for PES, with 0.34 and 2.2 million hectares respectively being enrolled recently. However, their traditional protected areas are still respectively 3 and 10 times larger than their PES areas. In Brazil, a PES laggard, 4,480 hectares of land are in protected areas for each hectare of PES. What is more, over the recent decade protected areas have continued to grow much faster in both Mexico (factor 3.2) and Brazil (factor 1,596). This enormous difference in scope of implementation might thus also be reflected in our EGM: it would be counter-intuitive to have protected areas and PES be represented with equal weight since the former continues to be much more important for conservation worldwide than the latter. In other words, such biases and uneven distribution of cases within intervention categories might not be a problem from the perspective of informing GCF decisions for conservation funding.

Table 9 Size and change of protected areas versus PES enrolled areas in three Latin American countries

COUNTRY	PES ENROLLED AREA (MILLION HA) (2010–2012)	RATIO AREA PA/PES	RATIO OF CHANGE IN PA/PES AREA (2000–2010)
Costa Rica	0.34	3.2	0
Mexico	2.20	10	3.2
Brazil	0.05	4,480	1,596

Note: PA = protected area
Source: Wunder (2013)

The second type of bias – research and evaluation bias – is harder to document quantitatively, but in some ways it is likely to run contrary to the implementation bias described above: both donors and researchers will be more curious about particular new, incipiently applied, yet seemingly promising instruments (such as PES) than about those that have already been known for many years (such as protected areas). Geographically, researchers tend to be perhaps even more reluctant than implementers to go to areas of violent conflict or extreme hardship. They often tend to concentrate in certain countries,

regions or even project areas – building on previous research or setting out to challenge the established wisdom. Researchers often congregate around civil society-led initiatives, which tend to be more open to research collaborations than public initiatives. Researchers also often tend to oversample specialty cases; for instance, PES on indigenous minority land might be more studied than PES on lands belonging to the vast majority of a *mestizo* dominant population group. Furthermore, new terms can sometimes be coined for quite similar interventions, which adds frictions to the proper classification of conservation approaches – for example, protected areas could be rebranded as ecotourism in the midst of debates about the rise of market-based instruments. It is worthwhile to keep these challenges in mind when we turn to interpret our results. Having said that, such biases are absolutely pertinent to identify, because they might not be justified by sound reasons in terms of where conservation money should flow.

Before proceeding with the presentation of data, we share additional reflections about the limitations of our EGM results. Sample limitations internal to the included studies also deserve our attention. The size of the samples (people, forest area) subject to the intervention, as well as the control groups being used for the counterfactual, both need to be sufficiently large to allow for statistically robust results. In practice, we can see that some studies exhibit low, statistically underpowered sample sizes, for a combination of two reasons: either the intervention has been small in scope, thus naturally limiting the sample size, and/or the study design has, for cost or other practical reasons, not prioritized a large sample size. Yet cases included in Tier 1 do not obviously exhibit such a pattern overall, and we are not able to conclude that results presented in this report would deserve to be questioned without any further investigation and discussion.

We should also note that sample size can be measured in several ways, depending on population and scale. For instance, one evaluation looks at six villages, but with hundreds of cells to assess forest cover (e.g. n=27 – PES in the Cardamom Mountains, Cambodia). Other studies are global and use remote-sensing data over the entirety of protected areas (e.g. n=116 – protected areas in 64 countries over three continents). Others again collect data at the household level (e.g. n=107 – sample includes 81 certified coffee growers out of a total of 454 cooperative members).

C. Overview (extended gap map including all tiers)

Turning now to our distribution of studies, we take advantage of our efforts towards the distribution of impact evaluations in three different tiers to present split results whenever relevant. We believe that this step adds value to the EGM and its robust review, and helps put into perspective the results from different tier studies. This is all the truer when it comes to presenting outcomes from collected cases for the sake of informing important decisions in the allocation of funding to conservation initiatives. Given that 48 cases from Tier 1 used quasi-experimental approaches and only 2 used experimental approaches, whereas by design the cases in Tiers 2 and 3 did not use either, putting the results from sophisticated, quasi-experimental studies on the same level as conclusions derived from surveys, with little consideration for longer-term contextual trends or confounding factors, would probably not help with decision-making.

We kept track of cases that refer to more than one intervention type in a single intervention case, whenever justified. This distinction proved particularly useful, for instance, in the case of protected areas under community management. Similarly, various REDD+ projects attempted to improve local forest management, yet the interventions often pre-existed the projects themselves (effects were

thus often difficult to disentangle). However, when graphically displaying the distribution of cases based on types of intervention, we focused on the main intervention only. Cases with more than one intervention are dealt with in the data analysis of the systematic review.

Note that the distinction of "with versus without comparator" is not a sufficient, unambiguous indicator of scientific quality: some studies without a proper comparator are well documented and constitute an interesting source of information to understand the dynamics and outcomes of a given intervention. But since we needed to have an objective and applicable indicator to make the distinction between tiers, we decided to stick to our original classification.

A first observation relates to the geographical distribution of evidence, reminding the reader here that we only collected data on low- and middle-income countries. It is striking to see in Figure 2 and Figure 3 the overwhelming representation of Asia and Latin America, with Africa lying far behind. This finding is likely to illustrate the second bias mentioned earlier regarding the number of factors that lead to research being undertaken on specific interventions and in specific locations. Although donors have invested massively in African countries within the framework of REDD+ and beyond, these efforts are not reflected accurately in the relatively low number of studies that were analysed. The first position for India needs to be looked at in context, as it relies mostly on Tier 3 cases (with only one case study in Tier 1) whose results can be challenged because the methods can be assumed to be less robust, on average. Nepal also stands out because of its high-profile community-based forest management policies and programmes that have attracted much research in the social sciences. Otherwise, the usual suspects are well represented: Brazil and Indonesia as historic deforestation hotspots, Mexico for its *ejidos* community management, and Ecuador and Peru (well represented in Tier 1 cases too) for their strategic importance for the future of the Amazon biome. Central African countries are arguably underrepresented, given that they hold the world's second-largest area of tropical forests.

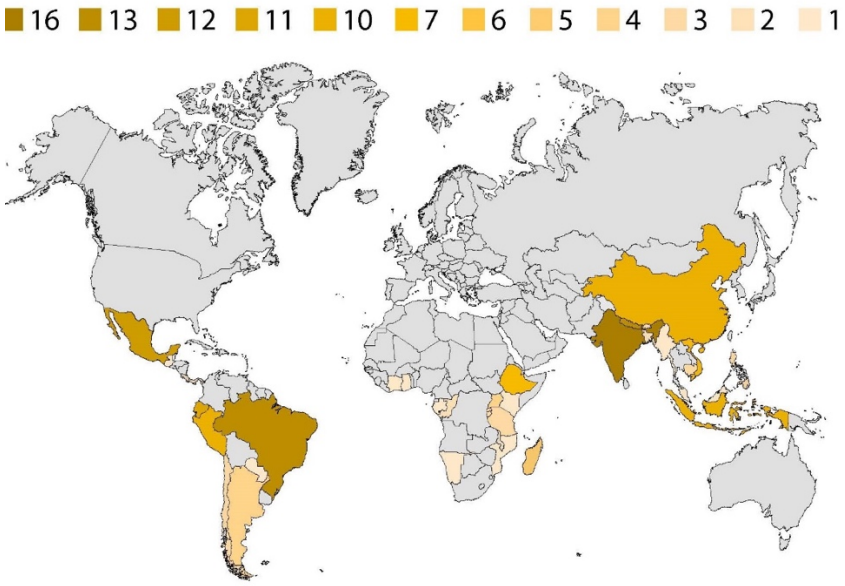

Figure 2 Geographical distribution of studies on a world map (all tiers aggregated)

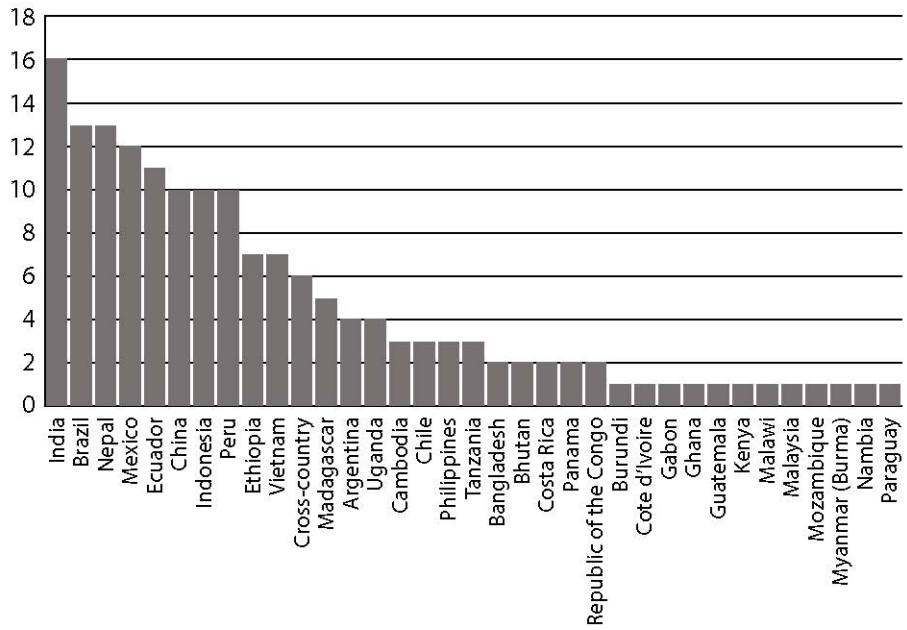

Figure 3 Number of studies in each country (all tiers aggregated)

A second observation relates to the distribution of studies focused on different intervention types (Figure 4). Because the GCF encourages interactions between government, civil society and private sector actors in order to best support the most promising forest protection and recovery options, attention should be paid to a diversity of interventions. For instance, most policies could be supported within the framework of REDD+ with the training of human resources or funding of events during its operationalization, even though these interventions are not clearly spatially located. Land tenure reforms or higher agricultural yields, for example, could be accompanied by land ownership/use rights data collection and processing, or the creation of a network of offices for extension services.

We find the distribution of intervention types to be highly uneven: the lion's share is predominantly for protected areas and to a lesser extent for conservation projects based on management by local communities (usually of the community-based forest management kind). PES interventions that base conservation on conditional incentives to either people or companies lag behind, despite their high visibility in conservation debates. Worth noting too, especially from the perspective of informing decisions with solid data, is that cases from Tier 1 cover other intervention categories such as conservation based on product markets (mostly certification: 7 cases overall), or tenure reforms (e.g. securing land titles held by locals: 7 cases overall).

Last, presumably important interventions of a more indirect nature, such as those creating the right conditions (e.g. ICDPs and capacity-building) or improving technologies to spare land for standing forests (e.g. more efficient cooking stoves), are surprisingly almost absent from the map; this could be a consequence of our data search criteria if the related cases do not explicitly mention conservation as their primary objective.

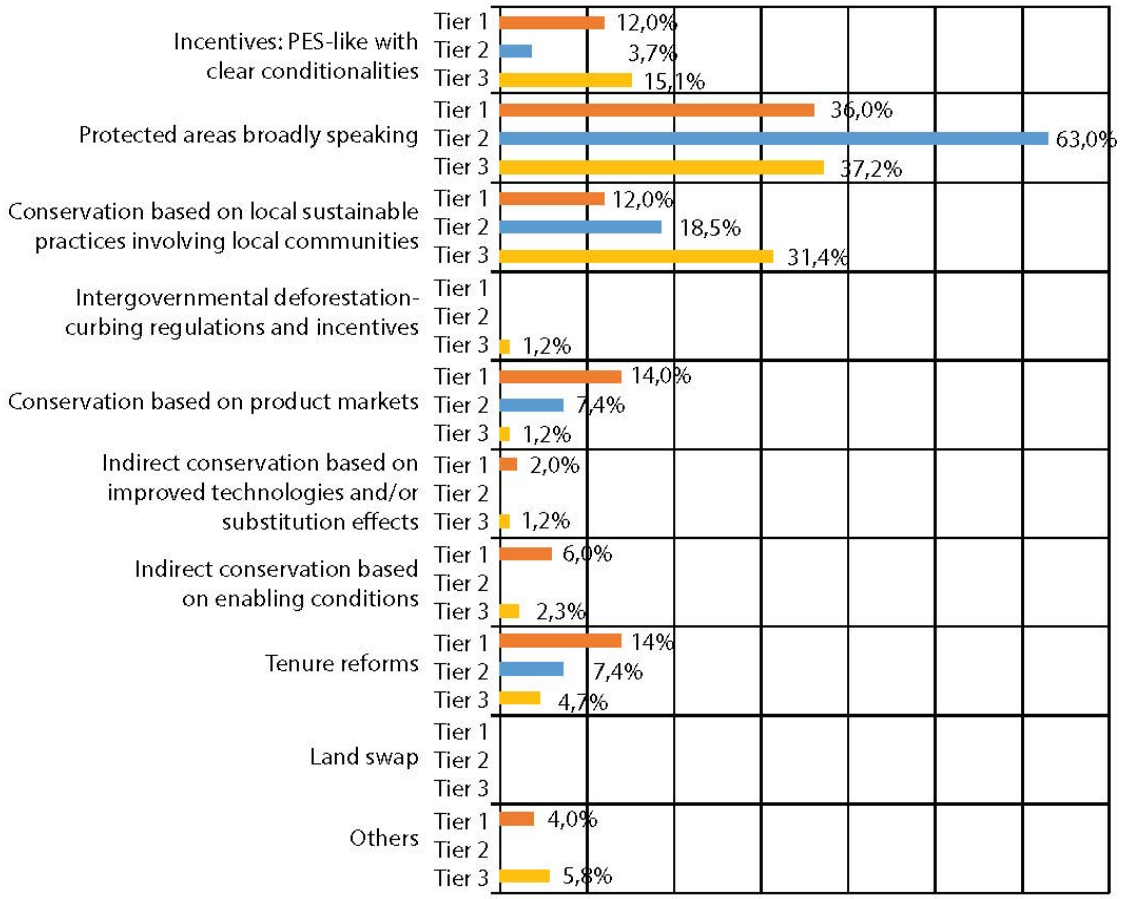

Figure 4 Distribution across types of conservation interventions (percentages within each tier)

A third observation relates to the distribution of outcome categories for Tiers 1 and 2. We first mapped this distribution independently of forest conservation intervention type to get an initial glimpse at the overall situation (Figure 5). Unsurprisingly, the majority of cases evaluate impacts on forest cover, with livelihoods in the second position, albeit far behind (Figure 6 reveals very few overlaps because only four studies deal with both environmental and socioeconomic outcomes at the same time; we thus have very limited evidence of potential trade-offs). GHG emissions were usually not evaluated specifically, but can be inferred to some extent from forest cover. The relative absence of biodiversity as a measured outcome might be more problematic because its relation to forest cover is less straightforward (think of forest fragmentation and the type of forest cover). This absence might be explained by the difficulty in assessing biodiversity, as specific methods need to be applied. Another problematic lack of evidence relates to cost-effectiveness, which is strategic information to help support GCF resource allocation decisions in the future. Note that little difference exists when splitting cases into Tiers 1 and 2, as the main trends remain.

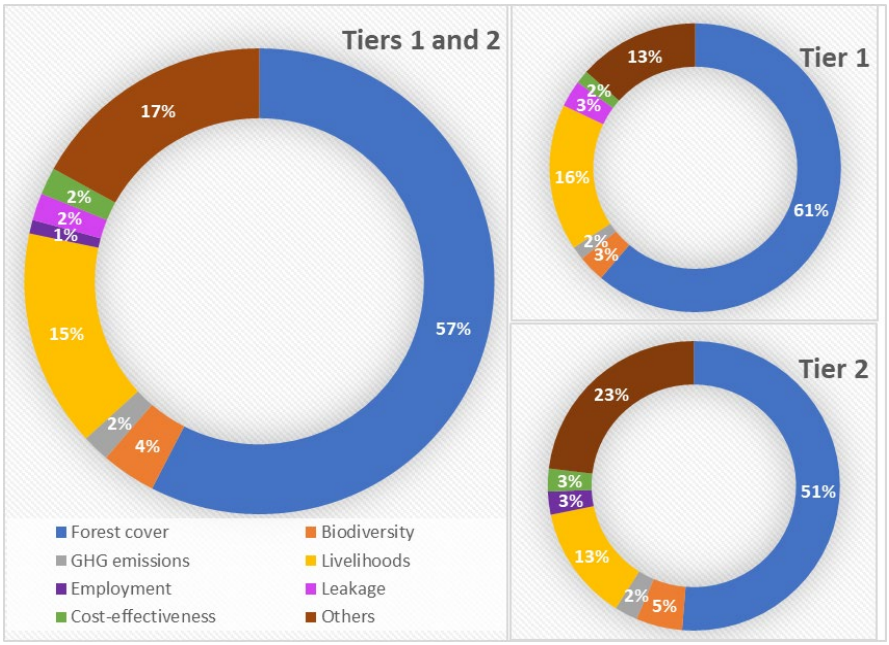

Figure 5 Distribution among outcome categories

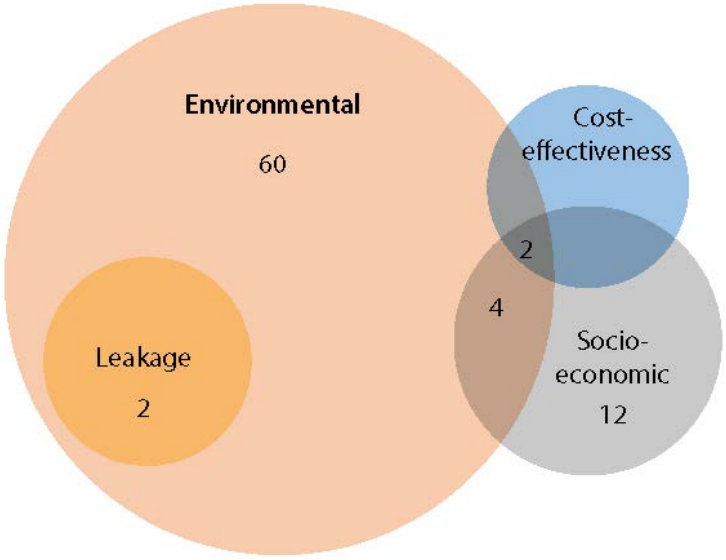

Figure 6 Distribution among broad outcome categories (Tiers 1 and 2 aggregated – broad categories)

Note: "Environmental" includes forest cover, biodiversity and GHG emissions; "socioeconomic" includes livelihoods and employment; "others" is not represented. Overlaps represent studies where at least two types of outcomes were assessed.

Table 10 presents the EGM for Tiers 1 and 2. A first observation is the prominence of empty cells – that is, the lack of evidence for a majority of outcomes and a majority of interventions. Yet this lack of evidence is not evenly distributed, and we notice that protected areas and community-based forest management and the like have been evaluated for most of the outcome types. Conversely, only forest cover can be said to have been evaluated across most of the spectrum of conservation interventions. Regarding

livelihoods, there is frequently only one evaluation case for most of the intervention types. This shows that despite the relatively high number of cases overall for Tiers 1 and 2 when the two dimensions of outcomes and interventions are combined, this body of evidence remains insufficient to cover most aspects of interest.

Some categories of intervention call for a lack of evidence because they seem to remain rare in practice. Fiscal transfers from central to local governments based on conservation performance are one such example, as are land swaps, the idea of which looks perfect on paper but meets considerable challenges in its operationalization. Other categories are not expected to be so under-studied – for example, the Brazilian initiative to blacklist municipalities that was shown to considerably reduce deforestation (Cisneros, Lian Zhou, & Börner, 2015).

Table 10 Intervention–Outcome types matrix (Tiers 1 and 2 aggregated)

Forest conservation interventions	Outcome types								
	Forest cover	**Biodiversity**	**GHG emissions**	**Livelihoods**	**Employment**	**Leakage**	**Cost-effectiveness**	**Others**	
Private and NGO interventions	2	1		2			1	1	Incentives: PES like with clear conditionalities
Subsidy programmes	5			1				1	
	30	2	2	3		1	1	9	Protected areas broadly speaking, various categories as defined by IUCN based on the degree of protection
	6	1		4	1	1		2	Conservation based on local sustainable practices involving local communities
Transfers from central to local government based on conservation performance									Inter- governmental deforestation-curbing regulations and incentives
Central government exposing publicly high-deforesting municipalities									
Environmental certification	5			1					Conservation based on product markets
Moratorium	1								
Zero-deforestation commitments	2							1	
Cooking stoves									Indirect conservation based on improved technologies and/ or substitution effects
Plantations with clear conservation purposes									
Agroforestry				1					
Capacity-building				1				1	Indirect conservation based on enabling conditions
Improving the rule of law									
Integrated conservation and development projects (ICDPs)	1			1				1	
	8			1				1	Tenure reforms

		Outcome types								
		Forest cover	**Biodiversity**	**GHG emissions**	**Livelihoods**	**Employment**	**Leakage**	**Cost-effectiveness**	**Others**	
										Land swap
	Mix of REDD+ projects	1			1				1	Other interventions

Note: The column on the left indicates broad categories; the column second to left indicates subcategories and when there are no subcategories, the column remains blank; coloured cells indicate the intervention outcomes with the most occurrences.

Other, more minor aspects can also be presented (Figure 7). With respect to ecosystems, natural forests are addressed in almost all cases, whereas mangroves and agroforestry are not on the map, most likely because of their much smaller areas and lesser media coverage and donor visibility. It might be surprising to see that local communities are addressed about four times more than private companies in collected cases. Indeed, with the rapid emergence of a variety of private commitments (e.g. zero-deforestation supply chains, certification) and incentive-based approaches (e.g. PES, although the private sector is usually a buyer of services, and hence is not addressed in cases as the target of conservation interventions), one could expect the private sector to receive more attention in conservation research.

With respect to the use of comparators, we take note of a relatively even distribution among before/after comparisons (looking at historical trends), control groups (but without matching methods) and other methods (e.g. econometric tools). Recall that the use of comparators only applies to Tier 2 cases; for Tier 1, all cases used control groups to qualify as either experimental or quasi-experimental, and for Tier 3 there were no comparators, except for a handful of cases that were downgraded due to conclusions not logically derived from results and data.

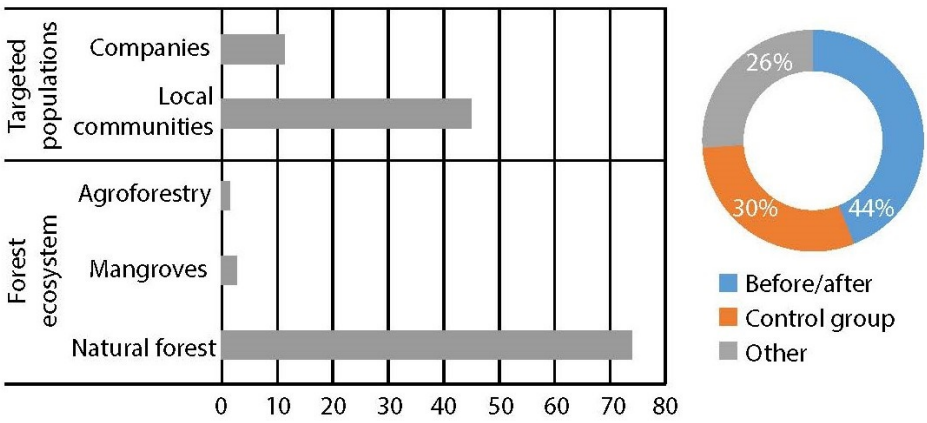

Figure 7 Targeted populations and ecosystems (Tiers 1 and 2 aggregated) and comparator types (Tier 2)

Data sources are presented in Figure 8 and chiefly consisted of remote-sensing data to monitor forest-cover changes, with the remainder consisting of either self-reported evolutions based on field surveys and direct observations (e.g. market surveys). This information was not collected for Tier 3 cases during the full data extraction process.

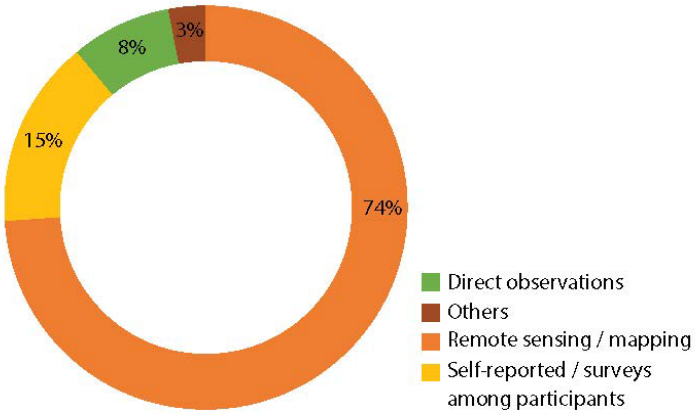

Figure 8 Data sources (Tiers 1 and 2 aggregated)

D. EVIDENCE GAP MAP RESULTS

In this section, we present the EGM with only experimental and quasi-experimental studies for which a substantial number of cases were found (n=50). We then elaborate on the outcomes reported in these studies.[2] We provide an analysis based on the various categories of impacts on forest cover, biodiversity, GHG emissions, livelihoods, employment, leakage (forest loss occurring outside of the area covered by the intervention), cost-effectiveness and others (not applicable to pre-defined categories). Subject to a series of limitations – number of articles, site selection biases, statistically small underlying sample sizes, methodological biases, etc. – the EGM results gave us some clues as to which interventions have the greatest potential for impacts.

Figure 9 reveals the nature of the evaluated outcomes for cases in Tier 1 and is hence based on a significant corpus of 50 cases of the highest quality. Coloured areas represent different types of outcomes and are proportionally commensurate with the number of cases that substantiate them. Although it would be problematic to have a significant number of negative impacts on forest cover for interventions aiming at supporting forest conservation, one isolated case shows negative impacts (case #75, which refers to the Forest Management Policy in the Democratic Republic of the Congo; the methods employed in this study have been challenged[3]), three others have mixed impacts, and another four cases had no impact (neutral).

[2] Comparisons of outcomes between Tiers 1 and 2 could also trigger some reflection: Tier 1 positive outcomes – such as higher forest cover and improved livelihoods – are slightly higher (72 per cent vs. 79 per cent, although this might not be statistically significant); more strikingly, neutral outcomes are much higher (12 per cent vs. 0 per cent). One possible explanation could be that higher-quality studies go deeper into details, control better for confounding factors and might thus reach more nuanced results.

[3] As context, the article triggered a response (Karsenty et al., 2017) criticizing the methods used in the case study. It was claimed that the authors of the original article had underestimated the impacts of a number of presumably key factors that could explain high rates of forest loss in the Forest Management Policy areas: population density, in particular, was not controlled for. They also point to the alleged weaknesses in choosing units to be included in the comparison group because critical aspects such as the inactivity of a concession or its non-production purposes have a decisive influence on its operations. This example stands as a lesson that puts the results of our systematic review into perspective because this study was classified in Tier 1, based on our objective indicator that the study was properly designed as a quasi-experiment with the use of control groups; however, its control groups only considered factors such as markets and distance to roads and failed to include other influential ones.

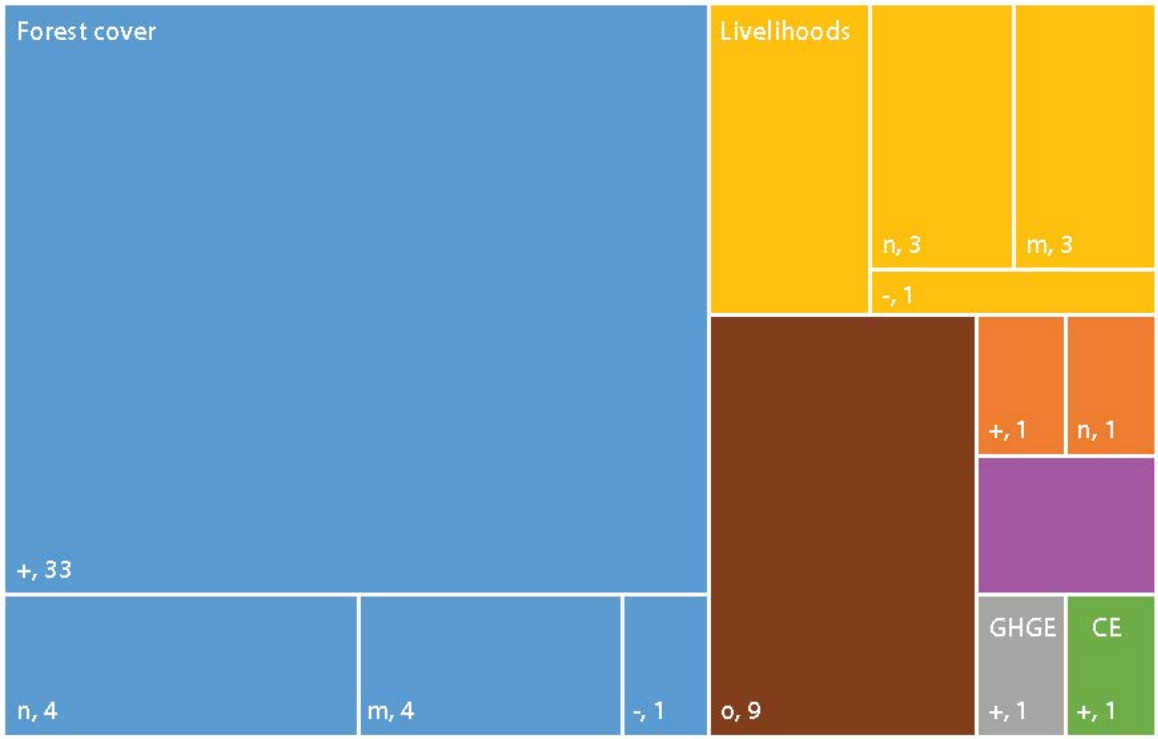

Figure 9 Outcomes (all intervention categories aggregated – Tier 1 only)

Note: Numbers indicate the number of cases for each category; areas are proportional to the relative number of cases; "+" for positive impacts against counterfactual (e.g. maintained forest cover when counterfactual exhibits loss; or low levels of GHG emissions when counterfactual exhibits higher levels of emissions); "-" for negative impacts against counterfactual (e.g. maintained livelihoods when counterfactual exhibits improvement); "n" for neutral impacts (same as counterfactual); "m" for mixed against counterfactual (e.g. when one dimension is positive and another dimension is negative, such as elite capture with contrasted livelihood impacts in the targeted population, or fluctuating levels of forest cover over time); "rl" for reported leakage in the case study; the direction of impacts for the others category ("o") was not specified.

The other outcome types are of greater interest because they represent residual impacts or, at best, the secondary objectives of these interventions, which means that their nature is less obvious and predictable. However, we report a tangible lack of evidence because livelihoods, biodiversity and leakage are evaluated respectively 11, 2 and 2 times only. Although livelihood impacts are evaluated in slightly more cases, their distribution does not reveal a clear pattern.

The "others" outcomes include increased surveillance by forestry user groups and changes in timber production; these are very specific to their intervention and its local context. They commonly pose a problem of consistency when dealing with dimensions that were directly handled by the project: increased surveillance sounds tautological when the project funds patrols, and reduced timber production is hardly unexpected when the project consists in changing the status of land from productive forest concession into a protected area.

Our EGM results (Table 11) unveil the distribution of outcomes depending on the types of intervention, for Tier 1 exclusively (experimental and quasi-experimental methods). It basically confirms what the various streams of information presented earlier in the report suggest:

- Protected areas seem to deliver effectively on forest conservation, as shown by converging evidence from experimental and quasi-experimental studies.

- Forest conservation interventions generate positive environmental outcomes for all categories where evidence was collected (except for one controversial case, see footnote 3 above).
- Livelihood outcomes are unclear and are quite often said to be either mixed or neutral, which might be a consequence of this dimension being more difficult to assess (and three quarters of Tier 1 cases use remote-sensing data, which does not help).
- Leakage is reported in two cases. This type of outcome was poorly reported across studies, and generalizations are thus difficult to make. However, we think this finding deserves attention because leakage might be found to be happening in many more cases if it were assessed more frequently.
- Geographical coverage of evaluations does not accurately reflect the distribution of conservation initiatives being implemented, and studies from Africa, in particular, are underrepresented. Indeed, the research emphasizes some sites (and intervention types) over others, for other reasons that are independent of the distribution of conservation interventions.

Table 11 Intervention – Outcomes matrix (Tier 1 only)

Forest conservation interventions	Forest cover			Biodiversity			GHG emissions			Livelihoods			Employment			Leakage		Cost- effectiveness			Others	
Private and NGO interventions			2			1				1		1								1	1	Incentives: PES like with clear conditionalities-
Subsidy programmes			4																			
	1		15	1					1	1	1						1				3	Protected areas broadly speaking, various categories as defined by IUCN based on the degree of protection
	1		3							1		1					1				1	Conservation based on local sustainable practices involving local communities
Transfers from central to local government based on conservation performance																						Inter- governmental deforestation- curbing regulations and incentives
Central government exposing publicly high-deforesting municipalities																						
Environmental certification	3		2									1										Conservation based on product markets
Moratorium																						
Zero-deforestation commitments	1																					
Cooking stoves																						Indirect conservation based on improved technologies and/ or substitution effects
Plantations with clear conservation purposes																						
Agroforestry										1												
Capacity-building										1											1	Indirect conservation based on enabling conditions
Improving the rule of law																						
Integrated conservation and development projects (ICDPs)			1									1									1	

	Forest cover			Biodiversity			GHG emissions			Livelihoods			Employment			Leakage		Cost- effectiveness			Others	
	1		6																		1	Tenure reforms
																						Land swap
Mix of REDD+ projects and Forest Management Policy		1								1											1	Other interventions
	others	negative impact	positive impact	others	negative impact	positive impact	others	negative impact	positive impact	others	negative impact	positive impact	others	negative impact	positive impact	no reported leakage	reported leakage	others	negative impact	positive impact		
	Outcomes																					

Comparing our results with the previous 3ie study, we also found major gaps in evidence for a number of interventions. Analyses of moratoriums, zero-deforestation commitments (trade laws and management), education and awareness campaigns were lacking in both studies. Owing to our new categories, we also identified other potentially important types of interventions for future conservation funding that call for more research and evidence: intragovernmental deforestation-curbing regulations and incentives, and a number of approaches resorting to indirect conservation measures such as improved cooking stoves, tree plantations as substitutes for degradation of natural forests, or ICDPs.

Our results also reinforce previous findings on the large representation of protected areas (although these also exist in much larger numbers than any other implemented measure), as well as decentralized forest management (conservation based on sustainable local practices) and PES to some extent. Also, in line with the previous study, we found that despite a large number of cases these interventions were usually evaluated from the perspective of forest cover. Biodiversity and the variety of socioeconomic outcomes were poorly addressed, yet it must be noted that the previous 3ie study found a higher number of evaluations of livelihood impacts. We agree with the conclusion from the 3ie study that "outcomes requiring primary data collection […] are rarely examined". We could substantiate this claim further with our recording of data sources used for the impact evaluations that show the appetite for remote sensing. As a consequence, we also take note of the small number of studies that examine trade-offs between outcomes (n=4). Cost-effectiveness is also absent from the sample, except for one isolated case (Jayachandran et al., 2017).

In terms of methods, in principle we support the conclusion by the previous 3ie study that "quasi-experimental methods can and should be considered for impact evaluations", but we beg to consider that experimental methods face strong obstacles in the field of conservation: researchers usually do not have the capacity to randomize large-scale interventions, there may be ethical problems related to randomization, and implementers probably lack the motivations to strongly engage. However, we argue that quasi-experimental methods should be taken as valid substitutes, as long as control groups are selected with the appropriate means (e.g. propensity score matching). Other non-experimental studies can also document specific local conditions and processes that might be of interest to help understand on-the-ground implementation challenges.

Regarding the geographical distribution of cases, we observe many similarities between both studies: in short, the previously observed locational gaps remain. Minor differences are a lower relative representation of studies from Africa and a higher representation of studies from India in the updated study. Ecuador, Argentina and Chile were not represented in the previous study sample; in contrast, Costa Rica had a very strong presence due to the prominent PES initiatives implemented in the country, yet it turned out to be underrepresented in the current study. Overall, the countries with large areas of tropical forest, such as Brazil and Indonesia, maintained their high visibility.

E. KEY FINDINGS FROM CONSOLIDATED EVIDENCE GAP MAP

To make the analysis complete, we developed a consolidated EGM from the results of the two study periods, which spans almost two decades of literature evaluating forest conservation interventions. Details about the methods employed to integrate the 3ie study (1990–2015) into the updated EGM (2016–2018) are discussed in the annex section. Analysis of the results of the consolidated heat map shows some key insights (see Table 12 below).

Table 12 Consolidated EGM (1990–2018)

Forest conservation interventions		Outcome types: Forest cover	Biodiversity	GHG emissions	Livelihoods	Employment	Leakage	Cost-effectiveness	Others
Incentives: PES-like with clear conditionalities	Private and NGO interventions	2	1		2			1	1
	Subsidy programmes	13			4	1	2		3
	Protected areas broadly speaking, various categories as defined by IUCN based on the degree of protection	47	3	2	14	1	3	5	3
	Conservation based on local sustainable practices involving local communities	16			6		1	1	2
Inter-governmental deforestation-curbing regulations and incentives	Transfers from central to local government based on conservation performance								
	Central government exposing publicly high-deforesting municipalities								
Conservation based on product markets	Environmental certification	7			1				
	Moratorium	1					1		
	Zero-deforestation commitments	1							
Indirect conservation based on improved technologies and/or substitution effects	Cooking stoves								2
	Plantations with clear conservation purposes								
	Agroforestry				1				
Indirect conservation based on enabling conditions	Environmental education/awareness building								
	Capacity-building				1				1
	Improving the rule of law	1							
	Integrated conservation and development projects (ICDPs)	3			3				1
	Tenure reforms	7			1				2
	Land swap								
Mix of REDD+ projects and Forest Management Policy	Other interventions	1			1				1

A first observation is that a majority of cells are empty: although references were collected over a period of almost two decades, the evidence is still lacking for a majority of intervention/outcome combinations. Furthermore, a significant number of interventions are not evaluated at all based on our corpus – or are only evaluated once. This group includes prominent intervention types such as improving the rule of law and zero-deforestation commitments.

Second, three types of interventions stand out as they comprise three quarters of all intervention/outcome combinations' evaluations: protected areas, conservation based on local communities' practices, and PES managed by public authorities. These three types of interventions cover distinct and complementary approaches, with protected areas being the oldest and most classical approach to forest conservation; community-based forest management being increasingly praised in the conservation community of practice; and PES being a fairly recent high-profile innovative instrument alongside discourses around market-based approaches.

A third observation is that – unsurprisingly – forest cover is by far the most evaluated outcome as the primary target of conservation. Livelihoods appear as a typical complementary outcome, since socio-economic implications of conservation are increasingly seen by donors and practitioners as both a necessary aspect to consider for ethical reasons and a condition for the long-term success of conservation.

A fourth observation is that – surprisingly – GHG emissions only appear once as an outcome variable. This lack of evidence seemingly contradicts narratives about the role of forest in climate change mitigation, yet it can be put into perspective as this may also be covered by evaluations that focus on forest cover as a proxy for the measurement of carbon emissions.

A fifth observation is that leakage remains under-studied, with only seven occurrences across the consolidated sample. This result occurs despite general recognition that the chances are high that conservation somewhere might lead to forest degradation or loss somewhere else. We believe that one reason for this lies with the methodological challenges of properly capturing such dynamics.

Overall, it seems that evaluations focus on the interventions and outcomes that are easiest to assess given available data sets and technologies. Measuring forest cover in well-defined protected areas with clear boundaries is within reach (owing to the wealth of remote-sensing data), without boots on the ground and the time-consuming collection of primary data. In contrast, biodiversity and socio-economic aspects require particular field collection methods that demand longer-term commitment, and a broader combination of skills if high-quality experimental or quasi-experimental methods are to be applied.

This challenge may not be solvable any time soon, due to existing incentives in the scientific community in favour of more publications that lead to the application of particular methods and the use of secondary data (e.g. maps). This, in turn, pleads for better recognition and increased attention to lower-grade evaluations using non-experimental methods, but providing more context and analysing the causal relationships in more depth. Although we recommend using results from studies based on experimental and quasi-experimental methods, there is a trade-off between having more robust results for a highly limited number of intervention categories and outcomes on the one hand, and on the other having less robust results but ones that can be applied to a much broader group of conservation approaches. It remains to be seen whether this trade-off can be solved by supporting more experimental and quasi-experimental methods. Perhaps, a more pragmatic approach in the short term to midterm would be to find ways to give more value to the existing corpus of evaluations that use case studies with rigorous methods,

for instance, which implies the design and use of specific quality assessment criteria to ensure their validity. These studies can also document specific local conditions and processes that might be of interest in understanding on-the-ground implementation challenges.

In terms of implications, we can only add our voice to the statements made in the previous 3ie report. The organizations that are going to provide a substantial share of funding for conservation in the years to come (GEF, GCF, CIF, IUCN, WWF, and others) need access to information in a format that enables evidence to move from the sphere of science to the world of donors and policy. This is feasible because many programmes have procedures in place to collect data of direct use to evaluators. Better coordination with research centres and universities is thus a requirement, not only to improve the quality of evaluations but also to reduce biases in site and intervention selection to the extent possible. This coordination effort should be the prime responsibility of donors because they make decisions on the allocation of funds and are also one of the primary users of evidence.

On the research side, more can be done too: (a) the reasons behind the outcomes could be further explained with more attention paid to the cause-to-effect relationships, which in turn pleads for the usefulness of studies that deliver comprehensive descriptions of local contexts; (b) the degree of impacts also needs to be more systematically put into perspective with the costs involved, so cost-effectiveness should be measured more regularly; (c) for interventions with plenty of available evidence and a huge body of cases – such as protected areas – shedding light on the efficiency of different subtypes (e.g. strict protected area without the tolerated presence of certain human activities versus others with it) may eventually constitute a knowledge-gap filling of higher priority than filling in blank spots for very seldom-used conservation tools; (d) systematic reviews could also look more at the degrees of impacts, to identify intervention types with the highest potential; while environmental outcomes are usually positive with conservation initiatives, some have greater impacts than others, and we need to know more about this piece of critical evidence; (e) last, leakage is another piece of missing information that could be more often integrated in evaluations, even though it implies the collection of more data by evaluators and the refinement of their methods.

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ANNEX 2. SCOPE OF INTERVENTIONS ELIGIBLE WITH THE GCF

To establish the scope of this study, we reviewed the guidelines for GCF REDD+ support and examined forest and land-use projects supported by the GCF. These helped us determine inclusion criteria for the review and are discussed below.

1. GCF/B.17/16

Strategic documents provided some indication of the directions and programmatic priorities for forestry and REDD+ support. GCF support for REDD+ is guided by criteria presented in the document GCF/B.17/16, titled "Green Climate Fund support for the early phases of REDD-Plus".[4] Of these criteria, the most relevant are those related to "paradigm shift": GCF guidance is to think beyond the forest sector and to consider forest ecosystems as part of the wider landscape, where the action takes place towards conservation and sustainable management. The GCF strategy for REDD+ interventions does not restrict them to spatially targeted interventions. The strategies of REDD+ support not only programmes with economic incentives for forest conservation, but also the paradigm shift/transformational change vision of the Fund.[5]

GCF support for Phase 2 of REDD+ (the implementation of interventions), the most relevant for the review, is further defined according to three major land uses:

> ***Previously forested lands:*** *to reduce pressure on forests and prevent increasing deforestation, possible alternatives could include increasing productivity of agricultural lands through more efficient and proven technologies to maximize the use of the land through climate-smart and more sustainable agriculture, enhancing carbon stocks through reforestation and agroforestry and implementing restoration of natural forests where possible (GCF/B.17/16, p. 9).*

This domain refers to interventions in areas without forest cover that either:

a) Have a deliberately intended positive impact on forests elsewhere by optimizing production (typically through increased agricultural yields); or

b) Increase carbon stocks with reforestation/restoration or agroforestry.

While the former is a field of intervention with high potential, and one that we knew should be covered in the review (we suspected evidence might be weak though, and this was to be informed by the EGM), the latter does not qualify as a "forest conservation intervention" (except for agroforestry, if it is understood that it contributes to maintaining carbon stocks).

> ***Managed forests:*** *for forests, which are threatened by deforestation due to their proximity to the agricultural frontier, there is a need to increase the perceived value for their maintenance. This may come in the form of sustainable forest management for timber or non-timber forest products, payment for ecosystem services, and ecotourism, where viable* (GCF/B.17/16, p. 9).

This constitutes the core of the study and was reflected in our proposed categories.

> ***Primary forests:*** *recognizing land tenure rights, strengthening law enforcement measures, creating large-scale protected areas through proper consultation mechanisms (among other activities of minimum or no human intervention), will contribute to maintaining the livelihoods and cultural values of forest-dependent*

[4] GCF/B.17/16. Available at https://www.greenclimate.fund/documents/20182/751020/GCF_B.17_16_-_Green_Climate_Fund_support_for_the_early_phases_of_REDD_plus.pdf/574e7c22-df75-42f9-811d-98432a2f3bc0

[5] Other criteria include impact potential, sustainable development potential, efficiency and effectiveness, needs of recipient, and country ownership. In our view these criteria are not relevant for the review's framework.

> *people living in and around these areas and to the long-term conservation of these forests and the ecosystem services provided by them* (GCF/B.17/16, p. 10).

This also constitutes the core of the study, but it was anticipated that some categories of intervention would be difficult to cover in this evidence review. For instance, it was decided that studies examining the effectiveness of law enforcement or conservation-oriented land tenure reforms would likely not find their way into this EGM, because of their diffuse spatial nature.

The GCF distinguishes between two types of interventions: those that create enabling conditions (usually a government's responsibility), and private sector interventions. Both subsume a wide range of forest conservation-oriented interventions, for which a large body of evidence can be found in literature.

Interventions for enabling conditions rely mostly on government actors at different levels, and include the following:[6]

a) *Land tenure reform and land-use planning:* It was expected that these types of interventions would be easy to capture in the EGM.

b) *Strengthening law enforcement and regulatory framework:* Such interventions were anticipated to be easy to capture in the EGM.

c) *Policy, legal and institutional reforms in the forestry and related sectors:* These types of interventions were considered difficult to identify and include in the EGM, not least because differences between this class of interventions and the previous classes are hard to specify.

d) *Development of national forest inventories:* It was not anticipated that studies examining these interventions would be captured by this evidence review because programmes aiming to improve and strengthen national forestry inventories are usually designed through policy, are spatially diffuse and provide enabling conditions through policies.

e) *Strengthening institutional and local capacities of relevant stakeholders in the forestry and land-use sectors:* These held potential for the review, but also seemed a heterogeneous group with variable links to forest conservation.

Interventions targeted at the private sector are not well defined in the document but seem to include the following:[7]

a) *Sustainable agriculture and agroforestry either taking place outside forested areas or/and with improved yields*: It was anticipated that these types of interventions would be easy to capture in the EGM.

b) *Assisting small-scale farmers to engage in deforestation-free supply chains:* These types of interventions were deemed easy to capture in the EGM.

2. Approved GCF forest and land-use projects

The forest and land-use projects that have been approved by the GCF can be found on the GCF website.[8] We gained insights from these projects to help us define relevant categories of forest conservation interventions, as presented in Table 13. The table shows that GCF projects focus on indirect conservation interventions that usually address communities' needs, agriculture and capacity-building. It remains to be seen whether Phase 3 of REDD+ (results-based payments) will

[6] This section borrows from document GCF/B.17/16, p. 10.
[7] This section borrows from document GCF/B.17/16, p. 11.
[8] Available at https://www.greenclimate.fund/how-we-work/redd

fund projects that fall in other categories of interventions.[9]

Table 13 Approved GCF projects and connections to intervention categories used in the study

NAME OF GCF PROJECT	DESCRIPTION	RELEVANT INTERVENTION CATEGORIES
Climate-Friendly Agribusiness Value Chains Sector Project	This initiative targets four agricultural value chains in four provinces in Cambodia. It will enhance the resilience and productivity of crops, and increase agricultural competitiveness and household incomes in the targeted provinces. It will address each stage of the agricultural value chain.	• Indirect conservation based on improved technologies and/or substitution effects. • Indirect conservation based on enabling conditions.
Low-Emission Climate Resilient Agriculture Risk Sharing Facility for Micro, Small and Medium Enterprises (MSMEs)	Supporting the transition to low-emission, climate resilient agriculture in Guatemala and Mexico through the creation of a risk-sharing facility to unlock innovative and scalable financial instruments for MSMEs. It will support them to engage lenders for the longer-term loans needed for climate-smart investments.	• Indirect conservation based on improved technologies and/or substitution effects. • Indirect conservation based on enabling conditions.
Priming Financial and Land-Use Planning Instruments to Reduce Emissions from Deforestation	Reducing deforestation in Ecuador by investments to support sustainable agricultural production and conservation of forests. The targeted investment will control agricultural expansion into forest areas, while agricultural and livestock production practices will be implemented to reduce deforestation. Land-use zoning plans will be aligned with national climate change related targets, and measures will be implemented to support the restoration, conservation and sustainable production in vulnerable watersheds. The project will also ensure that financial instruments are aligned with the objectives of the action plan, by orienting public credit lines towards sustainable agricultural production practices, promoting tax incentives for REDD-supportive activities, and strengthening purchasing policies for deforestation-free commodities, their certification and traceability.	• Indirect conservation based on improved technologies and/or substitution effects. • Conservation based on product markets.
Building the Resilience of Wetlands in the Province of Datem del Marañón, Peru	The project will facilitate better land-use planning and management of the region's wetlands while strengthening sustainable, commercial bio-businesses of non-timber forest products. It will entrust indigenous communities with the management of resources, improve their livelihoods and empower women in the decision-making processes. The largest share of funds will support bio-businesses, including funding for business plans, marketing and management, equipment and supplies, and the development of solar energy for operations. The nature-based products include salted fish, smoked meat, aguaje pulp (from palm trees) and "dragon's blood", a	• Indirect conservation based on enabling conditions. • Conservation based on local sustainable practices involving local communities.

[9] Available at https://www.greenclimate.fund/documents/20182/1203466/Terms_of_reference_for_the_pilot_programme_for_REDD__results-based_payments.pdf/e26651fc-e216-c8b0-55a1-8eea16a90f39

NAME OF GCF PROJECT	DESCRIPTION	RELEVANT INTERVENTION CATEGORIES
	croton tree resin used as an anti-inflammatory and anti-viral.	
Poverty, Reforestation, Energy and Climate Change Project (PROEZA)	Promoting forest planting and reforestation in eastern Paraguay, sequestering carbon and supporting local households to diversify their agricultural production to enhance their resilience to the impacts of climate change. Environmental conditional cash transfers will be provided in exchange for community-based climate-sensitive agroforestry. This will serve as a bridge until new farming models are financially sustainable. Credit will be made available to establish productive forest plantations for bioenergy, timber and silvo-pastoral production (combining forestry with livestock grazing). Capacity-building will support good governance and law enforcement.	• Indirect conservation based on improved technologies and/or substitution effects. • Conservation based on local sustainable practices involving local communities.
Development of Argan Orchards in Degraded Environment – DARED	Supporting rural communities in the Arganeraie Biosphere Reserve through the planting of argan orchards and the promotion of sustainable arganiculture to foster sustainable development, build resilience and support climate mitigation. This project will strengthen the resilience of rural communities and the Arganeraie Biosphere Reserve through planting 10,000 ha of argan tree orchards with soil conservation and rainwater harvesting capabilities. Supporting argan plantations and arganiculture will also contribute to relieve the anthropic pressure on the natural forest and improve livelihoods of the communities by moving from a model of fruit collection from natural forests towards sustainable forest co-management.	• Indirect conservation based on improved technologies and/or substitution effects. • Conservation based on local sustainable practices involving local communities.
Strengthening Climate Resilience of Rural Communities in Northern Rwanda (SCRNRP)	Increasing the resilience of vulnerable communities to climate change in northern Rwanda by targeting a range of integrated adaptation interventions. This project will focus on increasing the climate resilience of vulnerable communities in nine sectors of the Gicumbi District of Rwanda. It will restore and enhance ecosystems in degraded watersheds and increase the capacity of communities to sustainably manage forest resources. It will follow an integrated landscape management model.	• Conservation based on local sustainable practices involving local communities. • Indirect conservation based on enabling conditions.
Sustainable Landscapes in Eastern Madagascar	Sustainable landscape measures to enhance the resilience of smallholders, reducing GHG emissions and channelling private finance into climate-smart investments in agriculture and renewable energy. The project model is to initially address smallholder vulnerability through non-profit activities, which will prepare the smallholding farmers to eventually access private sector investment, providing a pathway out of extreme vulnerability and dependency. This approach is aimed at overcoming the barriers to private sector investment. This will enable	Indirect conservation based on enabling conditions.

NAME OF GCF PROJECT	DESCRIPTION	RELEVANT INTERVENTION CATEGORIES
	continued investment in landscape-level adaptation and mitigation activities.	
Bhutan for Life	Securing protected areas in Bhutan, which comprise 51 per cent of its territory, thus preventing deforestation and preserving resources. Much of Bhutan is managed under a network of protected areas, which are central to ensuring that at least 60 per cent of the country remains under forest cover. However, many of these areas are coming under increasing pressure from a combination of economic development in surrounding areas, illegal extraction of resources and the adverse impacts of weather-related events such as landslides, floods and forest fires. Bhutan for Life will support improved management of the country's protected areas, providing time and resources for the government to secure long-term revenues to maintain the improvements. Activities under the programme will increase forestry and land-use climate mitigation, and support ecosystem-based adaptation to improve natural resource management and livelihoods, and enhance biodiversity.	Protected areas.
Improving the Resilience of Vulnerable Coastal Communities to Climate Change Related Impacts in Viet Nam	Strengthening storm and flood protection for coastal communities in Viet Nam through resilient housing, planting and rehabilitation of mangrove forests, and systematized climate risk assessments for the public and private sectors. In order to create storm surge buffers, 4,000 hectares of mangroves will be planted and rehabilitated, which will also create sustainable ecosystem resources to support coastal livelihoods.	Indirect conservation based on enabling conditions.

ANNEX 3. CONSOLIDATED HEAT MAP INTEGRATING PREVIOUS 3IE STUDY COVERING 1990–2015

These two evidence gap maps (EGMs) were applied to two consecutive periods and sought to answer the same question. We have attempted to merge them to deliver results spanning almost two decades of literature evaluating forest conservation interventions. The methods for both studies are slightly different. Not only do they differ in terms of inclusion/exclusion criteria, but the frameworks to determine conservation intervention categories and the nature of outcomes also only partially overlap. For these reasons, we reprocessed the entire sample of the first 3ie report, to prepare the data for inclusion in the framework used for the latest study. Below we recapitulate these steps.

The consolidated heat map is made of Tier 1 references from the updated EGM and selected references from the 3ie report; indeed, inclusion/exclusion criteria used in the 3ie study focus on experimental and quasi-experimental studies and tend to align with those used for Tier 1. However, we discovered that studies included in the 3ie study might not always qualify based on the criteria used in the updated EGM. Therefore, we tested all of the references from the 3ie study against these criteria (systematic reviews were excluded as they were not part of the updated EGM). We also paid special attention not to include interventions that do not have conservation as their primary goal. We also separated evaluations within any given article whenever justified; for instance, when interventions were of a different nature and separately evaluated.

In the end, we kept 68 of the 110 references from the 3ie study, which contain 78 evaluations. This compares to the 42 articles with 50 evaluations in the updated EGM. The following were among those not included:

- 22 articles are not in line with the PICO framework of the updated EGM (the intervention is not primarily targeted at conservation, or it does not affect the population within clear spatial boundaries, or the method is non-experimental/no comparator, etc.)
- 17 articles are grey literature that we did not draw upon for the updated EGM
- 3 articles could not be downloaded

We have been conservative in two ways:

- The database (Excel file) that was provided by the GCF contains references that do not appear in the list of references at the end of the 3ie report. We reviewed these references and selected 3 out of 13.
- We found 5 references that were listed in the 3ie report but missing in the database, and we included them in the final analysis.

Last, we also ensured that articles were not considered more than once, although the 3ie database contained duplicates. Moreover, we made sure that different articles did not contain the same data on similar interventions, as happened in a couple of cases.

Ultimately, the consolidated heat map presented in Table 12 contains a total of 110 articles with 129 evaluations, spanning the period 1990 to 2018.

We also provide an Excel file that lists all references reported in the consolidated heat map, that contains the source file for the heat map, and that displays separately results for both studies (using the reprocessed sample for the 3ie study).

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