EBA

09
2015

IN SEARCH OF DOUBLE DIVIDENDS FROM CLIMATE CHANGE INTERVENTIONS EVIDENCE FROM FOREST CONSERVATION AND HOUSEHOLD ENERGY TRANSITIONS

G. Köhlin, S. K.Pattanayak, E. Sills, E. Mattsson, M. Ostwald, A. Salas, D. Ternald

In search of double dividends from climate change interventions: evidence from forest conservation and household energy transitions

Gunnar Köhlin, University of Gothenburg

Subhrendu K. Pattanayak, Duke University

Erin Sills, North Carolina State University

Eskil Mattsson, University of Gothenburg

Madelene Ostwald, University of Gothenburg

Ariana Salas, CATIE

Daniel Ternald, University of Gothenburg

Rapport 2015:09
till
Expertgruppen för biståndsanalys (EBA)

Acknowledgement: The team would like to thank the reference group (consisting of Kim Forss, chair, Anders Granlund, Måns Nilsson, Alison Pollard and Susanne von Walter) as well as Emma Öståker and Sonja Daltung from the Secretariat for the Expert Group on Aid Studies for constructive support throughout the report process. We would also like to thank Anders Ekbom, Gunilla Ölund Wingqvist and Veronica Brodén Gyberg for valuable comments on drafts of the report and the IDEA program at CATIE, particularly Francisco Alpizar and Alberto Vargas, for hosting part of the team during the report writing.

This report can be downloaded free of charge at www.eba.se

ISBN 978-91-88143-11-2

Printed by Elanders Sverige AB
Stockholm 2016

Cover design by Julia Demchenko

Gunnar Köhlin is Associate Professor at the Department of Economics at University of Gothenburg. He has a broad expertise within environmental and development economics with a focus on energy demand and forestry utilization in developing countries. Köhlin is the Director of the Environment for Development Initiative (EfD), a global network of environmental economics centers focusing on academic capacity building, applied research and policy interaction.

Subhrendu K. Pattanayak is Professor of Public Policy & Environment Economics at Duke University, USA. Pattanyak conducts economic analysis of policy and programs focused on environment, energy, global health, and climate-related outcomes in low and middle income countries. He relies on impact evaluations, non-market valuations, meta-analyses and systematic reviews to develop policy advice in these domains.

Erin O. Sills is Professor of Forestry and Environmental Resources at North Carolina State University, USA. Sills is an expert in international forestry, ecosystem services, and evaluation methods for climate-related actions. Her research interests include forest-based livelihoods and economic development, deforestation and land use in the tropics, and impact evaluation of conservation policies.

Eskil Mattsson is a researcher at the Centre for Environment and Sustainability, University of Gothenburg. Mattsson´s research focuses on multifunctional land use systems linked to climate policy instruments.

Madelene Ostwald is Associate Professor working at Physical Resource Theory at Chalmers University of Technology as part of the Centre for Environment and Sustainability in Gothenburg and the Centre for Climate Science and Policy Research (CSPR) at Linköping University. Ostwald's research focus is on land use and forestry issues in relation to climate change and policies and she has been part of the development of Focali, a Swedish research network focusing on forest/bio-energy, cliamate and poverty issues.

Ariana Salas is a research assistant at EfD Central America and holds a master's degree from the Erasmus Mundus Master Program on Sustainable Territorial Development. She is collaborating on various research projects related to the Payment for Environmental Services (PES) in Costa Rica and environmental policies in Central America.

Daniel Ternald is a research officer of EfD and holds a MSc in Development Economics from the University of Gothenburg. He has a background in energy research from working at the EfD office in Addis Ababa, Ethiopia, mapping the energy sector and assisting in EfD projects.

Table of contents

Preface

Over the last year, climate change has been high on the agenda of the international community. The 2030 Agenda contains several goals directly related to climate change, and at the UN Conference on Climate Change (COP21) world leaders agreed to unleash actions and investment towards a low carbon, resilient and sustainable future.

International development assistance is also increasingly shaped by climate change concerns. While much of the aid is distributed through multilateral channels, today more than 15 per cent of total bilateral aid is directed towards climate interventions. The target of the 2030 Agenda is a five-fold increase by 2020. Climate change has been a top priority of Sweden's international development cooperation for many years now and in this year's budget the Government announced a dramatic increase in the appropriation to climate financing.

These are responses to current and upcoming challenges. A changing climate means more extreme weather events, more droughts and rising sea levels, which will have an impact on water availability, food production and the frequency of natural disasters. Poor people in developing countries will be particularly adversely affected, and as the impacts of climate change worsen, ending poverty will become more difficult. The question is, what role should international development aid play in financing climate action? Is it possible to address both climate change and poverty in an effective way?

In this report, a team of researchers (Subhrendu K. Pattanayak, Erin Sills, Gunnar Köhlin, Madelene Ostwald, Eskil Mattsson, Ariana Salas and Daniel Ternald) has analysed what we know about the multifaceted impacts of aid-financed interventions. Their conclusion? Very little. The study focuses on two of the top five sectors receiving climate-related development finance, namely forest conservation and household energy. And although some solid knowledge does exist, the authors argue that there is a 'know-do gap', i.e. a gap between what we know and what we do. This gap emerges in different dimensions – the interventions implemented are not well represented by the ones studied, the intended impacts are not the impacts studied, the geographical areas studied do not fully represent the areas of implementation. This is, of course, cause for concern. And if this situation doesn't change, there is an obvious risk that aid-financed climate interventions will be ineffective.

The authors call for greater attention to the importance of 'knowing' before 'doing'. In their view, the way forward is to prepare for evaluations at a very early stage and to make sure that the assessment teams include individuals with complementary competencies. Other recommendations include strengthening domestic capacities in recipient countries and giving local research institutes the mandate and resources to provide new knowledge. Access to reliable data on climate aid is also identified as an area requiring further development. The authors attempted to map Swedish climate aid, but this proved to be a difficult task. They found that interventions could easily be double-counted since categories are not mutually exclusive, e.g. the same project can be marked as mitigating climate and contributing to climate adaption. They also found that many Swedish projects target climate change adaptation and/or mitigation as a 'significant' objective, and warn about the risk of overusing climate-related markers.

Donors play an important role in improving the knowledge base as commissioners and financiers of studies, but also as conveners and brokers between researchers, practitioners and potential financiers of evaluations outside the donor community. But equally important is that they provide researchers with correct data.

We hope that this report will stimulate discussion on how to ensure effective use of aid to tackle climate change. The authors have carried out an impressive task in systematically identifying and reviewing a large number of studies and evaluations. As a result, this report contains not only an assessment of the knowledge base but also essential evidence, and the interested reader will find comprehensive and systematised information and references for further reading.

The work on this report has been conducted in dialogue with a reference group chaired by Dr Kim Forss of the EBA. The analysis and conclusions expressed in this report are solely those of the authors.

Stockholm, March 2016

Lars Heikensten

Sammanfattning

Klimatförändringarna utgör mänsklighetens största utmaning och vi har bara börjat hantera dem. Forskningen pekar på att klimatförändringarnas effekter kommer att drabba fattiga människor i utvecklingsländer särskilt negativt. Det handlar t.ex. om minskande skördar till följd av temperaturökningar eller översvämningar till följd av höjd vattennivå och extrema väderfenomen. Samtidigt finns förväntningar på att utsläppen av växthusgaser kan minskas kostnadseffektivt exempelvis genom minskad avskogning och förbättrade spisar i utvecklingsländer. Det är därför inte förvånande att klimat-relaterade biståndsinterventioner ökar som andel av internationellt utvecklingssamarbete – 2013 uppgick det till 15 % av det globala bilaterala biståndet och i enlighet med det Hållbara utvecklingsmålet 13a skall det samlade klimatbiståndet uppgå till 100 miljarder USD årligen från och med 2020. Även vad det gäller svenskt bistånd så har vi sett samma trend mot ökat klimatbistånd.

Klimatbistånd – både för klimat och fattigdom?

Den dubbla målsättningen att motverka klimateffekterna och minska fattigdomen ökar kraven på noggrann planering och genomförande av biståndprojekt. Dessa dubbla mål ställer också högre krav på utvärderingar av sådana projekt.

Vårt huvudsakliga syfte med denna rapport är att dokumentera vad vi faktiskt känner till om de mångfacetterade effekterna av klimatinterventioner i de två sektorerna skog och energi. Givet resultaten, frågar vi oss också hur sådana projekt bör utvärderas för att kunna bedöma deras biståndseffekt och klimatpåverkan.

Vi tar oss an dessa frågor genom att (i) kartlägga klimatbiståndet från Sverige, ett antal referensländer och globalt mellan 2009 och 2013, (ii) genomföra en systematisk genomgång av utvärderingar av klimatprojekt inom skogs- och energisektorerna för att uppskatta kunskapsbasen och resultaten från dessa utvärderingar, (iii) relatera vad vi finner i dessa studier (vad vi *vet*) till interventionerna (vad myndigheter *gör*) för att identifiera luckor mellan vad vi vet och vad vi gör (”know–do–gaps”) som behöver fyllas för att öka effekten av framtida projekt, samt (iv) diskutera dagens utvärderingsmetoder, inklusive nya internationella initiativ, för att skapa den nödvändiga

kunskapen som krävs för att säkerställa både klimat- och utvecklingsmålsättningarna av framtida klimatinterventioner.

Fokus på skogsskötsel och hushållens förändrade energianvändning

I denna rapport fokuserar vi på två viktiga sektorer där klimatinterventioner har dessa dubbla målsättningar: ***Skogsskötsel***[1], en sektor kring vilken det har varit påtagliga kontroverser gällande de lokala effekterna på hushållens inkomster när skog skyddas för att minska utsläppen av växthusgaser, och ***Hushållens förändrade energianvändning*** kring vilka det funnits stora förväntningar på en tredubbel vinst från elektrifiering av landsbygden och användningen av bättre spisar genom dess positiva effekter på det globala klimatet, regional miljö och hushållens hälsotillstånd. Vi fokuserar på dessa båda sektorer eftersom de är: (i) två av de fem sektorer som är prioriterade i globalt klimatbistånd; (ii) särskilt nämnda inom ramen för de globala hållbarhetsmålen och i den svenska biståndsplattformen; (iii) särskilt relevanta för vårt fokus på bistånd som har de dubbla målsättningarna att både adressera klimatproblematiken och förbättra levnadsbetingelserna för fattiga människor; (iv) sektorer som rapportförfattarna har särskild kunskap och erfarenhet av utvärderingar inom.

Globala trender och svenska bidrag

Klimatfinansiering är fragmenterad och politiserad och biståndsgivarna har en hög grad av diskretion rörande dess användning. Klimatbiståndets innehåll påverkas ofta inte bara av biståndsmyndigheter och utrikesdepartement, utan även av miljö- och finansministerier. Detta leder till en stor variation i fokus mellan olika givare, och denna risk för politisering leder även till ett än större behov av att luta sig mot faktisk kunskapsinhämtning för att säkerställa effektivitet i biståndet.

---

1 Med skogsskötsel menar vi i denna rapport insatser för att förhindra avskogning, hållbar skogsskötsel för timmer och andra skogsprodukter, och skydd av skog för att upprätthålla ekosystemtjänster. I denna rapports sammanhang så har skogsskötsel som målsättning att minska utsläppen av växthusgaser och/eller öka upptaget av koldioxid i skogen och/eller stödja hushållens kapacitet att anpassa sig till växthuseffekten.

Klimatinterventioner har blivit en allt viktigare del av svenskt bilateralt bistånd under perioden 2008 – 2013, särskilt inom ramen för den ”gröna sektorn” (jord- och skogsbruk). Till en början kanaliserades majoriteten av svenskt klimatbistånd genom multilaterala fonder. Fördelen med multilateralt bistånd är att interventionerna samordnas med andra givares klimatbistånd, medan nackdelen är att Sverige har liten påverkan över genomförandet och har små möjligheter att utvärdera effekten av investeringarna. Inom svenskt bilateralt bistånd minskar det generella miljöbiståndet medan stödet till klimatinsatser ökar. Detta pekar mot att klimatinsatserna har ökat på bekostnad av det generella miljöbiståndet och att klimatbiståndet inte är additionellt till traditionellt bistånd.

Systematisk litteraturöversikt av utvärderingar skogsskötsel- och hushållsenergiprojekt

Vi definierade först protokoll (urvalsverktyg) för att identifiera utvärderingar av de lokala effekterna av interventioner avsedda att stärka skogsskötsel och hushållens förändrade energianvändning. Vi använde sedan dessa protokoll på de akademiska databaserna Web of Science och EconLit varefter vi manuellt gick igenom materialet för att identifiera studier som innehöll empiriska utvärderingar av effekten av genomförda projekt. Vi kompletterade sedan dessa studier med relevanta referenser (i) som vi redan hade identifierat, (ii) citerade av andra studier i vår översikt, (iii) identifierade bland de utvärderingar som biståndsgivare har lagt upp på sina hemsidor. Vi utökade sedan vårt underlag genom att använda oss av andra nyligen genomförda systematiska litteraturöversikter och meta-analyser av utvärderingar inom skogs- och energiområdena. Till sist gick vi igenom de senaste trenderna vad det gäller utvärderingar och den snabbt expanderande metodologiska litteraturen kring noggranna miljö- och biståndsutvärderingar för att identifiera erfarenheter relevanta för svenskt bistånd.

Resultat från skogsskötselprojekt

Vi fann endast 22 publicerade utvärderingar av skogsskötselprojekt avsedda att hantera klimateffekter som innehöll evidens rörande de lokala effekterna av projektet och dessa berörde endast ett dussin

länder. Vi fann dock systematiska litteraturöversikter av liknande projekt som ofta – men inte alltid – syntetiserade resultaten från skogsskötselprojekt som inte hade klimatinsatser som specifikt mål. Betalning av ekosystemtjänster har visat sig öka skogstäcket och hushållens inkomster bland dem som deltar. Avskogning minskas effektivt av skogsskyddsområden. Lokalt deltagande i framtagandet av regler och institutioner som är avsedda att skydda skogen leder ofta till bättre resultat både för kvaliteten på skogen och för hushållens välfärd.

Resultat från projekt avsedda att förändra hushållens energianvändning

Vi fann nästan 100 utvärderingar av insatser ämnade att förändra hushållens energianvändning, inte minst i Kina och Indien. Dessa insatser fokuserar främst på förbättrade spisar, men också elektrifiering av landsbygden och ökad användning av andra förnyelsebara energikällor med målsättningen att förbättra luftkvaliteten inomhus och hälsan, framförallt hos unga barn. Vad det gäller förbättrade spisar för biobränsle är resultaten blandade medan det finns mer konkreta bevis på att elektrifiering av landsbygden och mer avancerade teknologier för matlagning faktiskt levererar både hälso- och välfärdsvinster.

Gapet mellan kunskap och handling: ”the know–do–gap”

De systematiska litteraturöversikterna påvisade en olycklig brist på överlappning mellan vad som utvärderats av forskare och de projekt, program och den politik som genomförs i de berörda länderna. Denna bristande överensstämmelse finns i olika dimensioner – de insatser som genomförs är inte väl representerade bland dem som analyseras, de eftersträvade effekterna av insatserna är inte de som analyseras, och de geografiska områden som utvärderingarna fokuserar på utgör inte en bra representation av de platser där insatserna genomförs. Denna diskrepans mellan vad som studeras och vad som genomförs uppkommer till stor del på grund av att utvärderingar är kollektiva varor – men det är sällan som individuella projekt beställer ambitiösa och dyra utvärderingar som projektet själv inte kommer att kunna dra nytta av. Det är också stora skillnader mellan forskare och tjänstemän

rörande vilken tillförlitlighet som man kräver av analysen. Dessutom saknas det ofta lokal kapacitet för att genomföra utvärderingarna. Det är därför viktigt att man från båda håll (forskare och tjänstemän) bidrar till att göra kunskapsinhämtningen mer baserad på vad som faktiskt genomförs genom att uppmuntra rigorösa utvärderingar av faktiska insatser, såsom beskrivs nedan.

Lovande initiativ för att utvärdera klimatinsatser

Det finns tecken på förändring och genom att inkludera utvärderingar (genomförda av lokala experter) parallellt med själva interventionen minskas dessa know–do–gaps. Till exempel har NORAD byggt in utvärderingar i designen av sin biståndsportfölj vad det gäller REDD+[2] och den norska ambassaden i Addis Ababa har gjort detsamma rörande Etiopiens ambitiösa klimatstrategi. Även Sverige skulle kunna använda sin finansiering för att säkerställa att incitamenten för implementerande personal och forskare är sådana att vi inte bara lär oss huruvida insatserna bidrar både till minskade växthusgasutsläpp och ökad välfärd för lokalbefolkningen utan även hur detta sker, för vem och under vilka förutsättningar.

Rekommendationer

Klimatfinansieringen är till stor del fragmenterad eftersom en stor del av klimatbiståndet, liksom det svenska, är bilateralt med en hög grad av diskretion från givarnas sida rörande både vad biståndet skall fokusera på och hur det skall implementeras. Detta leder till två rekommendationer för det för tillfället snabbt växande klimatbiståndet: för det första bör givare koordinera sina insatser för att säkerställa att det begränsade biståndet faktiskt uppnår bästa möjliga effekt. För det andra, bör givare använda sig av data och analys rörande effektivitet och faktisk effekt när de väljer vilka insatser att prioritera.

Sverige bör överväga att utöka sitt bistånd när det gäller hushållens förändrade energianvändning, särskilt när det gäller mer avancerade energitjänster (såsom elektrifiering och förnyelsebara energikällor) för

2 REDD+ är en mekanism som UNFCCC initierade för att minska växthusgasutsläppen från avskogning och skogsförstörelse.

fattiga människor eftersom det finns ökad evidens att dessa interventioner leder till ökad välfärd, förbättrad inomhusluft, bättre kvalitet för närliggande skogar, och hälsofördelar, inte minst för små barn. Bistånd till förbättrade spisar för biomassa får endast försiktigt stöd i rapporten eftersom resultaten är blandade.

Givet bristen på studier, och farhågorna för de potentiellt negativa lokala effekterna som skogsskötselprojekt kan ha, krävs det mer försiktighet innan man ökar stödet till denna sektor. Medan det finns en del vetenskapligt stöd för att vissa strategier i denna sektor, såsom betalning för ekosystemtjänster och skydd av skogsområden genererar både positiva miljöeffekter och ökad inkomst, så behövs fler studier från de områden som är värst utsatta för tropisk avskogning. Gemensamt för olika typer av skogsinterventioner är att effektiv lokal delaktighet i framtagandet av regler och institutioner leder till bättre resultat både för kvaliteten på skogen och för hushållens välfärd, och framtida bistånd bör uppmuntra sådan decentraliserad skötsel och delaktighet.

Slutligen så stödjer vi de upprepade och allt mer ljudliga kraven att biståndsinsatser måste förekommas av lärande och tillämpade forskningsprogram så att vi kan ”veta” innan vi ”gör”. Specifikt så erbjuder vi följande skarpa förslag:

1. Forskare bör ges incitament (av biståndsgivare och tjänstemän) att generera ”evidens baserad på praktik” istället för att tvinga på myndigheterna ”praktik baserad på evidens” i situationer som inte liknar de utvecklingslaboratorier inom vilka resultaten har genererats. Det senare görs ibland baserat på randomiserade studier som kontrollerar många av verklighetens utmaningar vilket gör att man kan ifrågasätta generaliserbarheten.

2. Ett sätt att hålla forskare som har ambitionen att skapa ny kunskap inom detta område fortsatt involverade, vore om biståndsinsatser inkluderade experimenterande och lärande gällande programmens design, såsom hur deltagare väljs ut för deltagande i programmen (t.ex. för betalning av ekosystemtjänster, inkludering i elektrifieringsprogram och mottagande av förbättrade spisar), regler för användning av skyddade naturområden, och mekanismer för lokalt deltagande i dessa program. Eftersom de slutgiltiga effekterna av skogs- och energiprojekt på miljön (skogs- och luftkvalitet och därmed utsläpp) och fattigdom beror på hur

deltagarna väljs ut och även på hur de som inte deltar påverkas, är det viktigt att inkludera forskare i design och utvärdering.

3. Fler utvärderingar måste göras, antingen där problemen är som värst (d.v.s. antingen där skogen innehåller mest kol eller där hushållen släpper ut mest växthusgaser genom sin matlagning) eller där klimatbiståndet till dessa sektorer är störst. Detta är inte fallet nu. Vi fann t.ex. många utvärderingar av förbättrade spisar från Kina, men inte i Afrika.
4. Eftersom klimatbistånd har dubbla målsättningar så måste utvärderingsteamen ha kompetens i att både uppskatta klimateffekten (ofta naturvetenskaplig och ingenjörskompetens) och välfärdseffekten (ofta samhällsvetenskaplig och humanistisk kompetens). För tillfället är det väldigt få av studierna som rör skogs- och energiprojekt som tar socio-ekonomiska, miljö eller hälsoeffekter i beaktande i samma utvärderingsansats, vilket gör det svårt att analysera synergier och avvägningar mellan de olika målen. Denna svaghet bör åtgärdas när utvärderingar designas och köps upp.

Men det finns positiva signaler om förändring och ambitioner att man skall kunna minska de kunskapsluckor som finns mellan vad vi vet och vad som faktiskt genomförs inom ramen för klimatbiståndet. Norska insatser rörande deras REDD+ program och den klimatresilienta gröna tillväxtstrategin i Etiopien hör till dem.

Vi hävdar inte att det vare sig är enkelt eller billigt att följa våra rekommendationer. Tvärtom, så skulle de sammantaget kräva flervetenskapliga utvärderingsteam som genomför utförliga och ofta dyra studier över långa tidsperioder. Tyvärr är det svårt för biståndsgivare och implementerande myndigheter att genomföra detta. Men givet hur mycket som står på spel, både i termer av kortsiktig fattigdomsminskning och långsiktiga klimatimplikationer så uppmanar vi biståndsgivare, implementerande myndigheter, forskare och utvärderare att alla ta sig an dessa utmaningar. Vår slutliga rekommendation är därmed att detta genomförs genom att stärka inhemsk kapacitet i de mottagande länderna och att lokala, oberoende forskningsinstitut får mandatet, och de nödvändiga resurserna, att uppfylla denna viktiga roll.

Summary

Climate change is the greatest challenge facing humanity, and we are only starting to address it. Climate change scenarios indicate that poor people in developing countries will be particularly negatively affected, e.g. by increased temperature reducing their harvests or flooding due to sea-level rise and extreme weather events. There are also expectations that greenhouse gas (GHG) emissions can be cost-efficiently reduced in developing countries through for example reduced deforestation or improved stoves. It is therefore not surprising that climate interventions have become an increasingly important part of Overseas Development Assistance (ODA), reaching 15 % of the total bilateral ODA, or about 20 billion US dollars, by 2013. According to Sustainable Development Goal 13a, this is expected to grow to at least USD 100 billion by 2020. The same trend is seen with Swedish development assistance.

Climate aid – double dividend or climate mitigation at the expense of development?

The dual goals of both combating climate change and reducing poverty increase the demands on project design and implementation – and hence on careful evaluations.

Our main focus is to find out what we actually know about the multi-faceted impacts of climate interventions in these two domains of forestry and energy. Given what we find, we also ask how such interventions should be evaluated in order to assess both their development co-benefits and climate impacts.

We approach these questions by (i) mapping the flows of climate aid from Sweden, a few reference countries and at global scale from 2009-2013 (ii) making a systematic review of evaluations of climate interventions in the two fields of forestry and energy in order to assess the knowledge base and the results from these evaluations; (iii) relating these findings (what we *know*) to the interventions (what agencies *do*) in order to identify "*know – do gaps*" that need to be filled for greater impact of future projects, and (iv) discussing current evaluation practices, including new international initiatives, to build the necessary evidence to ensure both climate and developmental impacts of future climate interventions.

Focus on forest conservation and household energy transitions

In this report we focus on two important areas of climate interventions where these objectives are combined: ***Forest conservation***[3], where there has been significant controversy over the local livelihood effects of forest-based mitigation, and ***Household energy transitions***, where there are high expectations of a triple-win for the global climate, regional environment, and household health from expansion of rural electrification and promotion of clean cookstoves. We focus on forest conservation and energy transition because these domains are: (i) two of five sectors that have been prioritized in global ODA flows for climate change; (ii) highlighted in the Sustainable Development Goals and for Swedish ODA; (iii) particularly relevant for our focus on the potential double dividend in addressing both climate objectives and local livelihoods; (iv) sectors in which the study team has special expertise and experience with evaluations.

Global trends and Swedish contributions

Climate finance is fragmented and political, with a high degree of donor discretion regarding its use. The targeting of climate interventions is typically affected by several ministries, such as ministries of environment and finance and foreign affairs. This leads to large variations in target areas for different donors, and therefore also greater need to rely on evidence on effectiveness.

Climate interventions have become an increasing part of Swedish bilateral aid 2008-2013, particular for the "green sector" (agriculture and forestry). Initially, the majority of climate aid was channeled through multilateral funds, which has the advantage that interventions gets mainstreamed and focused but has the disadvantage that Sweden gets little influence over the process and further harder to evaluate the impacts from the investments. Swedish bilateral aid is declining in its general environmental portfolio, whereas support for climate

[3] By forest conservation we mean measures to avoid deforestation, sustainable forest management for timber and non-timber products, and forest preservation to maintain ecosystem services. In the context of this report, forest conservation is intended to reduce emissions and/or increase removals of carbon and/or support the adaptive capacity of local households.

interventions has been on an increase. This suggests that the climate interventions have taken over the role of environmental aid flows and is therefore not additional to traditional aid.

Systematic reviews of forest conservation and household energy transitions

We first defined search protocols to identify evaluations of the local impacts of interventions designed to promote forest conservation and household energy transitions, next applied the protocols to the academic databases Web of Science and EconLit, and finally screened these for empirical, *ex post* impact evaluations. We supplemented those search results with references (i) pre-identified by us, (ii) cited by other studies included in our review, and (iii) identified by scanning lists of evaluations posted on donor websites. We then expanded our results by drawing on other recent systematic reviews and meta-analyses of impact evaluations of forest conservation and household energy interventions. Finally, we reviewed recent evaluation efforts, and the rapidly expanding methodological literature on rigorous impact evaluations in development and conservation to identify lessons relevant to Swedish aid.

Findings on forest conservation interventions

We found only 22 published impact evaluations of the local impacts of forest conservation interventions designed to address climate change, in just a dozen countries. We found systematic reviews of similar types of interventions that often – but not always – synthesized larger bodies of evidence on forest conservation outside the climate change context. Payments for ecosystem services (PES) have been found to increase forest cover and household income among participants. Deforestation is effectively reduced by protected areas (PAs). Local participation in the design of institutions and rules governing forest use often leads to better outcomes for forest conservation and local livelihoods.

Findings on household energy transitions

We found almost 100 evaluations of interventions to promote household energy transitions, notably in China and India. These interventions focus primarily on improved cook stoves but also on rural electrification and other renewables with the objective to improve household air quality and health outcomes, especially among young children. There is mixed evidence whether improved biomass stoves deliver such benefits, whereas there is more concrete evidence that rural electrification and advanced cooking technologies deliver health and socio-economic benefits.

The know-do-gaps

The systematic reviews revealed unfortunate lack of overlap, or gaps, between what was being evaluated by scholars and the types of programs, projects and policies being implemented on the ground. These gaps emerge in different dimensions – the interventions implemented are not well represented by the ones studied, the intended impacts are not the impacts studied, the geographical areas studied do not fully represent the areas of implementation. Know-do gaps emerge largely because impact evaluations are public goods – but it seldom makes sense for the individual project to commission ambitious and expensive impact evaluations that the project itself will not benefit from. There are also large differences in evidentiary standards between researchers and policy makers, and often insufficient local on-site capacity to conduct the evaluations. It is therefore imperative to find common cause to make "evidence more practice based" by encouraging rigorous impact evaluations of actual interventions, as described below.

Promising initiatives to evaluate climate interventions

There are now signs of change and progress towards closing the "know-do" gaps, with initiatives to incorporate impact evaluation (involving local experts) into interventions. For example, NORAD has built evaluation into the design and evaluation of its aid portfolio

for REDD+[4] and the Norwegian Embassy in Addis Ababa has done the same for Ethiopia's ambitious Climate Resilient Green Economy strategy. Sweden could also use its funding to align the incentives of program managers and scholars to learn not just if interventions contribute to both climate change mitigation and local co-benefits, but how, for whom and under what circumstances.

Recommendations

Climate finance is to a large degree fragmented since much climate aid, including Swedish, is bilateral with a high degree of discretion from donors regarding targeting as well as implementation modes. This leads to two recommendations for the rapidly increasing climate aid flows: First, donors must coordinate to ensure that scarce aid realizes the benefits of scale and scope. Second, donors should rely on evidence and data regarding effectiveness and impact for targeting aid.

Sweden should clearly consider expanding its ODA for household energy transitions, especially advanced energy services (such as electricity and renewable energy services) for poor households because there is mounting evidence that it delivers socio-economic, indoor air quality, local forest quality, and health benefits especially to young children. ODA for improved biomass stoves receives cautious support because the evidence is mixed.

Given the paucity of evidence, and the concern over the potential local impacts of forest sector interventions, more caution is needed before scaling up support in this sector. While there is some evidence that strategies in this sector such as payments for ecosystem services (PES) and protected areas (PAs) generate environmental and economic benefits, more evidence is needed from the hotspots for tropical forest loss. Across different types of interventions, effective local participation in the design of institutions and rules governing forest use often leads to better outcomes for forest conservation and local livelihoods, and future ODA support should encourage such decentralized management and participation.

4 UNFCCC initiated mechanism for Reducing emissions from deforestation and forest degradation.

Finally, we support the repeated and rising call that aid efforts must be preceded by learning and applied research program so that we can "know" before we "do". Specifically, we offer the following strong suggestions.

First, scholars should be incentivized (by the practitioner and donor community) to generate "practice based evidence" rather than forcing "evidence based practices" onto settings that do not resemble evaluation laboratories, as is sometimes done in randomized control trials that control away many of the real world challenges and raise concerns about generalizability.

Second, one way scholars in pursuit of new knowledge will remain engaged is if ODA permits experimentation and learning about the design features such as selection into a program (e.g., PES, roll out of electrification and improved cook stoves), rules for use of PAs, and mechanisms for local participation. Because the ultimate impacts of forest or energy interventions on environment (forest or air quality and therefore emissions) and poverty depend on how participants are selected and how non-participants are affected (through spillovers), it is key to include scholars in the design of the interventions and their evaluation.

Third, more evaluations must be in places that reflect either the distribution of forest carbon or household cooking emissions or the allocation of climate aid in these sectors. For example, much of the evaluation of improved cook stoves comes from China, not Africa.

Fourth, because climate aid has dual goals, teams of evaluators must be competent in measuring both climate impacts (often natural and engineering science) and welfare impacts (often social science and humanities). Currently, very few of the studies of interventions in forest conservation or household energy consider both socio-economic and environmental or health outcomes in the same evaluation framework, making it difficult to assess trade-offs and potential synergies. This deficiency should be addressed when impact evaluations are commissioned and designed.

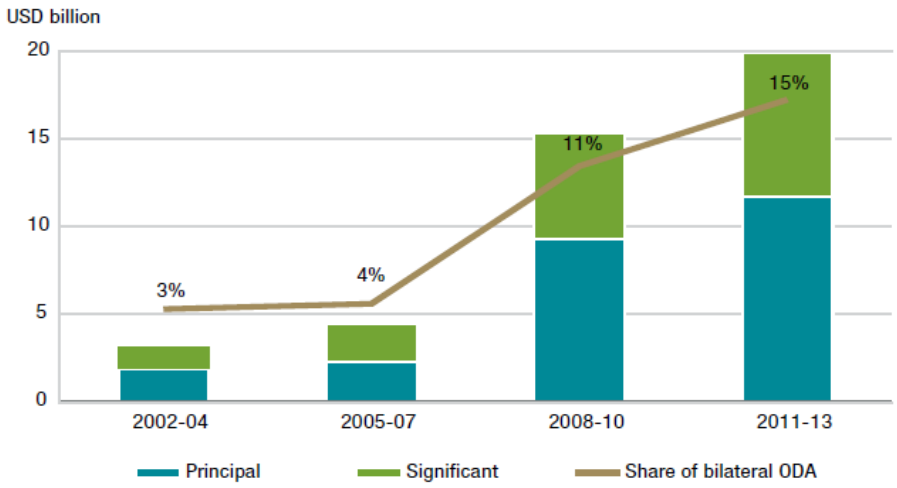
But there are also positive signs of change and progress towards closing the "know-do" gap. Norwegian efforts with REDD+ and the Climate Resilient Green Economy strategy in Ethiopia are among those.

We are not arguing that any of this is easy or cheap. On the contrary, our strong recommendations summarized, likely require multi-disciplinary evaluation teams implementing elaborate and often expensive designs over long periods of time. Unfortunately, these prerequisites are difficult for donors and implementing agencies to meet. However, given the high stakes, in terms of both short-term poverty reduction and long-term climate implications, we hope and urge donors, implementing agencies, scholars and evaluators all rise to the occasion and address these challenges. Thus, our final recommendation is that this is done by strengthening domestic capacity in the recipient countries and that domestic, independent research institutes are given the mandate, and necessary resources, to fulfill this important role.

1 Introduction

Climate related development interventions have increased at the global level. The share of climate related bilateral overseas development aid (ODA) from OECD countries went from 3 % of total ODA in 2002-2004 to 15 % in 2011-2013 (Fig. 1) or from 3 to close to 20 billion US dollars over the 10-year period. Climate related ODA combines the ambition to strengthen adaptation and enhance mitigation to global climate change at the same time as development is promoted through improved livelihoods and contributions to poverty eradication. Such interventions are well in line with many of the Sustainable Development Goals (in particular #1 on poverty, #2 on sustainable agriculture, #7 on energy, #13 on climate change, and #15 on sustainable forest management and protection of ecosystems), which suggests that the combined focus on climate and development will remain in the foreseeable future.

Figure 1. Trend in bilateral climate related ODA, 3-year annual averages



Source: OECD (2015). Figures in constant 2013 prices. Note: The label "Principal" reflects projects that primarily focus on climate change and representing what can be considered a "lower bound" of climate-related ODA. "Significant" reflects that there are multiple objectives and provides an "upper bound" of climate finance.

Interventions related to climate change have also become an important part of Swedish development assistance. In its special Climate Change Initiative (CCI) from 2009 to 2013, the Swedish Government spent more than 648 million USD on bilateral (164 million USD) and multilateral (484 million USD) aid for long-term adaptation to climate change and for efforts to limit emissions of greenhouse gases (GHG) in developing countries (Sida, 2013a).5 More recently, the Swedish Government has reiterated its commitment to address both climate change and access to sustainable energy by including them among their six objectives in the Aid Policy Framework (Sida, 2013b). Climate change mitigation and adaptation, with an emphasis on strengthening institutional capacity, is also one out of five prioritized areas (along with the closely related areas of ecosystem services, sustainable energy alternatives, water resources management and sustainable cities) in Sida's recent "Results strategy for global contributions to environmental and climatically sustainable development 2014–2017" (Government Offices of Sweden, 2014a).

This trend towards climate interventions in development assistance raises some interesting questions. One is whether these interventions imply new and additional resources or if it is a reclassification of existing environmental support. The more pertinent question for this report is whether climate interventions live up to their intentions of both addressing their climate change objectives and their development objectives. Is there evidence in the available impact evaluation literature that these interventions not only address climate concerns but also constitute "good develop assistance" in terms of their contributions to improved livelihoods and reduced poverty? Can we expect such a "double dividend" from climate interventions? From a methodological angle, the question is whether past and current impact evaluations have been answering these questions, and if they are even designed to do so? This report will attempt to answer these questions by focusing on trends and financial flows of climate aid and evaluations of interventions related to the forest preservation and the household energy sectors.

5 See Annex Table A1 for CCI bilateral payments to different countries and Table A2 for CCI multilateral distributions.

Focus and delimitations

The main questions motivating this report are:

- what are the flows of Swedish climate aid?
- what do we know about the impact of climate interventions?
- how should they be evaluated to assess both their development co-benefits and climate impact?

We approach these questions by:

(1) making a systematic review of evaluations of climate interventions in two fields - forestry and energy - in order to assess the knowledgebase and the results from these evaluations.

(2) relating these findings (what we *know*) to the interventions (what agencies *do*) in order to identify "*know – do gaps*" that need to be filled for greater impact of future projects.

(3) discussing current evaluation practices, including new international initiatives to build the necessary evidence to ensure both climate and developmental impacts of future climate interventions.

We focus on the two domains of forest conservation and household energy transitions for several reasons:

- forest conservation[5] and energy transition belong to two out of five sectors that have been prioritized in global ODA flows for climate change (see chapter 2);
- these sectors are highlighted in the Sustainable Development Goals (#7 on energy, #13 on climate change, and #15 on sustainable forest management) as well as in key policy documents for Swedish development assistance (see above);
- forest conservation and household energy interventions are particularly relevant for our focus on the potential double dividend in addressing both climate objectives and local livelihoods;
- the study team has special expertise and experience in conducting evaluations in these domains.

The first category of forest conservation[6] is exemplified by REDD+ that aims to reduce deforestation and forest degradation, which are responsible for up to 15 % of global human induced carbon emissions. REDD+ complements both conventional policies, such as protected areas, and new policies, such as direct payments (for environmental services). The second category of household energy is exemplified by the Global Alliance for Clean Cookstoves (GACC) Energy+, and Sustainable Energy for All initiatives to reduce household reliance on fuelwood and other forms of biomass for cooking, which is of climate change concern because wood burning also contributes to emission of carbon dioxide (because the biomass is extracted unsustainably) and black carbon (a short-lived climate forcer). GACC, Energy+, and Sustainable Energy for All initiatives complement a host of strategies, including the promotion of rural electrification and other renewable technologies.

Thus, forest conservation and household energy transition policies are an essential part of the policy response to climate change, especially because in addition to reducing emissions (of carbon dioxide and black carbon), they can improve local livelihoods both as a direct result of the interventions and as a result of improvements in local environmental quality and ecosystem services. That is, we are not arguing that these are the most effective strategies for mitigating and adapting to climate change, but rather that they are central to the integration of development and climate change goals.

These expectations of both climate and development impacts have been highlighted in both popular and policy discourses in the forest and household energy domains. First, there has been significant controversy over the local livelihood effects of forest-based mitigation (through the voluntary offset market and multilateral programs such as the Forest Investment Program (FIP) that are supported by Sweden), with both claims of co-benefits and concerns about exclusion of local people (Chhatre et al., 2012; Agrawal et al., 2013; Burgess et al., 2013). Second, there are high expectations of a triple-win for the global climate, regional environment, and household health from energy interventions such as rural electrification and clean

6 By forest conservation we mean measures to avoid deforestation, sustainable forest management for timber and non-timber products, and forest preservation to maintain ecosystem services. In the context of this report, forest conservation is intended to reduce emissions and/or increase removals of carbon and/or support the adaptive capacity of local households.

cookstove promotion (Jeuland and Pattanayak, 2012), exemplified by Sweden's recent launch of a 1 billion USD commitment to *Power Africa* (Sida, 2014a). Interventions in both of these domains can and have been cast as both mitigation (through reduced emissions) and adaptation (through maintenance of ecosystem services and poverty alleviation).

Methodology and data

In order to give a comprehensive and structured answer to what we know about recent climate interventions in our chosen domains, we organized a systematic review of the relevant literature. For our systematic review of the evidence base, we defined search protocols to identify impact evaluations of the local benefits and costs of interventions designed to promote forest conservation and household energy transitions. By impact evaluation, we refer to empirical studies on causal impacts of policies conducted by trained professionals in response to calls by mainstream policy organizations, governments and donors (Ravallion, 2009). The focus in these studies is on establishing the counterfactual (what would have happened without the policy) by reducing potential sources of confounding. With sufficient numbers of impact evaluations there is a need to systematically review how the impact varies by policy type, location, beneficiary population, and other contextual factors. This is done in systematic review protocols.

We applied those protocols to the academic databases (e.g., Web of Science and EconLit), and then proceeded to screen for empirical, *ex post* impact evaluations. We supplemented those search results with references (a) pre-identified by us, (b) cited by other studies included in our review, and (c) identified by scanning lists of evaluations posted on donor websites. We then extracted information about the interventions, evaluation methods, and findings from each study, and examined trends and relationships among these by cross-tabulation and visual presentations (maps and bubble charts). We supplemented our results by drawing on other recent systematic reviews and meta-analyses of impact evaluations of forest conservation and household energy interventions in developing countries.

Finally, we reviewed recent evaluation efforts (e.g., the real-time evaluation of Norway's International Climate and Forest Initiative, and the Global Comparative Study on REDD+ implemented by CIFOR), and the rapidly expanding methodological literature on rigorous impact evaluations in development and conservation (e.g., Miteva et al., 2012), to identify lessons relevant to Swedish aid.

Organization of the report

In the remainder of this report, we provide the global trends and Swedish contributions to climate aid in the next chapter. We then introduce the systematic review of the relevant scientific literature (including other systematic reviews) in chapter 3, focusing on the results of empirical *ex post* evaluations of interventions in the two areas of forest conservation (chapter 4) and household energy transitions (chapter 5). In chapter 6 we reflect on the gaps between the available knowledge and what is actually done in climate interventions and provide a number of examples of initiatives that try to address these gaps. In chapter 7 we draw our conclusions from the findings and put forth our recommendations regarding how Sweden could incentivize more rigorous and relevant impact evaluations and finally we conclude with some closing remarks.

2 Climate Aid – Global Trends and Swedish Contributions

Mitigation of climate change refers to efforts to reduce or prevent emission of greenhouse gases or to increase removals of those gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior. It can be as complex as a plan for a new city, or as a simple as improvements to a cook stove design. Efforts underway around the world range from high-tech subway systems to bicycling paths and walkways. Protecting natural carbon sinks like forests and oceans, or creating new sinks through afforestation or green agriculture are also elements of mitigation

Adaptation to global warming is a response to global warming that seeks to reduce the vulnerability of social and biological systems to current climate change and thus offset the effects of global warming. Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change.

The distinction between mitigation and adaptation is increasingly questioned. The distinction between mitigation and adaptation is not fruitful especially when we take a sustainable development approach that includes local ecosystem services and poverty reduction. Carbon storing or mitigating activities (forest rehabilitation or improved cook stoves) are often also adaptation strategies (Stern, 2015).[7]

Challenges in measuring climate aid

Defining and tracking climate aid can be challenging. The "Rio Markers" have been defined and developed by the OECD-DAC

7 "The challenges of development, growth, poverty reduction and sustainability are deeply and intricately interwoven with those of mitigation of and adaptation to climate change. It would be deeply damaging to try to treat them as separate entities for action and for finance." (Stern, 2015, p. 3)

(which monitors the implementation of the Rio Conventions) to track aid that addresses biodiversity, desertification, climate change mitigation and, since 2009, climate change adaptation.[8]

Interventions with a "primary objective" would not have been funded but for that objective, whereas activities marked "significant objective" have other principal objectives. Projects with Rio Markers can easily be double counted since the categories are not mutually exclusive. A given project can be marked as having the primary objective of adaptation, mitigation and/or biodiversity (OECD, 2015). Wingqvist et al. (2011) also concluded that these markers are not necessarily accurate, with possible overuse of the climate-related markers as indicated by the fact that climate change was marked as a significant objective in many Swedish projects. Since donors self-identify projects for Rio Markers, there is a risk of "grossly overestimated accounts of environmental aid allocation, as well as incomparable data due to lack of a standardized identification process" (Marcaux et al., 2013).

There is also the challenge of additionality in climate aid. Article 4.3 of the United Nations Framework Convention on Climate Change (UNFCCC) states that developed country Parties shall provide 'new and additional financial resources' to meet the 'full costs' incurred by developing country Parties to comply with their commitments under the Convention. While the OECD-DAC countries all use Rio Markers to identify climate financing, there is no consensus on how to determine which aid represents 'new and additional financial resources'. Many developing countries support the view that 'additionality' should be measured against the target set for ODA by OECD member countries: 0.7% of gross national income (GNI). Since Sweden has met this target as well as its own ODA target of 1% of GNI, it is less susceptible than other DAC countries to the charge that its climate aid is non-additional.

[8] The Rio Conventions are results of the Earth Summit held in Rio de Janeiro in 1992 and include the United Nations Framework Convention on Climate Change (UNFCCC); Convention on Biological Diversity (CBD); and United Nations Convention to Combat Desertification (UNCCD)

Some global trends

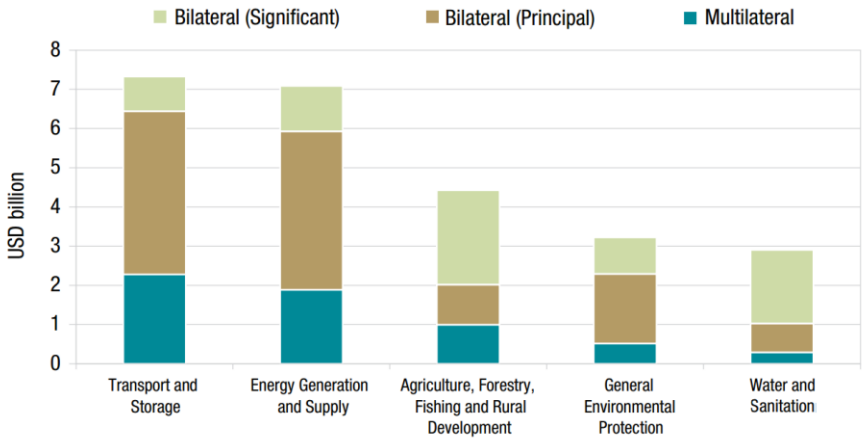
There are two interesting trends in international aid on climate and environment. First, analysis using independent classification of environmental aid (as opposed to the Rio markers applied by donors themselves) suggests a strong trend up until 2008 that "supranational" environmental aid (e.g. addressing climate change, biodiversity etc.) increased at the expense of aid addressing local environmental impacts (Marcoux et al., 2013). We expect that this trend has been intensified since then, as we also will see for Swedish bilateral aid, below. This trend further emphasizes the importance of measuring and studying the local co-benefits to climate aid, especially since climate aid now makes up an increasing part of total development assistance.

Second, bilateral aid has substituted for multilateral aid. It would seem that global challenges should be addressed by global institutions – and there has been a strong interest from developing countries to make use of UN institutions, as opposed to e.g., Bretton Woods institutions and bilateral aid. So far this match of global challenges and global funding has been largely unsuccessful (Pickering et al., 2015). As of today, climate funding is fragmented, which has led to a high degree of discretion to the donors, even to individual ministries, to influence the content of climate aid (Pickering et al., 2015). Given the increased focus on climate in development assistance, this has meant a greater involvement of other ministries (such as environment and finance) as countries make their aid allocation decisions (ibid).

According to OECD-DAC (2014) there has been a great focus on two sectors in particular when it comes to climate-related development finance: Transport and storage, and Energy generation and supply, see Figure 2. The assistance labeled as principal had climate as the primary target of the project, while those labeled significant have the policy objectives as a secondary result of other objectives. With that in mind, it is notable that both our chosen domains – forestry and energy, belong to the prioritized sectors.

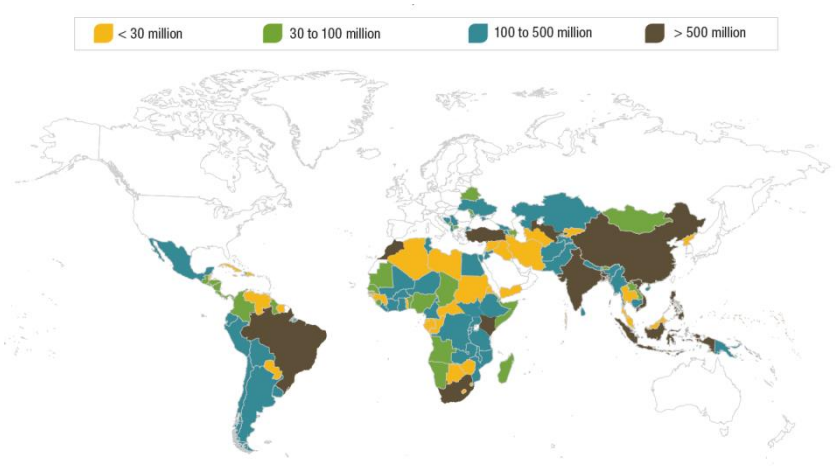
In Figure 3 we see the geographical allocation of climate related aid commitments. This should be related to our findings regarding impact evaluations in chapters 4 and 5 of this report.

Figure 2. Top 5 sectors receiving climate-related development finance in 2013



Source: OECD DAC Statistics, November, 2014.

Figure 3. Climate related development finance by recipient 2013 (M USD commitments)



Source: OECD (2015)

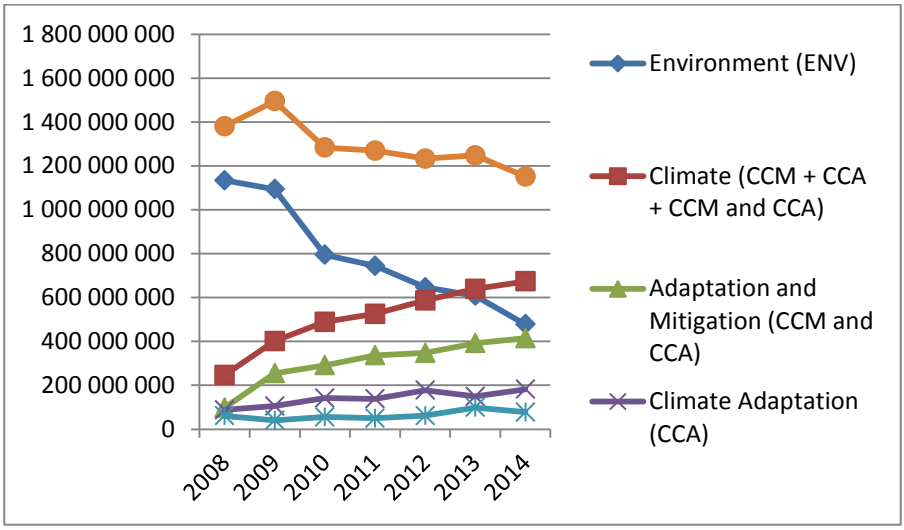
Swedish climate aid

As a response to the increased focus on climate change mitigation and adaptation in the international arena and to the Swedish EU Presidency in 2009, the Swedish Government initiated the Government's Special Initiative for Climate Change in Development Cooperation, or 'the *Climate Change Initiative* (CCI)'. The CCI is part of Sweden's contribution to "fast-start" climate change finance, a financial pledge that the Parties of the UNFCCC made at the Conference of the Parties (COP) 15, in support of the immediate need to undertake actions on climate change in the developing countries (Sida, 2011). The aim of the CCI was primarily to "provide effective support to long-term interventions on climate change adaptation in the poorest countries" (Sida, 2013c). In total, the Climate Change Initiative amounted to 650 million USD for the period 2009–2013. The major part of the budget was earmarked for initiatives targeting adaptation. The bilateral and regional initiatives focused entirely on adaptation, while of the multilateral part 41% was aimed for mitigation (including REDD+), 35% to adaptation and 24% were targeting both mitigation and adaptation (Ministry of Foreign Affairs, 2013) (see Annex A Tables A1, A2, A3 and A4 for more information).

Swedish bilateral climate aid

In 2013, 45 % of the total bilateral development support from Sida had either environment (ENV) and/or climate change as primary or significant objective (Sida, 2015b). In 2013, 20 % of Sida's portfolio focused on (was a primary or significant objective) on climate change adaptation, while 17 % of the portfolio focused on climate change mitigation. As shown in Figure 4, the bilateral climate aid (mitigation, adaptation or both) increased from 260 million USD in 2008 to 670 million USD in 2014 while disbursements marked as environment (including the Rio markers of biodiversity and desertification markers) decreased from 1.18 billion USD in 2008 to 480 million USD in 2014. The net effect for environment and climate was thus negative, while projects without environment and climate markers almost doubled in size.

Figure 4. Bilateral disbursements (USD) from Sida's bilateral aid to recipient countries 2008-2014



Note: Environment (ENV+BES and desertification) and Climate (CCA+CCM) are coded with climate markers with a principal or a significant objective. The same activity can be marked for several objectives. Source: Sida statistical database, 2015.

Within the CCI, 164 million USD was channeled through Sida to bilateral and regional support for climate change adaptation measures in countries where Sida already had existing cooperation (see Annex Table A3 for receiving countries of Swedish CCI). This was done through 60 interventions. Most interventions are in the environment sector, but the large number of other sectors concerned is a reflects the fact that impact of climate change will be on all parts of society, including sanitation, water resources, agriculture, forestry, and disaster preparedness. Five of Sida's existing partner countries (Bangladesh, Bolivia, Burkina Faso, Cambodia, and Mali) were included in the CCI. Support was also provided to regional cooperation in Africa and in Asia.

Forest Conservation

Forest conservation is supported through general environmental protection as well as the forestry sub-sector of agriculture, forestry, fishing and rural development. Less than 1 % of total ODA is allocated to the forestry sub-sector, including afforestation (development), policy, and research. Within this sub-sector, Sweden is a significant donor, contributing the seventh greatest amount of all DAC countries, or around 4 % of total forestry aid.[9]

Forestry is a good example of how climate objectives have been integrated into traditional aid sectors. In 2013, Sida's bilateral support to agriculture, forestry, fishery and rural development was only 134 million USD (5 % of Sida's total support). Within forestry, projects that have a combined climate mitigation and adaptation focus increased from 2.58 million USD (23 % of the portfolio) in 2008 to 12.4 million USD (88 %) in 2014 while climate mitigation projects decreased to 10 % in 2014 (Sida statistical database, 2015). Thus, by 2014, nearly the whole forestry portfolio was designed to address climate change mitigation or adaptation. Similar trends have been noted in ODA for biodiversity protection (which overlaps with ODA for the forestry sector). A recent DAC report noted that of total biodiversity-related ODA, 79 % is designed to simultaneously address climate change mitigation, adaptation, or desertification concerns.

There were six interventions primarily focused on forest conservation within CCI, amounting to 20.9 million USD or 11 % of all bilateral or regional interventions. Another six interventions indirectly supported forest conservation objectives (15.4 million USD – 8 %), and 11 interventions had a possible link or co-benefit (68.7 million USD - 38%). Forest conservation interventions with a primary, indirect or possible link, are shown in relation the total number of interventions in each country within the CCI in Annex Table A4.

Household energy

Household energy interventions fall under Sida's sub goals of Environment and Climate and Sustainable Energy, which are both in

9 From http://stats.oecd.org/

the domain of "sustainable societal development" in the Swedish aid policy framework. Although not as extreme as in the case of forestry, climate related support is increasing its importance in this sector too, and 62 % of the funds in this category were classified as climate aid. Climate interventions surpassed other environmental interventions already in 2009 and are now more than twice the size of environmental projects in support of "sustainable societal development". Sida reports allocating 83.3 million USD to the energy sector in 2013 (Sida, 2015d), while openaid.se list 70 activities with a combined value of 93.4 million USD allocated to the "Energy generation and supply" sector in 2013. None of the bilateral interventions in the CCI targeted household energy or local energy development in an explicit way.

Swedish multilateral climate aid

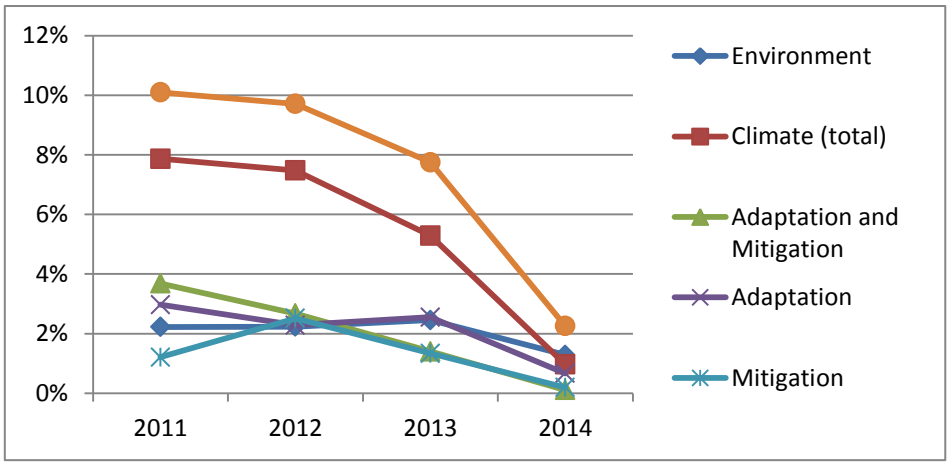
According to openaid.se roughly 21 % of Swedish total ODA is distributed to international multilateral development bodies and fund in 2014. Sweden fund about 50 different multilateral organizations and is the top provider of core funds to several UN agencies (Dzebo and van Asselt, 2014) Total multilateral disbursements have decreased slightly from 1.77 billion USD in 2011 to 1.47 billion USD in 2014 (Sida Statistical Database, 2015).

From 2009 to 2013, the Ministry of Foreign Affairs (MFA) provided development assistance to 18 programs, funds or initiatives targeting climate interventions within the CCI. Six of these programs financed climate adaptation; three aimed at climate mitigation while seven programs targeted both climate mitigation and adaptation. In Figure 5 it can be seen that multilateral climate aid has decreased significantly since 2011, when it represented 901 million or 8% of all multilateral disbursements to about 18 million USD or 1% of all disbursements in 2014.

In 2014, the 18 million USD climate-labeled disbursements were distributed over four initiatives:

- 1.46 million USD to the Green Climate Fund for start-up costs;
- 5.67 million USD the Global Environmental Facility (GEF);
- 8.75 million USD to the Nordic Environmental Facility; and
- 2.19 million USD to the Least Developed Countries Fund.

Figure 5. Swedish multilateral environment and climate (adaptation+mitigation) disbursements in percent of total multilateral disbursements.



Source: Sida database, 2015.

Forest conservation

Out of the 484 million USD allocated to multilateral investments within CCI, 28.4 million USD specifically targeted forest conservation initiatives.

Multilateral initiatives supporting primarily forest conservation interventions between 2009 and 2013 included support to GEF REDD+ (14.4 million USD) and the World Bank's Forest Investment Programme (14.4 million USD). Many of the multilateral banks and institutions to which Sweden provides significant support (such as World Bank IDA and UNDP) also have programs that directly and indirectly support forest conservation interventions.

Household energy transitions

Out of the 484 million USD allocated to multilateral investments within CCI, almost 9 % or 43.4 million USD were targeted to household energy initiatives. It included 24.2 million USD for Scaling

Up Renewable Energy Program in Low Income Countries (SREP) – a Climate Investment Fund managed by the World Bank, 1.42 million USD for the Climate and Clean Air Coalition of the UNEP, and indirectly 85 million USD for the Clean Technology Fund. Projects within the World Bank (with Swedish funding commitments) such as the renewable energy program on Solar Home Systems (SHS) have been set up during this timeframe. Swedish support for other multilateral banks and institutions such as World Bank IDA and UNDP also have programs that directly and indirectly support household energy interventions.

An international outlook – what do other donors do?

As we showed already in Figure 1, climate aid has grown rapidly over the last decade – a trend that can be expected to continue in the wake of the COP in Paris in 2015. Based on Rio Marker reporting (OECD, 2015), the DAC members' total multilateral and bilateral aid related to climate change amounted to 37 billion USD[10] in 2013. Of this total, 23 billion USD (61%) addressed mitigation, 9.625 billion USD targeted adaptation only (26%), and 4.75 billion USD (13%) was targeted to activities designed for both mitigation and adaptation.

In Table 1 we see the five largest multilateral aid channels for Sweden, Norway, Denmark and Finland during the period 2009 – 2013. This table highlights the great variation between otherwise quite similar countries, both when it comes to the size and the targets for multilateral climate aid. Norway – leading among Nordic countries provides six times the Swedish multilateral allocations and more than 15 times that of Finland. Norway has a very strong focus on initiatives in relation to forest conservation (Amazon Fund, UN-REDD as well a number of bilateral schemes) while Sweden, Denmark and Finland focus more on funds active in low-income countries dealing with new technologies and adaptation.

[10] US dollars 21.9 billion was bilateral, representing 17% of total bilateral ODA, while 13.5 billion was multilateral, representing 19% of total multilateral ODA in 2013.

Table 1. Five largest multilateral aid channels for Sweden, Norway, Denmark and Finland from 2009–2013 (million USD)

Sweden		Norway		Denmark		Finland	
Top 5 funds		Top 5 funds		Top 5 funds		Top 5 funds	
CTF	86.6	Amazon Fund	1049.5	LDCF	31.7	LDCF	30.9
LDCF	74.3	UN-REDD	225.7	CGIAR	31.6	GEF 5	29.1
AF	57.7	FCPF-CF	179.8	GEF 5	27.3	CGIAR	20.9
GEF 5	43.9	FIP	161,6	PPCR	24.1	FCPF-RF	20.9
SREP	41.1	CGIAR	119.9	SREP	12.6	SCCF	10.5
Total	303.6	Total	1736.5	Total	127.3	Total	112.4

Source: Ministry of Foreign Affairs, 2013. CTF - Clean Technology Fund, LDCF – Least Developed Countries Fund, AF – Adaptation Fund, GEF – Global Environment Facility, SREP – Scaling Up Renewable Energy Program in Low Income Countries, FCPF-CF – Forest Carbon Partnership Facility Carbon Fund, CGIAR – the Consultative Group for International Agricultural Research, PPCR – Pilot Programme for Climate Resilience, SCCF – Special Climate Change Fund, FCPF-RF – Forest Carbon Partnership Facility Readiness Fund

These cases demonstrate the great diversity in terms of funding strategies. Norway is exceptional in its creation of Norway's International Climate and Forest Initiative (NICFI) that with its volume of funds has shaped REDD+ initiatives globally (3 billion NOK/year) and a real-time evaluation strategy. This reflects a clear focus on climate change mitigation. Also, while Sweden and UK have focused on adaptation, Germany, Norway and Finland have focused more on mitigation. In terms of the areas of focus in this report – forest conservation and household energy it is interesting to note that there are big differences in how bilateral donors focus on these areas or not. Compared to Sweden, Germany, UK and Norway have more explicitly emphasized both forest conservation and energy (including household energy transitions) as part of their climate aid.

3. Systematic reviews – a method for more evidence based practice

In our search for evidence on local development impacts of climate interventions, we have used a specific method – systematic review – for screening the current knowledge base. Systematic reviews provide a basis for "evidence-based practice" or "evidence-informed decision making" through a transparent, unbiased and replicable process of searching for and synthesizing evidence (Pullin and Knight, 2009; Petrokofsky et al., 2011).

The prescriptions and terminology that define systematic reviews were developed in the medical and social policy fields and have been codified by organizations such as the Cochrane and Campbell collaborations, the Evidence for Policy and Practice Information (EPPI) Centre, and the International Initiative for Impact Evaluation (3IE). These organizations also publish protocols (e.g., Nguyen et al., 2012; Roe et al., 2014) and findings (e.g., Puzzolo et al., 2013; Samii et al., 2014) from systematic reviews. We draw on this guidance to implement a "systematized review" that identifies and synthesizes a range of evidence on impacts.

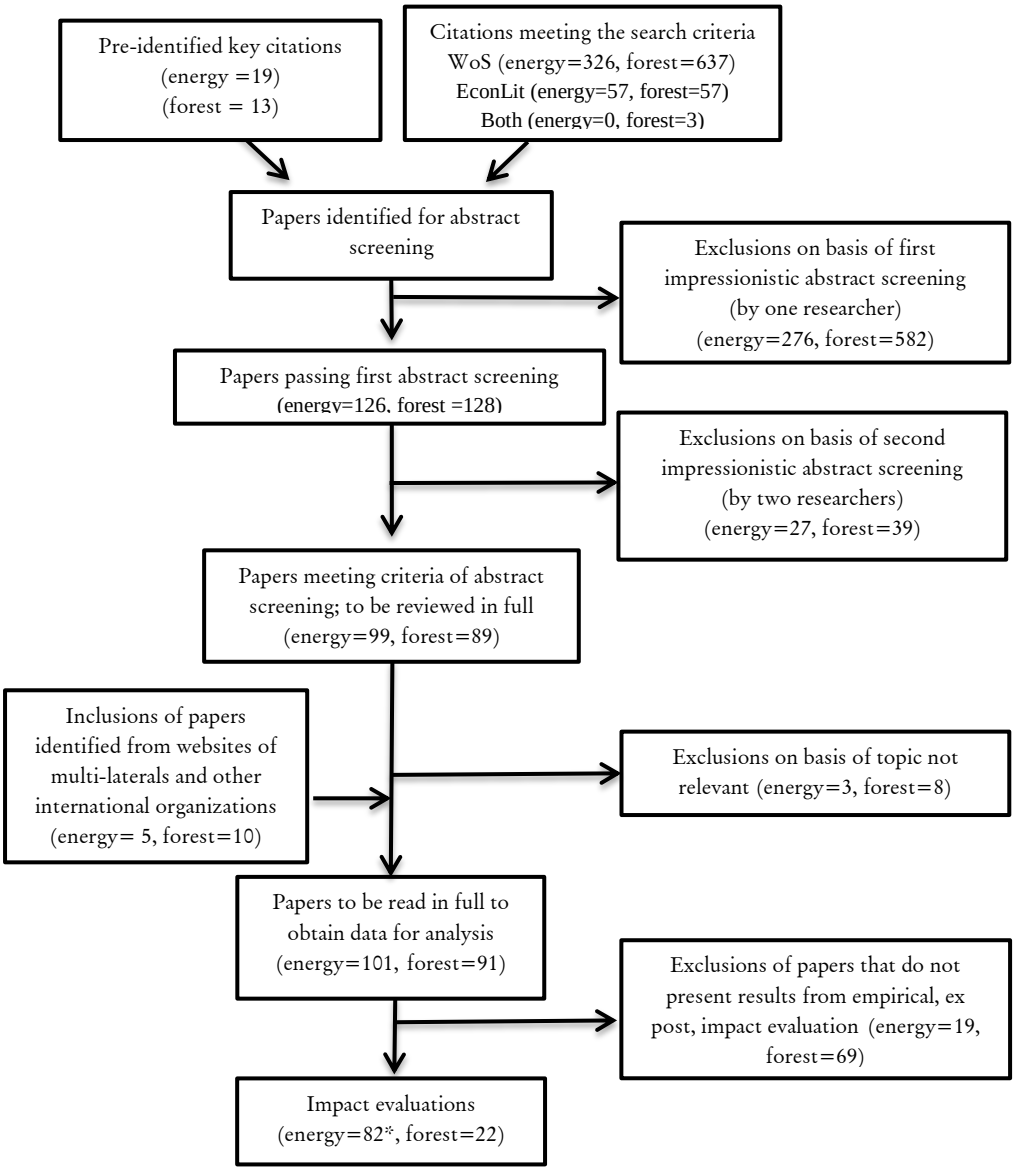
We apply our systematic reviews on what we define to be relevant impact evaluations of forestry and energy climate projects. As is now widely accepted in the academic, practitioner and donor community, the new norm for a rigorous evaluation is to have an established counterfactual (what would have happened without the policy) to reduce potential sources of confounding. Thus, Pattanayak (2009) contends that it is imperative to separate the effect of the policy from the confounding factors by using some mix of control groups (sites or households without policy), baselines (i.e., situation before policy), and covariates (i.e., other institutional, behavioral, and geographic factors). As we discuss in the conclusion, while the increase of this evidence base from a practically zero level is welcome, it is important to (i) complement policy impact evaluations with qualitative process evaluations to ensure a focus on mechanisms of change, and (ii) examine whether and if we can generalize the findings by examining how the context matters. Hence, when sufficient numbers of impact evaluations have been completed, we must systematically review how the impact varies by policy type, location, beneficiary population, and other contextual factors.

While there are many variations on systematic reviews (Grant and Booth, 2009), all specify explicit protocols for searching the literature in a replicable way, screen studies for quality using *ex ante* inclusion and exclusion criteria, and apply consistent coding to extract results from the studies that are then summarized and/or analyzed (Atmadja and Sills, 2015). The process of systematic reviews advocated and taught by the organizations listed above includes screening only for studies that employ methods considered capable of establishing attribution and estimating causal effects, sometimes limited to experimental and quasi-experimental methods (Camfield et al., 2014). There have been many calls for more methodological pluralism (Stern et al., 2012).

Our systematic review is focused on identifying the current knowledge base on the local development impacts of climate interventions in two domains: forest conservation and household energy transitions. In our reviews, we retained all studies that employed empirical evidence to assess the impacts of relevant interventions through some form of attribution analysis, including studies that assess whether interventions made plausible contributions to outcomes as well as studies that quantify the causal effect of single interventions on specific outcomes. Specifically, we included studies as long as they acknowledge and make some effort to control for potential confounding factors. Figure 6 summarizes the search and screening process. The numbers are typical of systematic reviews: from over a thousand citations on the topics of interest, we identified just over 100 studies that met even our generous screening criteria. The initial list of over 1000 citations all contained terms from each of the following five categories in their title, abstract, or keywords. The specific terms used are listed in Annex B.

- *intervention*: possible interventions to promote household energy transitions or forest conservation,
- *location*: developing and low-income countries and regions,
- *co-benefits*: non-carbon benefits that are intended and/or mentioned as outcomes of the interventions,
- *climate*: climate change at global or local scale, and
- *evaluation*: evaluation of the impact(s) of a specific intervention (*ex post* or *ex-ante*, quantitative or qualitative).

Figure 6. Flow chart of the systematic search protocol



* 82 studies correspond to 106 analyses as some studies either examined multiple interventions (ICS, electrification) and or multiple outcomes (emissions, health, fuelwood).

Many but not all of the final list of just over 100 studies use "quasi-experimental" strategies to control for potential confounding factors due either to the process of selecting units for the intervention or to other policy or economic changes that happen at the same time. Most of these methods require data on baseline conditions (before the intervention) and/or on comparison groups ("controls" not subject to the intervention), but *all* of the retained studies use data on the places or agents that were subject to the intervention gathered after the intervention had taken place (Jagger et al., 2010). Hence we refer to them as "*ex post*, empirical, impact evaluations".

We supplemented our key word search of academic databases by reviewing the resource lists and catalogs of studies provided on the websites of relevant multi- and bi-lateral organizations. Although many websites link to literature that discusses and provides methodological guidance for impact evaluations, we only identified new *ex post*, empirical impact evaluations through the websites of the 3IE and the World Bank, adding 15 citations to the list that we screened in full.

4 Impacts of forest conservation interventions

We define forest conservation in a broad sense to include avoided deforestation, sustainable forest management for timber and non-timber products, and forest preservation to maintain ecosystem services. In the context of this report, forest conservation is intended to reduce emissions and/or increase removals of carbon and/or support the adaptive capacity of local households. Forest conservation interventions that reduce deforestation, improve forest management, or expand tree cover (including through agroforestry) can help mitigate climate change by reducing emissions and increasing removals of carbon and can help with adaptation to climate change by securing flows of ecosystem services that buffer households against increased variability in weather. This is true regardless of whether the original intended purpose of these interventions was climate change mitigation and adaptation. Thus, the broader literature on forest conservation interventions (prior to and separate from concerns about climate change) is also relevant, and is referred to in Annex D.[11]

Forest conservation interventions

Interventions to conserve forest are typically grouped into four broad categories: protected areas, payment for ecosystem services, decentralization of forest land to local governments and communities, and prescriptions/prohibitions on forest use ('command and control' approaches). While our search encompassed all four categories of interventions, we found that most evaluations considering co-benefits of forest conservation in the context of climate change focus on the first two types of interventions.

Protected areas: the most common intervention has been the creation and management of protected areas. Approximately a quarter of the tropical forest estate is included in some type of protected area. From the perspective of climate mitigation, there are several

11 We supplement our systematic review with findings from other research syntheses including 'systematic reviews', 'meta-analyses', and empirical studies based on large pan-tropical data sets, which present findings on both the conservation effectiveness and the impacts on local people of the three types of interventions considered in the literature on the co-benefits of climate interventions in the forest domain.

limitations of this strategy. First, in order to effectively mitigate climate change, much larger portions of tropical forest must be conserved. Second is that most mechanisms to include forest conservation in climate change mitigation require additionality, which may rule out forests that are already legally protected (i.e., already in protected areas). Third is that the emphasis has been on using positive incentives to induce voluntary forest conservation in order to help mitigate a problem that is due primarily to emissions from other countries and other sectors. These three factors mean that existing protected areas usually are not considered part of climate mitigation strategies, although we do find a few evaluations of protected areas in the context of climate change mitigation. This reflects the importance of protected areas as a forest conservation strategy. Further, where significant areas of forest are under private tenure, incentives to expand private forest reserves or place forest under conservation easements are consistent with the typical climate change mitigation framework.

Payment for Ecosystem Services (PES): much of the discussion about REDD+ has focused on the potential to induce forest conservation with direct payments, labeled payments for ecosystem services (PES) (Angelsen, 2009; Corbera, 2012). Half of the studies that met our screening criteria evaluate PES. Financial incentives have long been used to encourage improved forest management, ranging from intensive silvicultural practices to forest regeneration on erodible lands. In developed regions, these incentives often take the form of tax breaks or cost share. Conservation of tropical forests typically takes place on land where taxes are not effectively collected and does not require purchased inputs. Thus, there has been greater emphasis on conditional direct payments for the desired outcome of tropical forest conservation, often set up as conservation contracts that last a specified number of years. The key question is who should be paid for which areas of forest. One of the most commonly cited and evaluated examples of PES for tropical forest is the Costa Rican PSA system, but this is a relatively rare case where a substantial portion of the forest estate is owned by private landowners with clear titles. In other countries, initial investments in forest-based climate mitigation have focused on clarifying land tenure, to lay the basis for these types of direct payments, as well as other market-based interventions like tradeable forest reserves. In other cases, PES systems are targeted to communities who can protect common or public forest lands.

Decentralization of forest land: a third category of interventions is devolution or decentralization of control over forest land to local governments and communities. Rights and Resources Initiative (RRI, 2014) estimates that 15% of tropical forests are under indigenous or community ownership or management, and this area continues to expand although at a slowing rate. We found evaluations of a few interventions for the purpose of climate change mitigation or adaptation that combine decentralization with measures to increase benefits that forest stewards receive from standing forest, e.g., via integrated conservation and development projects or certification and eco-labeling. Combined, these provide a package of incentives for forest conservation.

Prescriptions and prohibitions on forest use: the forest conservation policy mix also includes government prescriptions and prohibitions on forest use, ranging from the rules for timber extraction in public concessions to requirements to maintain forest reserves on private properties. In many tropical developing countries, there are laws on the books governing all aspects of forest and land use, but limited government capacity for law enforcement. Thus, increased capacity for law enforcement is widely considered a higher priority and likely to be more effective than instituting new laws and regulations on paper. However, such efforts may be less appealing for ODA or other forms of international aid, because they clearly are not voluntary, and in fact are contrary to the interests of at least some local forest users. Perhaps not surprisingly, we did not find evaluations of these types of interventions in the literature that focuses on the co-benefits of climate interventions.

Co-benefits of forest conservation interventions

In the context of climate change mitigation, the dominant perspective on forest conservation is that it brings global benefits but imposes local costs, most notably the opportunity costs of foregone alternative land uses. However, forest conservation interventions can also offer co-benefits for local people through two channels. First, conservation of forest provides locally valuable ecosystem services, including (i) provisioning services such as non-timber forest products that can serve as "natural pharmacies" or "natural insurance," diversify diets, and be converted into cash income, (ii) regulating services that support human well-being directly as well as through agricultural

production, e.g. by regulating base flow and assuring pollination, and (iii) cultural services, especially for indigenous populations. Second, the interventions may provide direct benefits as incentives or compensation for restrictions on the use of forest land, ranging from technical and marketing assistance for alternative livelihoods (e.g. around protected areas) to direct payments (in PES systems) to a greater fraction of the revenue from forest products harvested and sold into the market (under decentralization). This second channel is often broadly characterized as "rural development" benefits.

Financing forest conservation interventions to mitigate climate change

Our review documented an increase in ODA from other European countries (including Germany, Norway, and the UK) for interventions to conserve forest for the explicit purpose of mitigating climate change. Interventions labeled as RED, REDD, or REDD+ (for reducing emissions from deforestation and forest degradation, plus conservation, sustainable management and enhancement of forest carbon stocks) have rapidly expanded over the past decade[12], raising both hopes and concerns about potential impacts on biodiversity and local livelihoods. These funds are tracked by both civil society and multilateral institutions, e.g. Forest Trends tracks REDD+ finance flowing to 14 countries via REDDX and the World Bank reports on disbursements under the Forest Carbon Partnership.

The current knowledge base

To find impact evaluations of the local costs and benefits of these forest-based climate interventions, we searched both academic databases and websites of relevant organizations for evaluations of the local co-benefits or costs of forest conservation interventions, intended and/or interpreted as supporting climate mitigation or adaptation, in developing countries. Our search confirmed that there are numerous on-going evaluations (e.g., impact evaluations planned as part of the real-time evaluation of NICFI) but as of yet, little

12 The concept of mitigating climate change through "avoided deforestation" is much older but was never fully accepted under the Kyoto Protocol.

published evidence on impacts. Specifically, we identified 12 *ex post*, empirical impact evaluations of the local co-benefits or costs of climate-related forest conservation interventions from academic databases and an additional 10 from 3IE and World Bank websites.

Our key word search of academic databases produced the 91 publications listed in Annex B. Based on our review of their full text, we identified 12 of these as empirical, *ex post*, impact evaluations of forest conservation interventions. The search protocols for each website, the search syntax for the academic databases, and the references that were screened out based on review of their full text are presented Annex B, and the 22 studies that we ultimately analyzed are listed in Annex C.[13]

Next, we summarize what and where forest-based climate interventions have been evaluated, which immediately exposes the narrowness of the knowledge base on the causal impacts of forest-based climate interventions.

What? Half (11) of the studies evaluate PES schemes, including three on Mozambique's Payments for Environmental Services (PES), three on Costa Rica's Payments for Environmental Services (PSA), two on Mexico's Payments for Hydrological Services (PSAH), two on the Sloping Land Conversion Program in China, and one on the

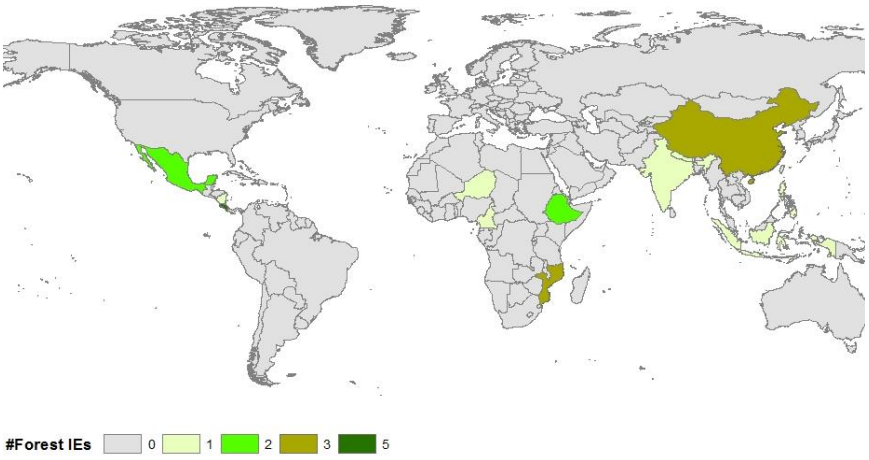
13 While we focus on the 22 empirical, ex post impact evaluations, our search also identified another 69 studies relevant to the general topic of forest conservation for climate change mitigation and adaptation, as listed in Annex B. Most (71 %) of these studies take a qualitative approach, such as case-study comparisons based on literature review, interviews with key informants, focus groups, and participatory observation. Most of the quantitative studies that were screened into this group are ex ante evaluations based on modelling, simulations or cost-benefit analysis. The case studies examined in this literature are almost evenly distributed across Latin America (46 % of the papers), Africa (36 % of the papers) and Asia (35 % of the papers). (Percentages sum to more than 100 % because of papers that consider interventions in two or three different regions.) The most frequently studied type of intervention is PES, which is examined in 5 papers on China, 4 on Costa Rica, and 3 on Bolivia. Three studies focus on carbon sequestration markets in Mexico. There is also a set of papers that discuss different types of intervention in general, without specifying geographic locations. Thus, in terms of the locations and interventions studied, this larger set of studies is similar to the 22 ex post empirical impact evaluations. Around 30 % of these papers recommend how to achieve better outcomes, for example how to better adapt an intervention to the local context. A quarter discuss the potential impacts that an intervention could have in a specific setting, and a fifth present an *ex ante* evaluation predicting the impacts of the intervention in different areas. Many are case studies of efforts to implement and enforce new tenure arrangements, reflecting the weak tenure arrangements in tropical forest regions due to the overlay of de jure ownership by national governments, customary use and traditional tenure rights of communities, and widespread unsanctioned extraction of forest products and clearing of forest for agriculture (including cattle pasture and commercial plantations).

Regional Integrated Silvopastoral Ecosystem Management Project (RISEMP) in Colombia.

The other 11 publications evaluate: (i) protected areas including national parks; (ii) REDD+ interventions, some of which involve PES and community forest management; (iii) packages of incentives designed to engage local people in forest conservation and restoration (including community-based conservation, community forest management, and integrated conservation and development); and (iv) one each consider agroforestry and a cash transfer program intended to support adaptation.

Where? The 22 studies report on evaluations of seven different types of interventions, evenly spread across Africa, Asia and Latin America (see Figure 6 below). In the case of Mozambique, the three publications consider exactly the same area. The publications on the other PES systems consider different parts of each country. It is worth noting that only one study has been published on Brazil or Indonesia, which together accounted for more than half of all tropical deforestation between 2001 and 2014 and are thus critically important in efforts to reduce forest carbon emissions.

Figure 7. Count of empirical, ex post impact evaluations of forest-based climate interventions by country.



How? The methodologies employed in each study are summarized in Annex C. Almost all of the studies (20 out of 22) take a retrospective approach to the evaluation, meaning that the evaluation began after the intervention was initiated.

Most (77 %) of the studies rely on data from a survey or structured interviews, in four studies supplemented with qualitative data. Some studies (36 %) also use secondary data, for example from the census or surveys carried out by others. Data analysis ranges from matching techniques to simple descriptive statistics comparing participants and non-participants. Modern program evaluation has demonstrated that counterfactual thinking is a useful way to think through and conceptualize the impacts of different policy options. In 68 % of the studies, the authors conceptualize impact as what happened compared to what would have happened with no intervention, while the other studies compare what would have happened under alternative interventions.

Who financed? Most of the interventions were funded by NGOs (with support from philanthropic organizations) and/or national governments (including a variety of agencies and departments). In around a quarter of the cases, it was not clear who funded the

intervention. In contrast, almost all (95 %) of the publications clearly state who funded the research, usually development and cooperation agencies (36 %) or universities (31 %).

Results from the review

We searched for studies that evaluate the local impacts of interventions intended or interpreted in the context of climate change, and thus it is not surprising that most (73 %) claim that the interventions studied were intended to either reduce emissions or increase removals of carbon (e.g., by reducing deforestation or expanding agroforestry). However, those impacts are quantified in only 36 % of the papers, typically by evaluating changes in forest cover or land use (e.g., changing land use between forest and either crops or pasture). Three-quarters (73 %) of the studies discuss environmental co-benefits (e.g., biodiversity conservation), and 40 % quantify impacts on environmental indicators other than climate, such as soil erosion or water holding capacity.

In addition to responding to climate change, 90 % of the interventions are explicitly intended to deliver benefits to local (rural) populations. Most often, the intended benefit is described in general terms as "rural development", but some of the studies focus specifically on impacts on indigenous populations or farmer livelihoods. Three-quarters of the studies quantify impacts on income (often specified as cash income) and/or labor allocation (often disaggregated into on-farm and off-farm employment). In addition to providing employment and income for local people, these interventions are intended to shift their livelihood portfolios towards activities more compatible with conservation. Such shifts are judged as positive impacts. For example, many of the interventions sought to generate off-farm employment, and an increase in off-farm employment is considered a positive impact because it draws labor away from cultivation of deforested land.

In order to summarize the findings of these 22 studies, we classify them according to whether or not the authors concluded that they were successful and whether they found positive impacts on (i) income, (ii) livelihoods, and (iii) environment, including reduced deforestation, reduced forest degradation, expanded forest area, reduced soil erosion, and increased water holding capacity (cf.

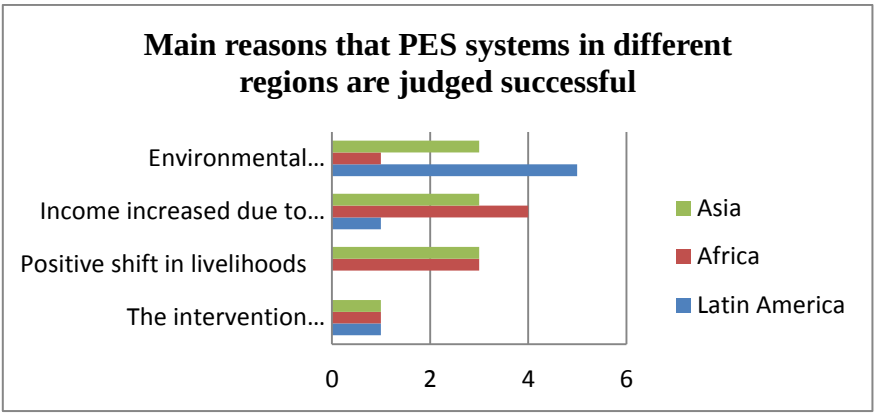
Brouwer et al., 2011 and Robinson et al., 2014 who also summarize studies in terms of whether they find broadly positive or negative impacts of the interventions evaluated). While these outcomes were the focus of the impact evaluations, the authors also frequently commented on the implementation of the interventions, e.g., their institutional design and whether the participants in the interventions were the ones intended by program design. We also report these insights, which are of critical importance because conservation interventions "often fail because of ineffective spatial targeting and dysfunctional institutions" (Miteva et al., 2012).

In almost half (10) of the studies, the authors conclude that the interventions were successful, usually because they led to improved environmental conditions (9 out of 10 studies) or higher income for local populations (8 out of 10 studies). In the other studies, the authors judged the results as either ambiguous (9 studies) or as indicating failure of the intervention (3 studies). For example, the authors of three studies indicated that the intended beneficiaries of the intervention were not effectively targeted, the authors of two studies concluded that there were other more influential causes of changes in socioeconomic status and environmental conditions.

There is often a presumption that forest-based climate change mitigation will involve PES-like conditional payments to local forest stewards. Thus, it is not surprising that fully half (11) of the studies that we identified evaluate PES. Of these, more than half (7) judged the PES intervention to be successful, while the rest considered the outcomes to be ambiguous.

The definition of successful PES varies across studies. Figure 7 reports how many studies in different regions reached different types of conclusions. The most common positive finding, reported in more than half (6) of the studies, is improved environmental conditions. This is almost entirely the result of the environmental success of PES in Latin America, while positive impacts on income are most likely to be reported as a result of PES in Africa.

Figure 8. PES success – main reasons by regions.



It is not surprising that voluntary conservation programs such as PES would have positive impacts on participants, but this begs the questions of who participates and how non-participants are affected? Voluntary conservation interventions should be designed to test different approaches to selecting participants and defining benefit levels. Similarly, carefully sited interventions, like protected areas, are likely to include land and land stewards who are systematically different from non-participants, creating a risk that the selection process will undermine the additionality or the broader impacts of the program. Donors should ensure that these issues are addressed in the design of selection mechanisms.

We found insufficient evidence to draw conclusions on other types of interventions, including packages of incentives for local forest users. Our review of reviews (as reported in Annex D) identified a similar paucity of evidence on the conservation impacts of decentralized forest management. Samii et al. (2014) found eight quantitative impact evaluations of decentralized forest management, all with positive (but not necessarily statistically significant) point estimates of impacts on forest cover, and Bowler et al. (2010, 2011) found 10 studies of community forest management that attempted to control for potential confounders, of which 8 reported positive and significant effects on forest quality. Neither Samii et al. (2014) nor Bowler et al. (2010, 2011) found enough evidence – or enough consistency in results – to draw any conclusions about the impacts of decentralization on local livelihoods.

Findings and reflections

Key issues that emerge from this systematic review include the following:

There is a gap between the knowledge base emerging from impact evaluations and the knowledge base needed to guide ODA. There are various dimensions of this "know-do" gap. First, there are relatively few evaluations of forest conservation interventions in the specific context of climate change. Second, most of the studies that make this link focus on PES, reflecting the original conception of REDD+ as a system of results-based payments but not the wide variation in how REDD+ is being implemented on the ground (Sills et al., 2014). Third, most evaluation work has been concentrated in a few countries, not necessarily reflecting either the distribution of forest carbon emissions or the allocation of forest-based climate aid. These biases can be ameliorated by drawing evidence from the broader literature on forest conservation interventions, as discussed in Annex D. However, this does not help address a fourth dimension of the know-do gap, which is that most evaluations focus on either carbon outcomes (e.g. deforestation) or development co-benefits (e.g. income). Even when both the carbon and non-carbon benefits of a particular intervention have been evaluated, those evaluations are typically carried out by different teams and make different assumptions. This makes it difficult to assess the trade-offs and complementarities that are fundamental to assessing the use of ODA for climate interventions.

There is not yet much evidence available from *ex-post* impact evaluations of climate interventions in the forest conservation domain, and most of those evaluations are retrospective, i.e. not initiated in parallel with the intervention themselves. This may partly reflect the inherent lag in obtaining results from prospective evaluations, but it also suggests a general tendency to initiate interventions without laying the groundwork for their later evaluation. Collection of baseline data from both intervention and comparison areas greatly expands the options for ruling out confounders as alternative explanations for observed outcomes of interventions. One potential strategy for capturing this benefit is to structure and archive data from the *ex ante* evaluations required by many donors in such a way as to facilitate their use in *ex post*, empirical impact evaluations.

The evidence that is available reflects thematic and geographical biases: Impact evaluations tend to be conducted in places and on

topics where data are available (e.g., PES in Costa Rica and Mozambique; PAs in Latin America). In order to draw reliable policy conclusions, more should be invested in rigorous impact evaluations of a more representative and policy-relevant sample of interventions (cf. Lund et al., 2009; Pullin and Knight, 2009).

Fragmentation of evaluations: Very few of the studies of forest conservation interventions consider both social and ecological outcomes in the same evaluation framework, making it difficult to assess trade-offs and potential synergies (cf. Agrawal et al., 2011; Caplow et al., 2011; Persha et al., 2011; Samii et al., 2014). Evaluation teams should include the expertise and have access to sufficient resources to consider both carbon and non-carbon benefits in the same framework, so that impacts on both can be estimated relative to the same counterfactual.

Of the forest conservation interventions to address climate change that have been evaluated, PES has most often been found to deliver co-benefits, specifically increasing the income of participants. This is consistent with the notion that people only participate in a voluntary program when they expect to benefit from participation, and also consistent with the findings of other systematic reviews of PES in general (not restricted to the climate change context) by Samii et al. (2014) and Miteva et al. (2012) (Annex D). The critical issues still to be explored are how different program designs affect who participates and the consequences for non-participants (cf. focus on threat of "adverse selection" in review of PES for the GEF STAP by Wunder et al., 2010). These are active areas of research, which could benefit from collaboration with ODA funded interventions.

5 Impacts of household energy interventions

Billions of people in rural and peri-urban areas of low and middle-income rely on fuelwood and other biomass fuels to meet their energy needs. Besides the obvious inequities in how little energy these households can access relative to developed country citizens, this inefficient practice causes many local and regional harms, including contributing to climate change. To re-state, the goal here is to reduce household reliance on fuelwood and other forms of biomass for cooking that are of climate change concern because wood burning contributes to emissions (1) of CO_2 because the biomass is extracted unsustainably, and (2) of *black carbon* (a short-lived climate forcer), which is essentially soot. Thus, a whole host of global initiatives such as the GACC, Energy +, EnDev, and Sustainable Energy for All have emerged to complement national and regional government policies to promote clean energy (Pattanayak et al., 2014).

Household energy interventions

Although a wide variety of energy technologies have been promoted to households, most interventions can be classified as either *advanced energy services* or *biomass ICS (improved cooking stoves)*.

Advanced energy services and products relate to the promotion of rural electrification (grid expansion and off-grid schemes) and other renewable technologies (wind, solar, and bio-gas).

Biomass improved cooking stoves (ICS) include improved stoves that are purportedly more efficient in burning fuelwood, charcoal and other biomass. To ensure that households make this sustainable energy transition has required coordinated efforts by governments, donors, private sector and civil society beyond simply boosting household demand and strengthening the supply chain (Lewis et al., 2015) to setting up an entire ecosystem where financial credit, market accessibility, road infrastructure and billing and maintenance systems have had to be built from scratch. Although such initiatives have been seen earlier, there is currently a significant increase in global attention and funding.

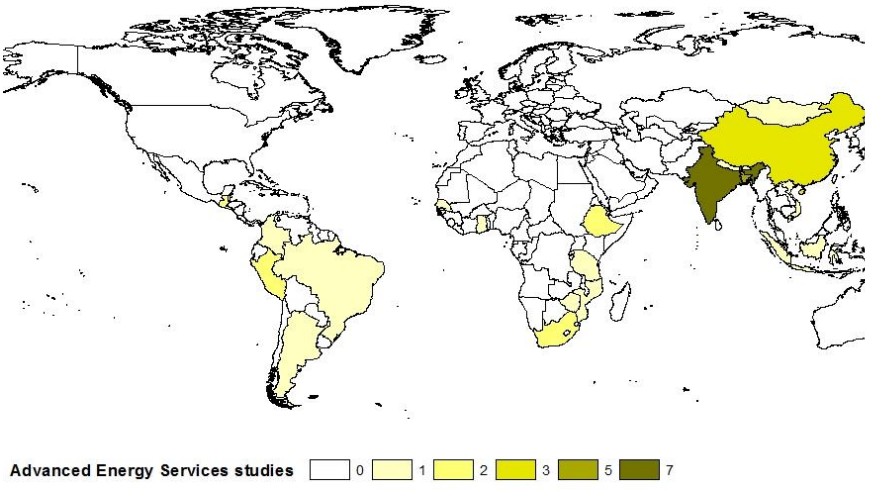
The current knowledge base

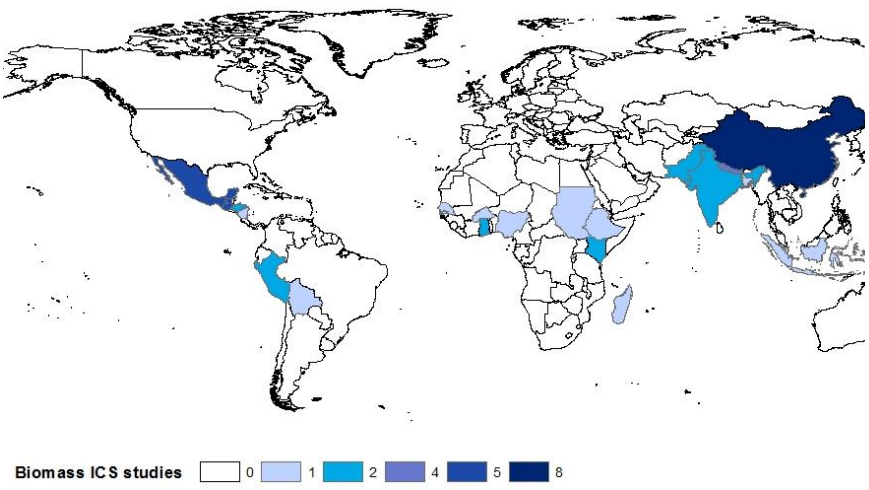
To examine if these efforts have paid off, we conducted a systematic review. We supplemented our key word search in Web of Science and EconLit with key citations from a recent review (Bonan et al., 2015) and Duke (DHEHI) research. To arrive at our final set of papers, we screened and rejected studies if: (i) not undertaken in a developing country, (ii) not related to energy use at a scale such as household or community, (iii) does not consider an intervention related to energy use or transition or if the intervention is not described, (iv) no mention of local impacts on households and people, or (v) presents simple *ex ante* analysis, simulation results, or opinions based on case studies. This resulted in about 80 papers that generate 100 evaluations of the impacts of energy interventions.

What? Improved biomass cook stove programs are the most common intervention evaluated (almost 50 % of the meta-sample). Rural electrification (~15 %) and other improved cook stoves such as LPG and biogas (~25 %) constitute the other major interventions (each roughly 10 % of the meta-sample). Most interventions focus on rural populations, especially women, children and indigenous people.

Where? As depicted in Figure 8, most of the interventions are in Asia (especially the burgeoning economies of China and India) and Latin America (especially for improved biomass stoves). Africa remains in the dark, with very few evaluations except in East Africa. More than 80 % of these impact evaluations are in peer reviewed scientific journals. About 70 % of the studies are in the context of a real policy, often designed as prospective evaluations that are developed in tandem with the policy or program, and thus are built into program implementation.

Figure 9. Global distribution of Energy Impact Evaluations.





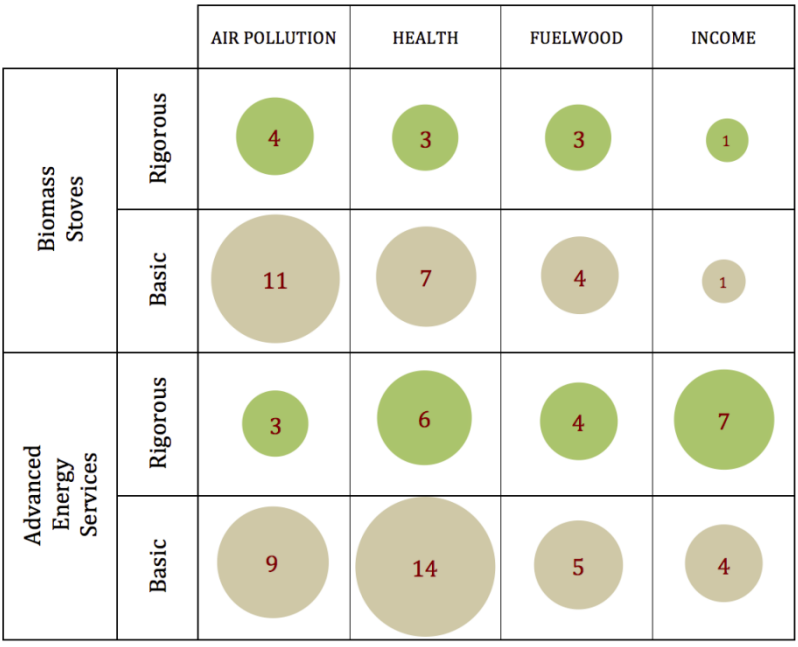
Results from the review

While only about ~20 % of the papers claim to assess climate impacts, very few measure and report impacts, typically proxied by carbon dioxide emissions reductions. Instead, evaluations of household energy interventions primarily focus on co-benefits for the local

population, especially improvements in indoor air quality and the associated health benefits. Environmental co-benefits (e.g., ambient air quality) are only briefly mentioned and rarely, if ever, measured. In principle, estimates of reductions in biomass fuel use and air pollution emissions could be used to calculate impacts on forests and climate change. However, because of the silo nature of different development sectors and a lack of agreement on methodology (Clark et al., 2015), these calculations are not actually provided in the literature we reviewed.

Data are mainly analyzed using a combination of comparisons (e.g., before-after, or with-without), correlations, and regressions (although only ~50 % estimate multivariate regressions). Although impact evaluations should consider a counterfactual to assess impacts, only 30 % employ rigorous experimental or quasi-experimental methods to construct a counterfactual. Figure 10 depicts the distribution of findings from studies employing experimental or quasi-experimental methods (labeled "rigorous") as compared to studies that estimate multi-variate regressions (labeled "basic"). In almost all cases, most of the findings linking either improved biomass stoves or advanced energy services to improvements in air quality, health, and income and reductions in fuelwood use are from studies that use basic methods (depicted by gray bubbles). The sole exception is that most of the findings linking advanced energy services to higher income are based on rigorous methods. Meta-regressions of impacts on methodological variables such as sample size and methods confirm the patterns depicted in Figure 10, suggesting that more rigorous study designs have a lower chance of finding air pollution and health impacts.

Figure 10: Distribution of findings from studies employing experimental or quasi-experimental methods (labeled "rigorous") as compared to studies that estimate multi-variate regressions (labeled "basic").



† The size of the bubble reflects the strength of the evidence, i.e., the number of studies that confirm a positive influence. These are sub-categorized by intervention type (improved biomasss cookstoves or advanced energy services) and by rigor of the evaluations (rigorous = experimental/quasi-experimental vs. multivariate regressions).

Findings and reflections

The findings discussed so far suggests the following empirical regularities:

- There is significantly more research on advanced energy services than on improved biomass stoves.
- There is a greater focus on environmental health outcomes and impacts than on social (fuelwood and income) outcomes.
- There is robust evidence that advanced energy services deliver health and income benefits.

- There is however, weaker (and less rigorous) evidence that ICS improve environmental health and income.

These findings are consistent with other recent attempts to take stock of the scientific literature on the impacts of household energy. For example, in the public health domain, systematic reviews have shown that biomass fuel use in traditional stoves increases the risk of childhood pneumonia by a factor of 1.8 (Dherani et al., 2008) and worsens household air quality (Balakrishnan et al., 2015 for the WHO). Our findings are also consistent with a recent review of the socio-economic benefits that advanced energy services are likely to deliver (e.g., income, consumption, employment, and schooling), and the more mixed evidence on improved biomass stoves (Bonan et al., 2015).

Although there are many more energy evaluations (*know*) compared to forestry evaluations, they still suffer from the following biases with regards to the content of interventions (*do*):

First, topically analyses of outcomes largely focus on health (reflecting donor and funding preferences?) and less on environment (air pollution, and firewood) and livelihoods (firewood, income).

Second, spatially, India and China have most of the studies – with nearly 40 % of the global population this might seem to represent global population, but it is far from clear that it represents where the energy poverty problem is concentrated. While South Asia (India) rightly is a hot spot (and not China), lots of states within India are still underrepresented, and other problem spots in South Asia like Bangladesh, Pakistan, Nepal etc. are missing.

Third, intervention-wise, given the great prolification of energy interventions, it is fair to say that the number and spread of energy impact evaluations are not keeping up with the interventions.

6. The knowledge-gap and initiatives to build up new evidence

From the systematic review of the literature, we find that there are very few high quality evaluations of climate aid, even in relatively popular and well researched domains such as REDD+. This finding is even more compelling because of the "know-do" gap, *i.e.*, lack of overlap between the types of impacts and interventions focused on by researchers and the types of programs, projects and policies being implemented on the ground.

This is consistent with Swartzendruber's (2014) conclusions from reviewing cross-cutting natural resource management interventions for climate change mitigation. Based on a review of about 60 evaluations of projects, half implemented by the World Bank and a quarter implemented by UNDP, Swartzendruber (2014) found consistent shortcomings in monitoring and evaluation, including "misidentification of project outputs as outcomes, and absence of meaningful baselines against which to evaluate project performance at closing". These shortcomings leave a gap between science and policy, which exists for climate aid as well. Without understanding the reasons for the gap, we cannot make adjustments so that we can better use scientific research to guide aid disbursement in the future. So why is there this "know-do" gap?

First, high quality impact evaluations are few and far between because of a market-failure (Center for Global Development, 2004; Ravallion, 2009). Essentially, such evaluations are international public goods that generate positive externalities. But they are, like most public goods, underprovided, in this case because they (a) rarely directly benefit a specific project, and (b) require upfront investments (e.g., to establish a baseline) but will likely be completed after the project cycle. Further, consumers of evaluation are often not discriminating (there might even be perverse incentives *not* to demand rigorous evaluations), and therefore poorly done evaluations crowd out high quality evaluations. Finally, there is insufficient competition in the market for evaluations – too few managers/funders exert their monopsonistic power and choose to (a) rigorously evaluate only 'good' (safe) projects, and (b) 'lightly' (subject to manipulation) evaluate 'bad' (weak) projects. Further, there are few rigorous

evaluations of projects that generate (a) diffused and widespread benefits, and (b) impacts far into the future.

Second, there is a cultural difference between scholars and policy makers with respect to evidentiary standards. While scientists defend vigorously against being proven wrong (e.g., confidence intervals of 99%), decision makers often decide and act before air tight knowledge arrives because they wish to avoid high political and social costs to constituencies, the economy, national security, the environment and because they operate with different levels of risk aversion (Kinzig et al., 2011). This means that scholars often pursue questions for which they can gather credible evidence, demonstrate cutting-edge methodologies, and justify their conclusions. Identification and attribution are of paramount concern, rather than criteria such as utility, feasibility and in some cases what is appropriate (Pattanayak, 2009). Some scholars have called for using adequacy assessments and or plausibility designs (as opposed to probability evaluations associated with impact evaluations) depending on who the decision maker is and what type of decisions will be made from the study findings (Habitch et al., 1999). Both complex (impact evaluations) and simple (plausibility or adequacy assessments) should be equally rigorous in the sense of providing sufficiently valid and precise information.

These reflections about the state of evaluation practice have led to our own recent calls for a second generation of impact evaluations (IE 2.0), with a focus not only on whether a program/policy/project has worked (as proven by an average treatment effect that is statistically significantly different from zero), but to answer why, for whom and under what circumstances the intervention worked (Miteva et al., 2012). Without opening the black box and answering questions related to 'why', 'for whom' and 'under what' circumstance, we cannot hope to scale up and sustain policies and programs (Pattanayak, 2009). To open this black box of impact, we need better theory, better methods and better data (Miteva et al., 2014). For example, we need to develop hypotheses about potential mechanisms based on theory and then estimate appropriate structural parameters to understand how and why an intervention works (or doesn't), in order to make out-of-sample predictions and forecast policy impacts in new contexts (Deaton, 2010; Heckman, 2010). In these scenarios, a mixed method strategy is critical: ideally prior to conducting a large N quantitative study in the field and address the many complexities inherent in the

causal chain, it is critical to call for careful design and piloting of intervention using smaller samples, case studies, qualitative appraisals or semi-quantitative approaches (Arriagada et al., 2009; Vreugdenhil et al., 2010). Such mixed-methods or iterative field research approaches are especially critical when the questions are relatively clear, but understanding of the socio-economic-institutional context for the behaviors in question is lacking (Kanbur, 2003). They also allow better interpretation and contextualization of results from large n evaluations.

Likewise, scholars could be urged to mainstream methods that shift from answering whether an intervention has an impact to examining the overall shape of the impact function – that is, the shape of the relationship between the impact and a continuous treatment, conditional on other factors. Finally, we need interdisciplinary collaborations. Mitigation of or adaptation to climate change, including through forest conservation and sustainable energy promotion, is necessarily an interdisciplinary question because it affects both environmental processes (emissions) and people in their socio-political milieu. Currently, natural scientists seem to collect abundant data in research designs that preclude rigorous impact evaluations. While social scientists are generally well versed in impact evaluation techniques, they are often at a loss about the collection and interpretation of ecological data.

Some promising initiatives

There are now some promising initiatives of how impact evaluations of climate interventions could be designed, implemented and made available for greater utilization. We will here give brief accounts of the Pan-tropical evaluation of REDD+ by Center for International Forestry Research (CIFOR) and the real-time impact evaluation of the Climate Resilient Green Economy (CRGE) Strategy in Ethiopia.

Example 1: Pan-tropical evaluation of REDD+

One such example of IE 2.0 is the pan-tropical evaluation of REDD+ by CIFOR, the Center for International Forestry Research (Sills et al., 2014), with funding from NORAD, AusAID, the European Commission, and DFID. REDD+ has attracted international policy

attention because of the potential co-benefits and costs for local people and biodiversity conservation (Agrawal et al., 2011; Visseren-Hamakers et al., 2012; Burgess et al., 2013). In response to these concerns, safeguard policies were promulgated at COP 16 of the UNFCCC, and certification standards that focus on these issues, e.g., from the Climate Community, and Biodiversity Alliance, have been widely adopted in voluntary carbon offset markets (Peters-Stanley et al., 2012). Development of safeguard policies and standards would benefit from more systematic evidence on the impacts of REDD+. The market failure for high quality IE was avoided in this instance because NORAD and CIFOR recognized these sub-national initiatives as an important testing ground for REDD+ and established a long-term research program to evaluate their impacts on local people.

First, as in other domains, impacts from REDD+ may take years to appear, and thus rigorous IE requires a long life relative to most program funding cycles (Levine, 2005; Pattanayak, 2009). CIFOR has been able to secure sufficient resources over a long enough time frame to evaluate at least medium-term impacts. The CIFOR REDD+ evaluation included an unusually large investment in collecting baseline household survey data to support rigorous IE. Research began in 2010 in six countries where CIFOR had an established research program on REDD+. By the beginning of 2015, CIFOR had completed a new survey with the same households interviewed in 2010, eliciting data on both their livelihoods and incomes and their perceptions and opinions of the REDD+ initiatives. These data will allow estimation of the short-run impacts of REDD+ and of the specific interventions implemented under these initiatives. While this type of evidence is undoubtedly in high demand, CIFOR's effort to generate it has required a large budget and many years. This raises the question of how to ensure the validity and utility of such a large data collection effort.

Second, CIFOR's approach follows the "ten commandments" for the design and implementation of impact evaluation posed by Ravallion (2009). The commandments include taking the time to engage stakeholders and jointly agree on how a program is described at the front end of the evaluation, paving the way for lessons to be shared and used at the back end. The transaction costs imposed by such processes are beyond the ability and capacity of many researchers. The CIFOR-REDD+ evaluation provided a common

cause and way to align the incentives of program managers (downwardly accountable to the communities and citizens they work with) and CIFOR scholars (accountable to their scientific and academic peers): funding, supporting data collection, and requiring analysis that evaluates whether, why and how interventions can contribute to both mitigation of climate change and local co-benefits.

Third, CIFOR was able to close the gap in evidentiary standards partly by choosing to work with initiatives, or REDD+ pilot projects, that were still in the planning stage. Integration of the evaluation design and scholars from the outset allows for more rigorous impact evaluation. For example, it is usually important to identify the baseline status of those groups receiving the program, as well as comparison (or "control") groups. Even better, early integration of program evaluation and design often permits the rollout of a program to be randomized, leading to more convincing results. Rather than seeking to influence the roll-out of REDD+ initiatives, CIFOR choose to work with initiatives in six countries where the implementing organizations had already defined where they would work (thereby identifying 'intervention villages' and potential 'comparison villages') but not yet offered conditional incentives to reduce forest carbon emissions (thereby allowing data collection on conditions before the intervention).[14] This made it possible to employ a quasi-experimental design to collect "BACI" data before and after from matched comparison and intervention villages (also commonly referred to as Before-After-Control-Impact), in order to compare trends (or DID, differences in differences) in welfare outcomes between similar (balanced) samples of comparison and intervention households. The BACI design allows the effects of REDD+ to be disentangled from contemporaneous policy, market, and social changes; and allows systematic differences in baseline conditions to be netted out of impact estimates (Jagger et al., 2010). Critically, CIFOR selected the comparison group of villages not in intervention areas by "pre-matching" villages based on data collected from secondary sources and key informants. This ensures that it will be possible to statistically "post-match" households from the selected intervention and comparison villages.

14 These sites and initiatives are described using the baseline data in Sills et al. (2014).

Example 2: Institutionalization of domestic impact evaluation capacity

The real impact of international climate change commitments comes when it finds traction in national strategies, plans and, most importantly, real investments. Ethiopia is a good example of how global climate initiatives find traction in domestic strategic plans. Ethiopia launched its Climate Resilient Green Economy (CRGE) Strategy at COP 17 in Durban, 2011. The CRGE sets out to transform the country into a middle-income economy by 2025 with a low-carbon strategy (keeping emissions at the 2010-level). The goal is for the country's economy to leapfrog to a modern energy-efficient course of development that improves resilience and ensures economic development with limited dependence on carbon fuels. The CRGE Facility, a multi-stakeholder government institution, is steering the implementation process. Among the key tasks of the Facility will be to mobilize internal and external finance and channel it to specific projects.

The institutional innovation has been to give an independent government research institute (the Ethiopian Development Research Institute) the mandate to carry out impact evaluations on CRGE projects. This responsibility falls under its existing mandate, but by making it explicit it enables donors to support impact evaluations with funds – but with clear, and independent, incentives to produce neutral information. This is in stark contrast to the usual modalities where both donors and implementing agencies have incentives to be selective in its evaluations. It also builds on domestic capacity that will be able to feed back the results in the long-term – also this in stark contrast to the many cases where international consultants and researchers make "hit-and-run" studies. The clear specification of the long-term policy objectives to be evaluated also decreases the risk that the research will focus on issues that are not useful for future interventions.

Reflections

It is fundamental to ensure proper incentives to carry out high quality impact evaluations of climate interventions. This could be done by involving an organization that has as its primary objective to carry out independent impact evaluations. This was exemplified both in the case of CIFOR's involvement in the pan-tropical REDD+ evaluation and

in the involvement of EDRI in impact evaluation of the CRGE. Such incentive compatibility at the institutional level goes a long way to ensure objectivity and attention to evaluation design.

The sheer size of climate interventions could be another factor. In the Ethiopian case, successful implementation of the CRGE strategy presents a great demand for impact evaluations to ensure that the multi-billion dollar interventions are efficient in reaching the developmental objectives at the same time as carbon emissions are not increased. The size of the CRGE has made the "know-do" gap more explicit and it has become clear to most parties that past approaches regarding monitoring, evaluation and approaches to assess impact will not be sufficient. The size and length of the CRGE makes it possible to internalize some of the reasons behind the "know-do" gap – (i) specific impact evaluations benefit the initiative although they might not benefit the specific project being evaluated, (ii) investments in baselines can be made to function for multiple impact evaluations, (iii) a broader mandate to evaluate the initiative decreases the risk of selection of 'good' (safe) projects to be evaluated.

7. Recommendations

The recommendations discussed in this section are based on the findings reported in the previous sections and also summarized in the concluding section next.

Climate finance is to a large degree fragmented since much climate aid, including Swedish, is bilateral with a high degree of discretion from donors regarding targeting as well as implementation modes. This leads to two recommendations: First, donors must coordinate to ensure that scarce aid realizes the benefits of scale and scope. Second, donors should rely on evidence and data regarding effectiveness and impact for targeting aid.

Given the first recommendation, Sweden should clearly consider expanding its ODA for household energy transitions, especially advanced energy services (such as electricity and renewable energy services) for poor households because there is mounting evidence that it delivers socio-economic, indoor air quality, local forest quality, and health benefits especially to young children. ODA for improved biomass stoves receives cautious support because the evidence is mixed. Recommendations regarding evaluations in this sector are reported below.

Given the paucity of evidence, despite the concern over the potential local impacts of forest sector interventions, more caution is needed before scaling up support in this sector. While there is some evidence that strategies in this sector such as payments for ecosystem services (PES) and protected areas (PAs) generate environmental and economic benefits, more evidence is needed from the hotspots for tropical forest loss. Across different types of interventions, effective local participation in the design of institutions and rules governing forest use often leads to better outcomes for forest conservation and local livelihoods, and future ODA support should encourage such decentralized management and participation.

Finally, we support the repeated and rising call that aid efforts must be preceded by learning and applied research program so that we can "know" before we "do". The international public good nature of rigorous impact evaluations and the large differences in evidentiary standards between researchers and policy makers creates a "know-do" gap: lack of overlap between the types of interventions evaluated by scholars (what we "know") and the types of programs, projects and

policies being implemented on the ground (what we "do"). Specifically, we offer the following strong suggestions.

1. First, scholars should be incentivized (by the practitioner and donor community) to generate "practice based evidence" rather than forcing "evidence based practices" onto settings that do not resemble evaluation laboratories, as is sometimes done in randomized control trials that control away many of the real world challenges and raise concerns about generalizability.
2. Second, one way scholars in pursuit of new knowledge will remain engaged is if ODA permits experimentation and learning about the design features such as selection into a program (e.g., PES, electricity roll out), rules for use of PAs and ICS, and mechanisms for local participation. Because the ultimate impacts of forest or energy interventions on environment (forest or air quality and therefore emissions) and poverty depend on how participants are selected and how non-participants are affected (through spillovers), it is key to include scholars in the design of the interventions and their evaluation.
3. Third, more evaluations must be in places that reflect either the distribution of forest carbon or household cooking emissions or the allocation of climate aid in these sectors. For example, much of the evaluation of improved cookstoves comes from China, not Africa. These biases can be ameliorated by drawing evidence from the broader literature on forest conservation interventions, as discussed in Annex D.
4. Fourth, because climate aid has dual goals, teams of evaluators must be competent in measuring both climate impacts (often natural and engineering science) and welfare impacts (often social science and humanities). Such evaluations of outcomes in multiple domains will support understanding of the trade-offs and complementarities between responses to climate change and local development.

Norwegian efforts with REDD+ and the Climate Resilient Green Economy strategy in Ethiopia offer signs of change and progress towards closing the "know-do" gap.

8. Conclusion

This report has characterized Swedish ODA for climate change mitigation and adaptation through forest conservation and household energy transitions, and reviewed the evidence on the development co-benefits or costs of interventions in these domains. We focused on forest conservation and household energy transitions for a number of reasons, most importantly because interventions in these domains both clearly influence local well-being as well as greenhouse gas emissions. We quantify the funds flowing into these types of interventions, examine how their development benefits or costs have been monitored and evaluated, synthesize findings from empirical, *ex post* evaluations, and recommend approaches to building up the evidence base.

The review of Swedish climate aid shows that climate interventions have become an increasing part of the bilateral aid 2009-2013, particular for the "green sector" (agriculture and forestry). While the majority of Swedish climate aid used to be channeled over multilateral climate funds, the trend is rapidly decreasing. Climate finance is fragmented and there is a high degree of discretion from donors regarding its focus. Other donor ministries than foreign affairs (such as ministries of environment and finance) become involved in targeting the climate interventions. Donor countries therefore show a great variation in target areas for their climate interventions and modalities for their implementation.

More and more of ODA is classified as climate interventions. There might be good reasons for this increase in climate aid, particularly given the long-term implications that climate change is expected to have on poor people in the least developed countries. But there is also the risk that rich countries prioritize climate mitigation, which ultimately also benefit themselves, and pay less attention to the developmental impacts of the aid. It is in this context that it is particularly important that proper impact evaluations are carried out to ensure that the interventions are meeting their dual purposes of both handling climate change and improving livelihoods.

In land use and household energy sectors, the distinction between mitigation and adaptation is not very fruitful. Carbon storing or mitigating activities (e.g., forest rehabilitation or improved cook stoves) often also serve as adaptation strategies especially when we

take a sustainable development approach. That is, mitigation strategies can make local people wealthier and healthier and therefore improve their adaptive capacity.

Despite the controversy and concern over the potential local impacts of interventions to mitigate climate change through the forest sector, we found only 22 published impact evaluations of the local co-benefits and costs of forest conservation interventions in developing countries that were designed to address climate change and that fulfilled our criteria. That so few rigorous impact evaluations on forests were found indicate the cost and complexity of designing and implementing evaluations of projects that mature over long time-periods.

Our systematic review of household energy programs and interventions found almost 100 evaluations of real programs and policies to promote household energy transitions, notably in Asia (especially China and India). These interventions focus on improved cook stoves primarily, and rural electrification and other renewables secondarily, all of which are intended to improve household air quality and health outcomes. There is mixed evidence that improved biomass stoves deliver such benefits, whereas there is more concrete evidence that advanced energy services deliver health and socio-economic benefits.

There are signs of change and progress towards closing the "know-do" gap, with initiatives to incorporate impact evaluation into interventions. For example, NORAD has built evaluation into the design and evaluation of its aid portfolio for REDD+, including support for CIFOR's long-term and large-scale impact evaluation of REDD+ (Sunderlin et al., 2010; Sills et al., 2014) and Norway is now also investing in domestic capacity with the mandate to evaluate the Climate Resilient Green Economy strategy in Ethiopia. Sweden could also use its funding leverage to align the incentives of program managers and scholars to learn not just if interventions contribute to both climate change mitigation and local co-benefits, but how, for whom and under what circumstances.

We are not arguing that this is easy or cheap. On the contrary, our systematic reviews of the literature leads us to four strong recommendations summarized in the previous section – (i) more sponsorship of evaluators who will study real life programs, policies and practices, (ii) involving evaluators in the design stage, (iii) better

topical and geographic matching of evaluations and policy needs, and (iv) multi-disciplinary evaluation teams, likely requiring elaborate and often expensive designs over long periods of time. Unfortunately, these prerequisites are difficult for donors and implementing agencies to meet, which is probably why there are few high quality impact evaluations found for the systematic reviews.

However, given the high stakes, in terms of both short-term poverty reduction and long-term climate implications, we hope and urge donors, implementing agencies, scholars and evaluators all rise to the occasion and address these challenges. Our final recommendation is that this is done by strengthening domestic capacity in the recipient countries and that domestic, independent research institutes are given the mandate, and necessary resources, to fulfill this important role.

Acronyms

3IE – International Initiative for Impact Evaluation

AF – Amazon Fund

AusAID – Australian Agency for International Development

CBC – Community Based Conservation

CCI – Climate Change Initiative

CEE – Collaboration for Environmental Evidence

CGIAR – Consultative Group for International Agricultural Research

CIFOR – Center for International Forestry Research

COP – Conference of the Parties

CRGE – Climate Resilient Green Economy

CTF – Clean Technology Fund

DFID – Department for International Development

DHEHI – Duke University's Household Energy and Health Initiative

DIME – Development Impact Evaluation program at the World Bank

EPPI – Evidence for Policy and Practice Information

FCPF-CF – Forest Carbon Partnership Facility – Carbon Fund

FCPF-RF – Forest Carbon Partnership Facility – Readiness Fund

FIP – Forest Investment Program

GACC – Global Alliance for Clean Cookstoves

GEF – Global Environment Facility

GEF-STAP – Global Environment Facility - Scientific and Technical Advisory Panel

GHG – Greenhouse Gases

GIZ – Deutsche Gesellschaft für Internationale Zusammenarbeit

GNI – Gross National Income

ICDPs – Integrated Conservation and Development Projects

ICF – International Climate Fund

ICS – Improved Cook Stoves

IDA – International Development Association

IE – Impact Evaluation

IFRI – International Forestry Resources and Institutions

LDCF – Least Developed Countries Fund

MFA – Ministry of Foreign Affairs

NGO – Non-Governmental Organization

NICFI – Norway´s International Climate and Forest Initiative

NORAD – Norwegian Agency for Development Cooperation

ODA – Overseas Development Assistance

OECD – Organization for Economic Co-operation and Development

OECD-DAC – Organization for Economic Co-operation and Development-Development Assistance Committee

PA – Protected Area

PES – Payments for ecosystem services

PPCR – Pilot Program for Climate Resilience

PSAH – Payments for Hydrological Services

REDD+ Reducing Emissions from Deforestation and Forest Degradation

RISEMP – Regional Integrated Silvopastoral Ecosystem Management Project

RRI – Rights and Resources Initiative

SCCF – Special Climate Change Fund

SHS – Solar Home Systems

Sida – Swedish International Development Cooperation Agency

SLCP – Short-Lived Climate Pollutants

SREP – Scaling Up Renewable Energy Program in Low Income Countries

STAP – Scientific and Technical Advisory Panel of the Global Environment Facility

UNDP – United Nations Development Programme

UNFCCC – United Nations Framework Convention on Climate Change

References

Agrawal, A., Nepstad, D., and Chhatre, A. 2011. Reducing emissions from deforestation and forest degradation. Annual Review of Environment and Resources, 36, 373-396.

Arriagada, R. A., Sills, E. O., Pattanayak, S. K., & Ferraro, P. J. (2009). Combining Qualitative and Quantitative Methods to Evaluate Participation in Costa Rica's Program of Payments for Environmental Services. Journal of Sustainable Forestry. doi:10.1080/10549810802701192

Atmadja S. and E. Sills. 2015. Identifying the Causes of Tropical Deforestation: Meta-analysis to Test and Develop Economic Theory. Tropical Forestry Handbook. Berlin: Springer-Verlag. DOI 10.1007/978-3-642-41554-8_252-1

BBC, 2015. Liberia signs 'transformational' deal to stem deforestation. Available at: http://www.bbc.com/news/science-environment-29321143

Befani B., C. Barnett and E. Stern (eds.) 2014. Rethinking Impact Evaluation for Development, IDS Bulletin, Volume 45, Issue 6, Pages 1–99.

Bonan, J, Pareglio, S and M Tavoni, 2014. Access to Modern Energy: A Review of Impact Evaluations. FEEM Working Paper No. 96.2014.

Bruce, N., Pope, D., Rehfuess, E., Balakrishnan, K., Adair-Rohani, H., and Dora, C. 2015. WHO indoor air quality guidelines on household fuel combustion: Strategy implications of new evidence on interventions and exposure–risk functions. Atmospheric Environment, 106, 451-457.

Center for Global Development, 2004. Will we ever learn? The Evaluation Gap Working Group. Report submitted to the Bill & Melinda Gates Foundation and The William and Flora Hewlett Foundation.
http://www.cgdev.org/files/7973_file_WillWeEverLearn.pdf

Church of Sweden, 2013. Footing the bill: What is Sweden's 'fair share' of global climate finance? http://www.seiinternational.org/mediamanager/documents/Publications/Climate/Footing_the_bill.pdf accessed 2015-01-19

Climate Funds Update, 2015a. Available at: http://www.climatefundsupdate.org/data

Climate Funds Update, 2015b. Available at: http://www.climatefundsupdate.org/listing/international-climate-fund

Corbera. 2012. Current Opinion in Environmental Sustainability 2012, 4:612–619.

Deaton, A. 2010. Instruments, Randomization, and Learning about Development, Journal of Economic Literature, 48(2), 424-455.

Dherani, M., Pope, D., Mascarenhas, M., Smith, K. R., Weber, M., and Bruce, N. 2008. Indoor air pollution from unprocessed solid fuel use and pneumonia risk in children aged under five years: a systematic review and meta-analysis. Bulletin of the World Health Organization, 86(5), 390-398C.Dzebo and van Asselt. 2014. Swedish development cooperation and climate change: Is there potential for better mainstreaming? Nord-star Policy Brief accessed 8 May 2015 http://www.nord-star.info/index.php/research/policy-briefs

Ferraro, PJ, K Lawlor, KL Mullan, and SK Pattanayak. 2012. Forest figures: A review of ecosystem services valuation and policies in developing countries. Review of Environmental Economics and Policy. 6 (1): 20 – 44.

Forest Peoples Programme, 2015. Swedish International Development Agency supports Forest Peoples Programme to help forest communities impacted by REDD in the Democratic Republic of Congo. Available at: http://www.forestpeoples.org/topics/redd-and-related-initiatives/news/2011/10/swedish-international-development-agency-supports-f

German Climate Finance, 2015. Database on German Climate Finance. Available at : http://datenbank.deutscheklimafinanzierung.de/project?page=3

Government of Sweden, 2014a. Resultatstrategi för globala insatser för miljö- och klimatmässigt hållbar utveckling 2014-2017. Available at: http://www.regeringen.se/content/1/c6/23/59/08/e57575dd.pdf accessed 2014-08-28

Government of Sweden, 2014b. Kraftigt höjd ambitionsnivå för klimatåtgärder. Available at: http://www.regeringen.se/sb/d/18334/a/248534 accessed 2014-11-23

Government of Sweden, 2015a. Multilateral cooperation. Available at: http://www.government.se/sb/d/11747

Government of Sweden, 2015b. Swedish assessment of multilateral organizations. Available at: http://www.government.se/sb/d/11747/a/122004

Government of the United Kingdom, 2015. Climate change international action. Available at: https://www.gov.uk/government/policies/taking-international-action-to-mitigate-climate-change/supporting-pages/reducing-emissions-from-deforestation-and-forest-degradation-redd

Grant MJ, Booth A. 2009. A typology of reviews: an analysis of 14 review types and associated methodologies. Health Information & Libraries Journal 26 (2):91-108

Habicht, J. P., Victora, C. G., & Vaughan, J. P. (1999). Evaluation designs for adequacy, plausibility and probability of public health programme performance and impact. International journal of epidemiology, 28(1), 10-18.

Heckman, J. J. 2010,Building Bridges between Structural and Program Evaluation Approaches to Evaluating Policy, Journal of Economic Literature, 48(2), 356-398.

Jagger P., Sills E.O., Lawlor, K. and Sunderlin, W.D. 2010. A guide to learning about livelihood impacts of REDD+ projects. Occasional paper 56. CIFOR, Bogor, Indonesia.

Jeuland, MA, and SK Pattanayak. 2012. Benefits and costs of improved cookstoves: Assessing the implications of variability in health, forest and climate impacts. PLOS One. 7(2): e30338.

Lewis, JJ, V Bhojvaid, N Brooks, I Das, MA Jeuland, O Patange, and SK Pattanayak. 2015. Piloting improved cookstoves in India. Journal of Health Communication 20 (sup1), 28-42

Lund JF, Balooni K, and Casse T. 2009. Change We can Believe in? Reviewing Studies on the Conservation Impact of Popular Participation in Forest Management. Conservat Soc 7:71-82.

Kanbur, SM Ravi, ed. (2003). Q-squared, combining qualitative and quantitative methods in poverty appraisal. Orient Blackswan.

Kinzig, A., D Starrett, et al. (2003). Coping with uncertainty: a call for a new science-policy forum. AMBIO: A Journal of the Human Environment, 32(5), 330-335.

Marcoux, C., Parks, B. C., Peratsakis, C. M., Roberts, J. T., and Tierney, M. J. 2013. Environmental and climate finance in a new world: How past environmental aid allocation impacts future climate aid (No. 2013/128). WIDER Working Paper.

Ministry of Environment 2009. Sweden's fifth National Communication to the United Nations Framework Convention on Climate Change, 2010

Ministry of Environment 2014. Sweden's sixth National Communication to the United Nations Framework Convention on Climate Change, 2014.

Ministry of Foreign Affairs, 2013. Regeringens klimatsatsning 2009-2012.

Miteva, DA., SK Pattanayak, and PJ Ferraro. "Evaluation of biodiversity policy instruments: what works and what doesn't" Oxford Review of Economic Policy 28.1 (2012): 69-92.

Nguyen DT, Tran-Nam B, Grewal B. 2012. Effects of natural resource revenue sharing and investment arrangements on economic growth and poverty reduction in low- and middle-income countries. Protocol. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

NORAD, 2014. Real-Time Evaluation of Norway's International Climate and Forest Initiative Synthesising Report 2007-2013

NORAD, 2015. The Norwegian Climate and Forest funding to civil society. Available at: http://www.norad.no/en/front/funding/climate-and-forest-initiative-support-scheme/grants-2013-2015/

Norwegian Government, 2015. Norway's International Climate and Forest Initiative (NICFI). Available at: https://www.regjeringen.no/en/topics/climate-and-environment/climate/climate-and-forest-initiative/id2000712/ accessed 2015-04-20

OECD, 2015. Climate-related development finance in 2013 Improving the statistical picture. Updated June 2015. Available at:

http://www.oecd.org/dac/environment-development/Climate-related%20development%20finance%20FINAL.pdf accessed 2015-07-15

Pattanayak, S.K., 2009. Rough guide to impact evaluation of environmental and development programs. SANDEE Working Paper 40. http://goo.gl/X47IWy http://www.sandeeonline.org/uploads/documents/publication/847_PUB_Working_Paper_40.pdf

Pattanayak, SK, MA Jeuland, JJ Lewis, V Bhojvaid, N Brooks, A Kar, L Morrison, O Patange, L Philippone, N Ramanathan, IH Rehman, R Thadani, M Vora, V Ramanathan. 2014. Cooking up change in the Himalayas: Evidence from mixing quasi-experiments with an experiment on cookstove promotion. Working Paper. Duke University.

Petrokofsky G., P. Holmgren, and N.D. Brown. 2011. Reliable forest carbon monitoring – systematic reviews as a tool for validating the knowledge base. International Forestry Review V.13 (1).

Pickering, J. Skovgaard, J. Kim, S. Roberts, J.T. Rossati, D. Stadelmann, M. and Reich, H. 2015. Acting on Climate Finance Pledges: Inter-Agency Dynamics and Relationships with Aid in Contributor States, World Development, Volume 68, April 2015, Pages 149-162.

Pullin A. S., and Knight, T. M. 2009. Doing more good than harm–Building an evidence-base for conservation and environmental management. Biological Conservation, 142(5), 931-934.

Puzzolo E, Stanistreet D, Pope D, Bruce N, and Rehfuess E. 2013. Factors influencing the largescale uptake by households of cleaner and more efficient household energy technologies. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Ravallion, M. 2009, Evaluation in the Practice of Developmen', The World Bank Research Observer, 24(1), 29-53.

Roe, D., Day, M., Booker, F., Zhou, W., Allebone-Webb, S., Kümpel, and Petrokofsky, G. 2014. Are alternative livelihood projects effective at reducing local threats to specified elements of biodiversity and/or improving or maintaining the conservation status of those

elements?: a systematic review protocol. Environmental Evidence, 3(6).

Samii C, Lisiecki M, Kulkarni P, Paler L, and Chavis L. Effects of Decentralized Forest Management (DFM) on Deforestation and Poverty in Low and Middle Income Countries: A Systematic Review Campbell Systematic Reviews 2014:10

Sida 2011. Adapting to a Changing Climate - The Swedish Government's Special Climate Change Initiative 2009–2012. Available at: http://www.sida.se/contentassets/4fd001ea4a9b4fa9a41a4309d01845b3/adapting-to-a-changing-climate---the-swedish-government8217s-special-climate-change-initiative-200982112012_3370.pdf

Sida, 2013a. The Governments Special Climate Change Initiative. Available at: http://www.sida.se/English/About-us/our-fields-of-work/Environment-Climate-Change-and-Sustainable-Services/The-Governments-Special-Climate-Change-Initiative/ accessed 2014-08-29

Sida 2013b. Aid Policy Framework – the direction of Swedish aid. Available at: http://www.regeringen.se/content/1/c6/24/28/99/5718b7f6.pdf accessed 2014-08-28

Sida, 2013c. Slutrapport Klimatsatsningen 2009 – 2012: bilaterala och regionala insatser. Sida, Promemoria 2013-04-30. Available at: http://www.sida.se/globalassets/global/about-sida/sa-arbetar-vi/hallbar-utveckling/slutrapport-klimatsatsningen-2013.pdf accessed 2014-10-21

Sida 2014a. Sverige bidrar med en miljard dollar till Power Africa Available at: www.sida.se/Svenska/aktuellt-och-press/nyheter/2014/Augusti-2014/sverige-bidrar-med-en-miljard-dollar-till-power-africa/ accessed 2014-08-29

Sida 2015d. Portfolio overview: Energy 2013. Available at: http://www.sida.se/contentassets/f412af209f8142acbca08eb21611f89c/e56e6541-17d2-4511-ac0f-a7e5815bc994.pdf accessed: 2015-02-17.

Sida, 2015a. Environment and climate. Available at: http://www.sida.se/English/how-we-work/our-fields-of-work/environment-and-climate/ accessed: 2015-01-25

Sida, 2015b. Portfolio overview: Environment and Climate Change 2013. Available at:

http://sidapublications.citat.se/interface/stream/mabstream.asp?filetype=1&orderlistmainid=3890&printfileid=3890&filex=5775263187770 accessed: 2015-02-17.

Sida, 2015c. Portfolio overview: Agriculture, Forestry, Fishery and Rural development 2013. Available at: http://www.sida.se/contentassets/b7e5a24148e941d787dca7af68ecdf9f/2a75b7f5-f234-4567-b98d-062dd228f216.pdf accessed: 2015-02-17.

Stern, Nicholas, 2015. Understanding climate finance for the Paris summit in December 2015 in the context of financing for sustainable development for the Addis Ababa conference in July 2015. Policy paper, ESRC Centre for Climate Change Economics and Policy & Grantham Research Institute on Climate Change and the Environment, London.

Swartzendruber, 2014 https://www.climate-eval.org/sites/default/files/studies/NRM-Study-Draft.pdf

Vreugdenhil, H., Slinger, J., Thissen, W., & Rault, P. K. (2010). Pilot Projects in Water Management, 15(3).

Wingqvist, G., César, E. and von Walter S. 2013. Categorisation of bilateral and regional contribution in the Climate Change Initiative. Sida's Helpdesk for Environment and Climate Change.

Wingqvist, G., César, E., Atteridge, A., Berg, H., Drakenberg, O., Axelsson, A. and Schultz, M. 2011. Environmental Statistics at Sida – A Review of Policy Markers on Climate Change Adaptation, Climate Change Mitigation, Biodiversity and Ecosystem Services, and Environment. Sida's Helpdesk for Environment and Climate Change, University of Gothenburg.

Annex A: The Swedish Special Initiative for Climate Change in Development Cooperation

Table A1. Bilateral interventions through Sida within the Climate Change Initiative 2009-2012 (million SEK). Source: Sida 2013c.

Country/ Region	Number of interventions 2009-2013	2009	2010	2011	2012	Total Outcome 2009–2012
Bangladesh	2	50	80	10	40	180
Bolivia	11	11.5	41.3	74.8	64.3	191.9
Burkina Faso	2	10.6	15.1	50.6	4.7	81
Cambodia	4	15	8	12.3	24.7	60
Mali	7	18.4	23.5	27.7	27.6	97.2
Regional Africa	17	100	57.2	59.7	140.7	357.6
Reg. Afr. – WSSCC	1				40	40
Regional Asia	16	34	25	25	26	110
TOTAL	60	239.5	250.1	260.1	368	1117.7

Table A2. Total multilateral distribution of payments within the Climate Change Initiative 2009–2012 (prolonged to 2013).

Disbursement per channel and year (SEK million)	2009	2010	2011	2012	2013	Total
Convention related interventions	**50**	**335**	**285**	**205**	**370**	**1245**
Least Developed Countries Fund (LDCF)	50	0	185	100	100	435
Adaptation fund (AF)	0	100	100	100	100	400
Global Environmental Facility (GEF)	0	135	0	0	165	300
GEF REDD+	**0**	**100**	**0**	**0**		**100**
Green Climate Fund (GCF)	0	0	0	5	5	10
Non-convention related interventions	**910**	**290**	**475**	**355**	**130**	**2160**
International Development Association (IDA)	520	0	185	0		705
Clean Technology Fund (CTF)	300	200	100	0		600
Scaling Up Renewable Energy Program in Low Income Countries (SREP)	0	0	0	170	115	285
Consultancy Group on International Agricultural Research (CGIAR)	50	50	50	0		150
Forest Investment Program (FIP)	**0**	**0**	**100**	**0**		**100**
Global Facility for Disaster Risk Reduction (GFDRR)	0	35	40	0		75
Program for Market Readiness (PMR)	0	0	0	50		50
World Food Program (WFP)	0	0	0	44		44
United Nations Development Program-Bureau for Crisis Prevention and Recovery (UNDP-BCPR)	15	0	0	23.5		38.5
International Strategy for Disaster Reduction (ISDR)	25	5	0	7.5		37.5
International Fund for Agricultural Development – Adaptation for Smallholder Agriculture Program (IFAD-ASAP)	0	0	0	30		30
Sustainable Energy For All	**0**	**0**	**0**	**20**		**20**

(SE4All)						
Climate and Clean Air Coalition (CCAC)	0	0	0	10	15	25
Total disbursements	**960**	**625**	**760**	**560**	**(500)**	**2905 (3405)**

Initiatives with direct bearing on forest conservation and household energy are presented in bold.

Source: Ministry of Foreign Affairs, 2013.

Table A3. Number of interventions and flows for each country or region for the bilateral and regional support within the Climate Change Initiative

Main target area of the programs is provided.

Country (total number. of interventions)	Primary objective (forest conservation)	Indirect objective:(e.g. Sustainable forest mngt., tree planting, rehabilitation)	Possible link or co-benefit (agriculture, food security, adaptation	Programs in CCI not targeted
Bangladesh (2)	0	0	1	1
Bolivia (11)	2	0	2	7
Cambodia (4)	0	0	1	3
Burkina Faso (2)	1	0	0	1
Mali (7)	1	4	1	1
Regional Africa (18)	1	1	6	10
Regional Asia (16)	2	0	0	14

Table A4. Bilateral and regional interventions within the Climate Change Initiative focusing directly or indirectly on forest conservation.

Name on intervention (country or region)	*Prim obj: (forest conservation.)*	*Ind obj: (Sust. forest mngt.,plant. rehab.)*	*Possible link or co-benefit (agri, food security, adaptation)*	*Total support (MSEK 2009-2013)*
BCCRF (Bangladesh)		*	**	*130*
Community-based Adaptation Prog. (Cambodia)		*	**	*21*
Baba Carapa (Bolivia)	**	*	**	*60.3*
Forestry Action Plan (Bolivia)	**	*	*	*52.3*
Proagro 1 (Bolivia)		*	**	*10.8*
Proagro 2 – (Bolivia)		*	**	*21*
Water reservoirs (Burkina Faso)		*	**	*90.5*
IUCN Adapt. fund (Burkina Faso)	*	**	*	*19.8*
REDDIN IUCN prep (Mali)		**	*	*0.4*
REDDIN IUCN (Mali)		**	*	*21.3*
GEDEFOR adaptation (Mali)		**	*	*22*
RESO Climate (Mali)		*	*	*39*
NCA project in Gao Kidal (Mali)	*	**	*	*14.5*
ITP 262 Cert.Forestière (Mali)	**	*	*	*0.5*
RFGI (Regional Afric	*	**		*30*
BecA (Regional Africa)		*	**	*30*
WIOMSA	**	*		*13.6*

(Regional Africa)				
Bio Innovate (Regional Africa)		*	**	*20*
UNEP - Marine and coastal programme (Regional Africa)		*	**	*29.2*
CAWT(Regional Africa)		*	**	*5*
ARC (Regional Africa)		*	**	*31.5*
MFF(Regional Asia)	**	*	*	*14*
RECOFTC (Regional Asia)	**	*	*	*6*
Total programs (primary target)	*7*	*6*	*11*	*23*
Total amount (primary objective - million SEK)	*146.7*	*108.1*	*483*	*682.7*

A scoring matrix is provided for the primary (**) and indirect objective (*, if any). See Sida (2013c) for explanation of interventions.

Annex B: Systematic search protocol

Systematic reviews require a fully transparent and replicable strategy for searching and screening the literature, in order to identify all studies that can provide evidence relevant to the research question. Typically, the search protocol identifies a large number of potentially eligible studies that much be evaluated based on their relevance to the topic and the methods that they employed. The process of systematic reviews advocated and taught by organizations such as the Cochrane and Campbell collaborations, 3IE, and CEE includes a rigorous quality screen, retaining only studies that employ methods judged capable of establishing attribution and estimating causal effects. For our review, we applied a more generous quality screen, retaining all studies that employed empirical evidence to assess the impacts of a relevant intervention (to promote forest conservation or household energy transitions). Typically, these studies are based at least in part on data gathered after the intervention has taken place from the places or agents that were subject to the intervention, and hence we refer to them as "ex post" and "empirical." Even with our more generous quality screen, we screened out most of the studies in the search results from academic databases, pre-identified (from our files and from other recent reviews of the literature), and listed in relevant sections of on-line catalogs. Our final count of ex post, empirical, impact evaluations is 82 in the household energy domain and 22 in the forest conservation domain (Figure 5 in main report).

Search explanation for on-line catalogs of multilateral and international organizations

We searched for impact evaluations in the on-line catalogs of selected bilateral, multilateral, and international organizations. Specifically, we considered the websites of the following bi- and multilateral organizations that were either recommended to us or represent countries that were selected as comparison cases: the World Bank, the Swedish International Development Cooperation Agency (Sida), the Norwegian Agency for Development Cooperation (NORAD), the Department for International Development from the United Kingdom (DFID), and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). Key words for the search varied depending on the available options in the organization's website, but typically

included "impact evaluation/assessment", "climate change", "environment", "environmental policies", "household energy", and "forest and climate change". There was no obvious way to search for impact evaluations on the GIZ website. Although all of the other sites offered process ("real-time") evaluations and methodological guidance on impact evaluations, we only found results of ex post, empirical impact evaluations via the World Bank's website.

Based on our prior knowledge and recommendations from experts, we focused on the websites of two international organizations: the International Initiative for Impact Evaluation (3IE) (www.3ieimpact.org/) and Climate Eval (www.climate-eval.org/eLibrary). Again, key words for the search varied depending on the available options the organization's browser offered. We only found results of ex post, empirical impact evaluations through the 3IE website.

Unlike academic databases, the World Bank and 3IE sites do not offer Boolean search options nor options to download the abstracts of studies identified through keyword searches. Thus, after identifying potential impact evaluations on our topic, we downloaded and screened the full text.

Search explanation for academic databases

We searched two databases: Web of Science, because it is widely recognized as one of the most comprehensive, and EconLit, because economists are often involved in impact evaluations. We designed the search protocols around five categories of keywords describing the: *intervention*, *location*, *co-benefits*, *climate* and *evaluation*. The keywords under *intervention* lists the possible interventions undertaken that would fall within our scope, *location* limits the search to developing and low-income countries and regions, *co-benefits* are the intended and/or mentioned possible benefits resulting from the interventions, *climate* covers local and global climate change terms, and *evaluation* limits the search to capture papers that evaluate an intervention (quantitative as well as qualitative, ex ante as well as ex post). We searched for these terms in the papers' title, abstract and keywords. See boxes B1 and B2 for specific search syntax.

Box B1: Search Syntax for Energy

"household energy" OR "cook* fuel*" OR "household fuel*" OR "energy poverty" OR "cook* method*" OR "household* cook*" OR cookstov* OR stove* OR "biomass fuel*" OR ICS OR "rural electrification" OR biogas OR firewood OR fuelwood OR charcoal OR photovoltaic OR "solar power*" OR "solar energy" OR "solar stove*" OR microgrid* OR micro-grid* OR "alternat* power" OR "stove* effective*" OR "energy transition*" OR "energy ladder" OR "energy access" OR "access to energy" OR "energy security"

AND

Africa* OR "Latin America*" OR "Central America*" OR "South America*" OR Asia* OR "low income" OR "less* developed countr*" OR "developing countr*" OR emerging OR "least developed countr*" OR LIC* OR LDC* OR "third world" OR Afghanistan OR Guinea OR Peru OR Albania OR Guyana OR Philippines OR Algeria OR Haiti OR Romania OR Samoa OR Honduras OR Rwanda OR Angola OR Hungary OR Samoa OR Argentina OR India OR "São Tomé and Principe" OR Armenia OR Indonesia OR Senegal OR Azerbaijan OR Iran OR Serbia OR Bangladesh OR Iraq OR Seychelles OR Belarus OR Jamaica OR Sierra OR Leone OR Belize OR Jordan OR "Solomon Islands" OR Benin OR Kazakhstan OR Somalia OR Bhutan OR Kenya OR Bolivia OR Kiribati OR Sudan OR Bosnia OR "Sri Lanka" OR Botswana OR Kosovo OR Lucia OR Brazil OR Kyrgyz OR "st* Vincent" OR Bulgaria OR Lao OR "Burkina Faso" OR Lebanon OR Suriname OR Burundi OR Lesotho OR Swaziland Cabo OR Liberia OR Syria OR Cambodia OR Libya OR Tajikistan OR Cameroon OR Macedonia OR Tanzania Madagascar OR Thailand OR Chad OR Malawi OR Timor OR China OR Malaysia OR Togo OR Colombia OR Maldives OR Tonga OR Comoros OR Mali OR Tunisia OR Congo OR Marshall Islands OR Turkey OR Mauritania OR Turkmenistan OR "Costa Rica" OR Mauritius OR Tuvalu OR "Côte d'Ivoire" OR Mexico OR Uganda OR Cuba OR Micronesia OR Ukraine OR Djibouti OR Moldova OR Uzbekistan OR Dominica OR Mongolia OR Vanuatu OR "Dominican Republic" OR Montenegro OR Venezuela OR Ecuador OR Morocco OR Vietnam OR Egypt OR Mozambique OR Gaza OR "El Salvador" OR Myanmar OR Yemen OR Eritrea OR Namibia OR Zambia OR Ethiopia OR Nepal OR Zimbabwe OR Fiji OR Nicaragua OR Gabon OR Niger OR Gambia OR Nigeria OR Georgia OR Pakistan OR Ghana OR Palau OR Grenada OR Panama OR Guatemala OR Paraguay

AND

"co-benefits" OR livelihood* OR "multiple-use" OR "multiple benefits" OR health OR "time-sav*" OR "time sav*" OR "socio-econom*" OR poverty OR "income generat*" OR "alternative income" OR "alternative livelihood" OR employment OR "impact* on the poor" OR "poverty impact*" OR "impact* on poverty" OR "rural livelihood*" OR "local impact*" OR "social safeguards" OR empowerment OR equality OR equity OR perception OR "social capital" OR attitude* OR "social welfare" OR "human well*" OR empowerment OR gender OR "local benefits" OR "rule making"

AND

"climate change" OR Adaptation OR mitigation OR carbon OR emissions OR GHG OR REDD* OR CDM OR offset* OR VCS OR CO2 OR "black carbon" OR "carbon sequestration"

AND

evaluat* OR (monitoring WITHIN "5" evaluation) OR impact* OR "causal effects" OR "logic model" OR counterfactual OR regress* OR econometric* OR "adopt* rate"

Box B2: Search Syntax for Forest Conservation

("protected area*") OR "forest protection" OR "forest manag*" OR "management area" OR "biosphere reserve*" OR "national park" OR reforestation OR "forest restoration" OR "forest conservation" OR "avoided deforestation" OR afforestation OR FUG OR "forest user group*" OR CFUG OR "community forest user group" OR "community forest*" OR (indoor* WITHIN "5" "black carbon") OR REDD OR "REDD+" OR "REDD plus" OR "community forest management" OR CFM OR "participatory forest management" OR PFM OR "joint forest management" OR JFM OR "community based forest management" OR CBFM OR NTFP OR "non-timber forest product*" OR "fuel wood" OR firewood OR "ecosystem services" OR "wildfire prevention" OR "preventing wildfire adaptation" OR (*forest* WITHIN "5" reserve*) OR (*forest* WITHIN "5" certific*) OR (*forest* WITHIN "5" mitigation) OR (*forest* WITHIN "5" decentrali*) OR (*forest* WITHIN "5" devolution) OR (*forest* WITHIN "5" ecotourism) OR (*forest* WITHIN "5" RIL) OR (*forest* WITHIN "5" timber)

AND

Africa* OR "Latin America*" OR "Central America*" OR "South America*" OR Asia* OR "low income" OR "less* developed countr*"

OR “developing countr*” OR emerging OR “least developed countr*” OR LIC* OR LDC* OR “third world” OR Afghanistan OR Guinea OR Peru OR Albania OR Guyana OR Philippines OR Algeria OR Haiti OR Romania OR Samoa OR Honduras OR Rwanda OR Angola OR Hungary OR Samoa OR Argentina OR India OR “São Tomé and Principe” OR Armenia OR Indonesia OR Senegal OR Azerbaijan OR Iran OR Serbia OR Bangladesh OR Iraq OR Seychelles OR Belarus OR Jamaica OR Sierra OR Leone OR Belize OR Jordan OR “Solomon Islands” OR Benin OR Kazakhstan OR Somalia OR Bhutan OR Kenya OR Bolivia OR Kiribati OR Sudan OR Bosnia OR “Sri Lanka” OR Botswana OR Kosovo OR Lucia OR Brazil OR Kyrgyz OR “st* Vincent” OR Bulgaria OR Lao OR “Burkina Faso” OR Lebanon OR Suriname OR Burundi OR Lesotho OR Swaziland Cabo OR Liberia OR Syria OR Cambodia OR Libya OR Tajikistan OR Cameroon OR Macedonia OR Tanzania Madagascar OR Thailand OR Chad OR Malawi OR Timor OR China OR Malaysia OR Togo OR Colombia OR Maldives OR Tonga OR Comoros OR Mali OR Tunisia OR Congo OR Marshall Islands OR Turkey OR Mauritania OR Turkmenistan OR “Costa Rica” OR Mauritius OR Tuvalu OR “Côte d'Ivoire” OR Mexico OR Uganda OR Cuba OR Micronesia OR Ukraine OR Djibouti OR Moldova OR Uzbekistan OR Dominica OR Mongolia OR Vanuatu OR “Dominican Republic” OR Montenegro OR Venezuela OR Ecuador OR Morocco OR Vietnam OR Egypt OR Mozambique OR Gaza OR “El Salvador” OR Myanmar OR Yemen OR Eritrea OR Namibia OR Zambia OR Ethiopia OR Nepal OR Zimbabwe OR Fiji OR Nicaragua OR Gabon OR Niger OR Gambia OR Nigeria OR Georgia OR Pakistan OR Ghana OR Palau OR Grenada OR Panama OR Guatemala OR Paraguay

AND

“co-benefits” OR safeguards OR livelihood* OR “multiple-use” OR “multiple benefits” OR health OR “household energy” OR “socio-econom*” OR poverty OR “income generat*” OR “alternative income” OR “alternative livelihood” OR employment OR “impacts on the poor” OR “poverty impact” OR “impact on poverty” OR “rural livelihood*” OR “local impact*” OR “food security” OR “social safeguards” OR “water access” OR watershed OR empowerment OR equality OR equity OR (adaptation WITHIN ”5” mitigation) OR perception OR “social capital” OR attitude* OR “social welfare” OR “human well*” OR empowerment OR gender OR “local benefits” OR “rule making”

AND

"climate change" OR Adaptation OR mitigation OR carbon OR emissions OR GHG OR REDD* OR CDM OR offset* OR VCS OR CO2 OR "black carbon" OR "carbon sequestration"

AND

evaluat* OR (monitoring WITHIN "5" evaluation) OR impact* OR "causal effects" OR "logic model" OR counterfactual OR regress* OR econometric*

After we obtained a list of citations from our keyword search, we read the abstracts of each paper and formed an overall impression of its relevance to our study. Specifically, we rejected studies that were not undertaken in a rural area in a developing country, are not related to a forest ecosystems, where no intervention has taken place (e.g., the study is solely observational), biodiversity is the sole outcome of interest (biodiversity as a co-benefit is accepted), or there is no mention of effects on residents in the location of the intervention.

Annex C: Impact evaluations

Table C1. Impact evaluations for household energy

Reference	Source *	Type of study **	Country	Type of intervention	Years between intervention start and IE	Data collection methods	Sample unit used	Method for data analysis	Counterfactual used***	Main results of the study
Barron, M. & Torero, M. (2015)	No	Pro	El Salvador	Electrification	3	*Survey/ interviews *Air samples	Households	Randomized controlled trial	NI	Air quality and health improvements
Alexander et al. (2014)	SciJ	Pro	Bolivia	Biomass ICSs	1	*Survey/ interviews *Air samples	Households	Correlation tests	Al	Air quality & health improvements
Bernard T. & Torero M. (2014)	SciJ	Retro	Ethiopia	Electrification	Unknown	*GPS information *Allocation of discount vouchers	Households	Randomized controlled trial	NI	No effects on air quality, health, fuel efficiency or income were found.

Brooks, N. et al. (2014)	No	Retro	India	Non-biomass ICSs	Unknown	*24-hour fuel weighing measurements *Fuel use report every 24h	House-holds	*Regression analysis *Propensity score matching *Heckman two-step estimator	NI	Fuel efficiency improve-ments
Burlando, A. (2014)	Other PR	Retro	Zanzibar	Electri-fication	2	External data	Villages	Difference-in-differences	NI	Health improve-ments
Hu et al. (2014)	SciJ	Retro	China	Biomass ICSs	Unknown	*Survey/ interviews *Air samples	Women	Regression analysis	Al	Air quality improve-ments
Khandker et al. (2014)	No	Retro	Bangla-desh	Electri-fication	10	Survey/ interviews	House-holds	*Regression analysis *Matching	NI	Air quality, health, fuel efficiency & income improve-ments

Lewis, J. J. et al. (2014)	No	Retro	India	Non-biomass ICSs	Unknown	*Survey/ interviews *Air samples *Health tests *Measurements of fuel used	House-holds	*Multivariate regression analysis	NI	Air quality, health & fuel efficiency improve-ments
Pant, K. P. et al. (2014)	No	Retro	Nepal	Biomass & non-biomass ICSs	Unknown	*Survey/ interviews *Air samples *Focus groups	House-holds	*Regression analysis *Instrumental variables	NI	Air quality, health, fuel efficiency & income improve-ments
Reference	**Sour-ce ***	**Type of study*****	**Country**	**Type of intervention**	**Years between intervention start&IE**	**Data collection methods**	**Sample unit used**	**Method for data analysis**	**Counter-factual used*****	**Main results of the study**

Pattanyak, S. et al. (2014)	No	Pro	India	Non-biomass ICSs	1	*Survey/ interviews *Focus groups *Solitication *Extensive piloting	House-holds	Matching	NI	Fuel efficiency improve-ments
Rosa et al. (2014)	Other PR	Pro	Rwanda	Biomass ICSs	1	*Survey/ interviews *Air samples	House-holds	Randomized controlled trial	NI	Air quality & health improve-ments
Sparrevik et al. (2014)	SciJ	Retro	Indonesia	Non-biomass ICSs	2	External data	Indivi-duals	*Cost-benefit analysis *Life cycle assessment	Al	No effects on air quality, health, fuel efficiency or income.
World Bank (2014)	No	Retro	Mongolia	Electri-fication	5	Survey/ interviews	House-holds	Descriptive statistics	Al	Fuel efficiency improve-ments

Yamamoto et al. (2014)	SciJ	NA	Burkina Faso	Not applicable	Unknown	*Air samples *External data	House-holds	*Correlation tests *Regression analysis	Al	Air quality improve-ments
Adetona et al. (2013)	SciJ	NA	Peru	Non-biomass ICSs	Unknown	*Survey/ interviews *Air samples * Healthtests	Women	Regression analysis	Al	Health improve-ments
Beltramo and Levine (2013)	SciJ	Pro	Senegal	Non-biomass ICSs	0	*Survey/ interviews *Air samples	House-holds	Randomized controlled trial	NI	No effects on air quality, health, fuel efficiency or income.
Bensch et al. (2013)	No	Retro	Burkina Faso	Biomass ICSs	6	Survey/ interviews	House-holds	*Regression analysis *Matching	NI	Fuel efficiency& income improvem.
Chowdhur y et al. (2013)	SciJ	Pro	China	Biomass & non- biomass ICSs	4	*Survey/ interviews *Air samples	House-holds	Regression analysis	Al	Air quality improve-ments

Clark et al. (2013)	SciJ	Pro	Nicaragua	Biomass ICSs	1	*Survey/ interviews *Air samples * Health tests	Women	Before-and-after analysis	Al	Air quality improve-ments
Costolanski et al. (2013)	No	Pro	Ethiopia	Non-cooking interventions	3	External data	Indivi-duals	Regression analysis	NI	Fuel efficiency improve-ments
Dasgupta et al. (2013)	No	Pro	Madagas-car	Biomass ICSs	1	*Survey/ interviews *Air samples *External data	House-holds	*Regression analysis *Before-and-after analysis	Al	Air quality improve-ments

Refer-ence	Source *	Type of study **	Country	Type of inter-vention	Years between intervention start and IE	Data collection methods	Sample unit used	Method for data analysis	Count-er factual used***	Main results of the study
Fetzer, T. et al. (2013).	No	Retro	Colombia	Electri-fication	15	External data	Women	Difference-in-diff.	NI	Health improvements
Hawley and Volckens (2013)	SciJ	NA	Not mentioned	Biomass ICSs	Unknown	*Collection of 3 human bronchial epithelial cells samples *Woodsmoke generation	Indivi-duals	In vitro laboratory experiment	Al	Health improvements
Huboyo et al. (2013)	SciJ	Retro	Indonesia	Biomass ICSs	0	*Air samples *Cooking tests	Not appli-cable	Descriptive statistics	Al	Air quality & fuel efficicency improvements
Johnson et al. (2013)	SciJ	Retro	India, Nepal & Peru	Biomass ICSs	1	Cooking tests	House-holds	*Correlation tests *Before-and-after analysis	NI	Fuel efficiency improvements

Khandker, S. et al. (2013)	SciJ	Retro	Vietnam	Electrifi-cation	5	*Survey/ interviews *External data	House-holds	*Panel data *Fixed effects	NI	School enrollment increase
Khudadad et al. (2013)	SciJ	Retro	Pakistan	Biomass ICSs&non cooking intervent.	Unknown	*Survey/ interviews *Air samples *Cooking tests	House-holds	Before-and-after analysis	Al	Fuel efficiency improvements
Ochieng et al. (2013)	SciJ	Pro	Kenya	Biomass ICSs	3-4	Cooking tests	House-holds	*Regression analysis *Before-and-after analysis	NI	Fuel efficiency improvements
Oluwole et al. (2013)	SciJ	Pro	Nigeria	Biomass ICSs	1	*Survey/ interviews *Air samples *Health tests	Mother-child dyad	Before-and-after analysis	Al	Air quality & health improvements
van de Walle, D. et al. (2013)	No	Retro	India	Electrifica-tion	18	External data	House-holds	*Panel data *Instrumental variables	NI	Income improvements
Bensch Peters (2012)	No	Retro	Senegal	Biomass ICSs	1	Survey/ interviews	House-holds	*Regression analysis *RCT	NI	Health & fuel efficiency improvements

Refer-ence	Source *	Type of study **	Country	Type of intervention	Years between intervention start and IE	Data collection methods	Sample unit used	Method for data analysis	Counter-factual used***	Main results of the study
Burwen and Levine (2012)	SciJ	Pro	Ghana	Biomass ICSs	1	*Survey/ interviews *Air samples *Cooking tests	Indivi-duals	*Regression analysis *Randomized controlled trial	NI	Health improvements
Chowdhury et al. (2012)	SciJ	Pro	Bangla-desh	Biomass ICSs	4	Air samples	House-holds	*Correlation tests *Regression analysis	NI	Air quality improvements
Fitzgerald et al. (2012)	SciJ	Pro	Peru	Biomass ICSs	Unknown	*Survey/ interviews *Air samples	House-holds	Before-and-after analysis	Al	Air quality improvements
Hanna et al. (2012)	No	Pro	India	Biomass ICSs	1-4	*Survey/ interviews *Air samples *Health tests	House-holds	Randomized controlled trial	NI	No effects on air quality, health, fuel efficiency or income.

Sekyere (2012)	SciJ	Retro	Ghana	Non-cooking interventions	Unknown	Luminous flux measurement	Not appli-cable	Cost-benefit analysis	Al	Fuel efficiency improvements
Singh et al. (2012)	SciJ	Pro	Nepal	Biomass ICSs	2-3	*Survey/ interviews *Air samples	House-holds	Before-and-after analysis	Al	Air quality & health improvements
Wei et al. (2012)	SciJ	NA	China	Biomass ICSs	Unknown	Cooking tests	Not appli-cable	Descriptive statistics	Al	Air quality improvements
Barnes et al. (2011)	SciJ	Pro	South Africa	Community counselling (behavioural ch.) interv	1	*Survey/ interviews *Air samples *External data	House-holds	Before-and-after analysis	NI	Air quality improvements
Bensch et al. (2011)	SciJ	Pro	Rwanda	Electri-fication	2	Survey/ interviews	House-holds	Propensity score matching	NI	Income improvements
Dinkelman, T. (2011)	No	Retro	South Africa	Electri-fication	5	External data	Commu-nities	*Fixed effects *Instr. variables	NI	Fuel efficiency improvements
Grieshop et al. (2011)	SciJ	Retro	Notappli cable	Biomass & non-biomass ICSs	Unknown	Air samples	ICSs	Descriptive statistics	Al	Air quality improvements

Harris et al. (2011)	SciJ	Pro	Guate-mala	Biomass ICSs	4	External data	Individu als	Before-and-after analysis	Al	Health improvements

Refer-ence	**Source ***	**Type of study ****	**Country**	**Type of inter-vention**	**Years between intervention start and IE**	**Data collection methods**	**Sample unit used**	**Method for data analysis**	**Count er-factual used*****	**Main results of the study**
Lipscomb , M. et al. (2011)	No	Retro	Brazil	Electri-fication	40	External data	Counties	*Fixed effects *Instrument al variables	NI	Labor productivity improvements
Malla et al. (2011)	SciJ	Pro	Nepal, Kenya & Sudan	Biomass ICSs	1-4	*Survey/ interviews *Air samples *Health tests *Focus groups	House-holds	Cost-benefit analysis	Al	Fuel efficiency improvements
Riojas-Rodrigue z et al. (2011)	SciJ	Pro	Mexico	Biomass ICSs	1-2	*Survey/ interviews *Air samples *Health tests	Women	*Correlation tests *Before-and-after analysis	NI	Air quality improvements

Smith, K. et al. (2011)	SciJ	Pro	Guate-mala	Biomass ICSs	2	*Air samples *Health tests	House-holds	Randomized controlled trial	NI	Air quality improvements
Armendariz-Arnez (2010)	SciJ	Pro	Mexico	Biomass ICSs	Unknown	*Survey/ interviews *Air samples *External data	House-holds	Descriptive statistics	NI	Air quality improvements
Asian Development Bank (2010)	No	Pro	Bhutan	Electrification	4	Survey/ interviews	House-holds	*Regression analysis *Matching	NI	Health improvements
Barnes et al. (2010)	No	Retro	Bangla-desh	Electrification	Unknown	External data	House-holds	*Regression analysis *Instrumental variables *Simulation	NI	Income improvements
Clark et al. (2010)	SciJ	NA	Honduras	Biomass ICSs	Unknown	*Survey/ interviews *Air samples *Calculation of ventilation conditions	Women	*Correlation tests *Regression analysis	NI	Air quality improvements

Garcia-Frapolli et al. (2010)	SciJ	Retro	Mexico	Biomass ICSs	Unknown	External data	Not appli-cable	Cost-benefit analysis	Al	Health & fuel efficiency improvements

Refer-ence	Source *	Type of study**	Country	Type of intervention	Years between intervention start and IE	Data collection methods	Sample unit used	Method for data analysis	Counter-factual used***	Main results of the study
Northcross et al. (2010)	SciJ	Retro	Guate-mala	Biomass ICSs	Unknown	External data	House-holds	*Regression analysis *Fixed effects analysis	NI	Air quality improvements
Wang et al. (2010)	SciJ	NA	China	Biomass & non-biomass ICSs	Unknown	Air samples	House-holds	Descriptive statistics	Al	Air quality improvements
Begum et al. (2009)	SciJ	NA	Bangla-desh	Non-biomass ICSs	Unknown	*Survey/ interviews *Air samples	House-holds	Descriptive statistics	Al	No effects on air quality, health, fuel efficiency or income.
Clark et al. (2009)	SciJ	Retro	Hond-uras	Biomass ICSs	Unknown	*Survey/ interviews *Air samples *Health tests	Women	Regression analysis	NI	Air quality & health improvements

Feng et al. (2009)	SciJ	Retro	Tibet	Non-biomass ICSs	4	Survey/ interviews	House-holds	*Cost-benefit analysis *Structural–functional analysis	Al	Air quality and fuel efficiency improvements
Grogan and Sadanand (2009)	No	Retro	Guate-mala	Electri-fication	Around 4	External data	House-holds	*Regression analysis *Fixed effects *Modelling	NI	Health improvements
Khandker et al. (2009)	No	Retro	Bangla-desh	Electri-fication	27	External data	Indivi-duals	*Regression analysis *Matching	NI	Income improvements
Pearce et al. (2009)	SciJ	NA	Peru	Non-biomass ICSs	Unknown	Air samples	Air samples	Descriptive statistics	Al	No effects on air quality, health, fuel efficiency or income.
Pennise et al. (2009)	SciJ	Pro	Ghana & Ethiopia	Biomass & non-biomass ICSs	Unknown	*Survey/ interviews *Air samples	House-holds	Before-and-after analysis	Al	Air quality improvements

Smith-Sivertsen et al. (2009)	SciJ	Pro	Guate-mala	Biomass ICSs	1-2	*Survey/ interviews *Air samples	Women	*Regression analysis *Randomized controlled trial	NI	Air quality & health improvements
Zhi et al. (2009)	SciJ	NA	China	Biomass ICSs	Unknown	Air samples	Not appli-cable	Descriptive statistics	NI	Air quality & health improvements

Refer-ence	**Source ***	**Type of study** ***	**Country**	**Type of intervention**	**Years between intervention start and IE**	**Data collection methods**	**Sample unit used**	**Method for data analysis**	**Counter factual used****	**Main results of the study**
Cynthia et al. (2008)	SciJ	Pro	Mexico	Biomass ICSs	Unknown	*Survey/ interviews *Air samples	Women	Before-and-after analysis	NI	Air quality improvements
Padhi and Padhy (2008)	SciJ	Retro	India	Non-biomass ICSs	Unknown	*Survey/ interviews *Air samples	Children	Regression analysis	NI	Air quality & health improvements
Edwards et al. (2007)	SciJ	Retro	China	Biomass ICSs	Around 20	Survey/ interviews	House-holds	Correlation tests	Al	Air quality improvements

Gonzalez-Eiras and Rossi (2007)	No	Retro	Argen-tina	Electrificatio n	Around 8	External data	Indivi-duals	*Regression analysis *Difference-in-differences	NI	No effects on air quality, health, fuel efficiency or income.
Khalequz zaman et al. (2007)	SciJ	NA	Bangla-desh	Non-biomass ICSs	Unknown	Survey/ interviews	Children	*Correlation tests *Regression analysis	Al	Air quality & health improvements
Zuk et al. (2007)	SciJ	Pro	Mexico	Biomass ICSs	Unknown	Survey/ interviews	House-holds	Before-and-after analysis	Al	Air quality improvements
Zhou et al. (2006)	SciJ	Pro	China	Biomass ICSs & non-cooking intervention	Unknown	*Survey/ interviews *Air samples	House-holds	Difference-in-differences	NI	No effects on air quality, health, fuel efficiency or income.
Jin et al. (2005)	SciJ	NA	China	Not applicable	Unknown	*Survey/ interviews *Air samples	House-holds	Descriptive statistics	Al	Air quality improvements
Khushk et al. (2005)	SciJ	Pro	Pakistan	Biomass ICSs	Unknown	*Survey/ interviews *Air samples *Focus groups	Women	Regression analysis	NI	Air quality improvements

Mishra et al. (2005)	SciJ	NA	India	Non-biomass ICSs	Unknown	External data	Women	Regression analysis	NI	No effects on air quality, health, fuel efficiency or income.
Peabody et al. (2005)	SciJ	NA	China	Biomass & non-biomass ICSs	Unknown	Survey/ interviews	House-holds	*Regression analysis *Descriptive statistics	Al	Health improvements

Reference	**Source***	**Type of study****	**Country**	**Type of intervention**	**Years between intervention start and IE**	**Data collection methods**	**Sample unit used**	**Method for data analysis**	**Counter-factual used*****	**Main results of the study**
Bhargava et al. (2004)	SciJ	NA	India	Non-biomass ICSs	Unknown	Air samples	House-holds	Correlation tests	Al	No effects on air quality, health, fuel efficiency or income.
Bruce et al. (2004)	SciJ	Retro	Guate-mala	Biomass ICSs	3	*Survey/ interviews *Air samples	Children	Regression analysis	NI	Air quality improvements

Mishra et al. (2004)	SciJ	NA	Zimbabwe	Non-biomass ICSs	Unknown	External data	Child-births	Regression analysis	NI	No effects on air quality, health, fuel efficiency or income.
Neufeld et al. (2004)	SciJ	NA	Guate-mala	Not applicable	Unknown	*Survey/ interviews *Air samples *Health tests	Women	Regression analysis	NI	Health improvements
Rollin et al. (2004)	SciJ	Retro	South Africa	Electrification	Around 10	*Survey/ interviews *Air samples	House-holds	Kruskal–Wallis test	NI	Air quality improvements
Albalak et al. (2001)	SciJ	Retro	Guate-mala	Non-biomass ICSs	1	*Survey/ interviews *Air samples	House-holds	Randomized controlled trial	NI	Air quality improvements
Ezzati et al. (2000)	SciJ	NA	Kenya	Not applicable	Unknown	*Survey/ interviews *Air samples	Indivi-duals	Descriptive statistics	Al	Air quality improvements
Ellegard (1996)	SciJ	NA	Mozam-bique	Non-biomass ICSs	Unknown	*Survey/ interviews *Air samples	Women	Regression analysis	Al	Air quality & health improvements

*SciJ: Scientific journal; Other PR: Other peer-reviewed source; No: Has not been peer-reviewed.
**Retro: Retrospective; Pro: Prospective; NA: Not applicable, as no intervention has taken place.
***NI: Counterfactual considered is when no intervention takes place; Al: An alternative counterfactual is considered, based on comparisons between different types, specificities, or moments (before and after) of the intervention.

C2. Bibliography of impact evaluations on household energy

Adetona, O., Li, Z., Sjodin, A., Romanoff, L. C., Aguilar-Villalobos, M., Needham, L. L., . . . Naeher, L. P. (2013). Biomonitoring of polycyclic aromatic hydrocarbon exposure in pregnant women in Trujillo, Peru - Comparison of different fuel types used for cooking. *Environment International, 53*, pp. 1-8.

Albalak, R., Bruce, N., McCracken, J. P., Smith, K. R., & De Gallardo, T. (2001). Indoor respirable particulate matter concentrations from an open fire, improved cookstove, and LPG/open fire combination in a rural Guatemalan community. *Environmental Science & Technology, 35*(13), pp. 2650-2655

Alexander, D., Linnes, J. C., Bolton, S., & Larson, T. (2014). Ventilated cookstoves associated with improvements in respiratory health-related quality of life in rural Bolivia. *Journal of Public Health, 36*(3), pp. 460-466.

Armendariz-Arnez, C., Edwards, R. D., Johnson, M., Rosas, I. A., Espinosa, F., & Masera, O. R. (2010). Indoor particle size distributions in homes with open fires and improved Patsari cook stoves. *Atmospheric Environment, 44*(24), pp. 2881-2886.

Asian Development Bank (ADB). (2010). Asian Development Bank's Assistance for Rural Electrification in Bhutan—Does Electrification Improve the Quality of Rural Life?. Manila: Asian Development Bank

Barnes, B., Mathee, A., & Thomas, E. (2011). The impact of health behaviour change intervention on indoor air pollution indicators in the rural North West Province, South Africa. *Journal of Energy in Southern Africa, 22*(3), pp. 35-44.

Barnes, D. F., Khandker, S. R., & Samad, H. A. (2010). *Energy access, efficiency, and poverty : how many households are energy poor in Bangladesh ?* The World Bank, Policy Research Working Paper Series: 5332. [Online], Available: http://search.ebscohost.com/login.aspx?direct=true&db=ecn&AN=1117688&site=ehost-live [20 Jan 2015].

Barron, M. & Torero, M. (2015). Household electrification and indoor air pollution. *Munich Personal RePEc Archive, 61424.*

Begum, B. A., Paul, S. K., Hossain, M. D., Biswas, S. K., & Hopke, P. K. (2009). Indoor air pollution from particulate matter emissions in different households in rural areas of Bangladesh. *Building and Environment, 44*(5), pp. 898-903.

Beltramo, T., & Levine, D. I. (2013). The effect of solar ovens on fuel use, emissions and health: results from a randomised controlled trial. *Journal of Development Effectiveness, 5*(2), pp. 178-207.

Bensch, G. & Peters, J. (2012). A Recipe for Success? Randomized Free Distribution of Improved Cooking Stoves in Senegal. *Ruhr Economic Papers, 325*.

Bensch, G., Grimm, M., Peter, K., Peters, J., & Tasciotti, L. (2013). *Impact Evaluation of Improved Stove Use in Burkina Faso – FAFASO*. Essen: Rheinisch-Westfälisches Institut für Wirtschaftsforschung.

Bensch, G., Kluve, J., & Peters, J. (2011). Impacts of rural electrification in Rwanda. *Ruhr Economic Papers, 284.*

Bernard, T. & Torero, M. (2014). Social interaction effects and connection to electricity: experimental evidence from rural Ethiopia. *Munich Personal RePEc Archive, 61303.*

Bhargava, A., Khanna, R. N., Bhargava, S. K., & Kumar, S. (2004). Exposure risk to carcinogenic PAHs in indoor-air during biomass combustion whilst cooking in rural India. *Atmospheric Environment, 38*(28), pp. 4761-4767.

Brooks, N., Bhojvaid, V., Jeuland, M., Lewis, J., Patange, O., & Pattanyak, S. (2014). *Do clean cookstoves reduce biomass fuel use? Evidence from North India*. Duke University, Working paper.

Bruce, N., McCracken, J., Albalak, R., Schei, M., Smith, K. R., Lopez, V., & West, C. (2004). Impact of improved stoves, house construction and child location on levels of indoor air pollution exposure in young Guatemalan children. *Journal of Exposure Analysis and Environmental Epidemiology, 14*, pp. S26-S33.

Burlando, A. (2014). Power outages, power externalities, and baby booms. *Demography, 51*, pp. 1477- 1500.

Burwen, J., & Levine, D. I. (2012). A rapid assessment randomized-controlled trial of improved cookstoves in rural Ghana. *Energy for Sustainable Development, 16*(3), pp. 328-338.

Chowdhury, Z., Campanella, L., Gray, C., Al Masud, A., Marter-Kenyon, J., Pennise, D., . . . Zuzhang, X. (2013). Measurement and modeling of indoor air pollution in rural households with multiple stove interventions in Yunnan, China. *Atmospheric Environment, 67*, pp. 161-169.

Chowdhury, Z., Le, L. T., Al Masud, A., Chang, K. C., Alauddin, M., Hossain, M., . . . Hopke, P. K. (2012). Quantification of Indoor Air Pollution from Using Cookstoves and Estimation of Its Health Effects on Adult Women in Northwest Bangladesh. *Aerosol and Air Quality Research, 12*(4), pp. 463-475.

Clark, M. L., Bachand, A. M., Heiderscheidt, J. M., Yoder, S. A., Luna, B., Volckens, J., . . . Peel, J. L. (2013). Impact of a cleaner-burning cookstove intervention on blood pressure in Nicaraguan women. *Indoor Air, 23*(2), pp. 105-114.

Clark, M. L., Peel, J. L., Burch, J. B., Nelson, T. L., Robinson, M. M., Conway, S., . . . Reynolds, S. J. (2009). Impact of improved cookstoves on indoor air pollution and adverse health effects among Honduran women. *International Journal of Environmental Health Research, 19*(5), pp. 357-368.

Clark, M. L., Reynolds, S. J., Burch, J. B., Conway, S., Bachand, A. M., & Peel, J. L. (2010). Indoor air pollution, cookstove quality, and housing characteristics in two Honduran communities. *Environmental Research, 110*(1), pp. 12-18.

Costolanski, P., Elahi, R., Iimi, A. & Kitchlu, R. (2013). *Impact Evaluation of Free-of-Charge CFL Bulb Distribution in Ethiopia*. Washington DC: World Bank.

Cynthia, A. A., Edwards, R. D., Johnson, M., Zuk, M., Rojas, L., Jimenez, R. D., . . . Masera, O. (2008). Reduction in personal exposures to particulate matter and carbon monoxide as a result of the installation of a Patsari improved cook stove in Michoacan Mexico. *Indoor Air, 18*(2), pp. 93-105.

Dasgupta, S., Martin, P., & Samad, H. A. (2013). *Addressing household air pollution : a case study in rural Madagascar*. The World Bank, Policy Research Working Paper Series: 6627. [Online], Available: http://search.ebscohost.com/login.aspx?direct=true&db=ecn&AN=1410760&site=ehost-live [20 Jan 2015]

Dinkelman, T. (2010). The effects of rural electrification on employment: New evidence from South Africa. *American Economic Review, 101(7)*, pp. 3078-3108.

Edwards, R. D., Li, Y., He, G., Yin, Z., Sinton, J., Peabody, J., & Smith, K. R. (2007). Household CO and PM measured as part of a review of China's National Improved Stove Program. *Indoor Air, 17*(3), pp. 189-203.

Ellegard, A. (1996). Cooking fuel smoke and respiratory symptoms among women in low-income areas in Maputo. *Environmental Health Perspectives, 104*(9), pp. 980-985.

Ezzati, M., Saleh, H., & Kammen, D. M. (2000). The Contributions of Emissions and Spatial Microenvironments to Exposure to Indoor Air Pollution from Biomass Combustion in Kenya. *Environmental Health Perspectives*, *108(9),* pp. 833-839.

Feng, T., Cheng, S., Min, Q., & Li, W. (2009). Productive use of bioenergy for rural household in ecological fragile area,. *Renewable and Sustainable Energy Reviews*, *13*, pp. 2070-2078.

Fetzer, T., Pardo, O., & Shanghavi, A. (2013). *An urban legend?! Power rationing, fertility and its effects on mothers*. Centre for Economic Performance, Discussion paper n° 1247.

Fitzgerald, C., Aguilar-Villalobos, M., Eppler, A. R., Dorner, S. C., Rathbun, S. L., & Naeher, L. P. (2012). Testing the effectiveness of two improved cookstove interventions in the Santiago de Chuco Province of Peru. *Science of the Total Environment, 420*, pp. 54-64.

Garcia-Frapolli, E., Schilmann, A., Berrueta, V. M., Riojas-Rodriguez, H., Edwards, R. D., Johnson, M., . . . Masera, O. (2010). Beyond fuelwood savings: Valuing the economic benefits of introducing improved biomass cookstoves in the Purepecha region of Mexico. *Ecological Economics, 69*(12), pp. 2598-2605.

González-Eiras, M., & Rossi, M. A. (2007). *The Impact of Electricity Sector Privatization on Public Health*. New York: Inter-American Development Bank.

Grieshop, A. P., Marshall, J. D., & Kandlikar, M. (2011). Health and climate benefits of cookstove replacement options. *Energy Policy, 39*(12), pp. 7530-7542.

Grogan, L., & Sadanand, A. (2009). Electrification and the Household. University of Guelph, Economics Department, Guelph, Ontario. Processed.

Hanna, R., Duflo, E., & Greenstone, M. (2012). *Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves*. National Bureau of Economic Research, Inc, NBER Working Papers: 18033. [Online] Available: http://search.ebscohost.com/login.aspx?direct=true&db=ecn&AN=1311677&site=ehost-live [13 Jan 2015].

Harris, S. A., Weeks, J. B., Chen, J. P., & Layde, P. (2011). Health effects of an efficient vented stove in the highlands of Guatemala. *Global Public Health, 6*(4), pp. 421-432.

Hawley, B., & Volckens, J. (2013). Proinflammatory effects of cookstove emissions on human bronchial epithelial cells. *Indoor Air, 23*(1), pp. 4-13.

Hu, W., Downward, G. S., Reiss, B., Xu, J., Bassig, B. A., Hosgood, H. D., . . . Lan, Q. (2014). Personal and Indoor PM2.5 Exposure from Burning Solid Fuels in Vented and Unvented Stoves in a Rural Region of China with a High Incidence of Lung Cancer. *Environmental Science & Technology, 48*(15), pp. 8456-8464.

Huboyo, H., Tohno, S., Lestari, P., Mizohata, A., Okumura, M., Utami, P., & Jara, E. (2013). Comparison between Jatropha curcas seed stove and woodstove: Performance and effect on indoor air quality. *Energy for Sustainable Development, 17*(4), pp. 337-346.

Jin, Y., Zhou, Z., He, G., Wei, H., Liu, J., Liu, F., . . . Ezzati, M. (2005). Geographical, Spatial, and Temporal Distributions of Multiple Indoor AirPollutants in Four Chinese Provinces. *Environmental Science & Technology, 39*, pp. 9431-9439.

Johnson, M. A., Pilco, V., Torres, R., Joshi, S., Shrestha, R. M., Yagnaraman, M., . . . Pennise, D. (2013). Impacts on household fuel consumption from biomass stove programs in India, Nepal, and Peru. *Energy for Sustainable Development, 17*(5), pp. 403-411.

Khalequzzaman, M., Kamijima, M., Sakai, K., Chowdhury, N. A., Hamajima, N., & Nakajima, T. (2007). Indoor air pollution and its impact on children under five years old in Bangladesh. *Indoor Air*, *17*, pp. 297-304.

Khandker, S. R., Barnes, D. F., & Samad, H. A. (2009). *Welfare Impacts of Rural Electrification- A Case Study from Bangladesh*. Washington: The World Bank.

Khandker, S. R., Samad, H. A., Sadeque, Z., Asaduzzaman, M., Yunus, M., & Enamul Haque, A. K. (2014). *Surge in Solar-Powered Homes- Experience in Off-Grid Rural Bangladesh.* Washington DC: World Bank.

Khandker, S., Barnes, D., & Samad, H. A. (2013). Welfare impacts of rural electrification: A panel data analysis from Vietnam. *Economic development and cultural change, 61(3)*, pp. 659-692.

Khudadad, N., Ali, B., & Jan, K. (2013). Measuring the impact of low carbon technologies and products on domestic fuel consumption. *Renewable Energy, 49*, pp. 115-118.

Khushk, W. A., Fatmi, Z., White, F., & Kadir, M. M. (2005). Health and social impacts of improved stoves on rural women: a pilot intervention in Sindh, Pakistan. *Indoor Air, 15*(5), pp. 311-316.

Lewis, J. J., Hollingsworth, J. W., Chartier, R., Foster, W. M., MacInnis, J., Kussin, P., …, Pattanyak, S. (2014). *Improved cookstoves in Odisha India reduce fuel consumption, reduce household air pollution, and may impact health.* Duke University, Working paper.

Lipscomb, M., Mobarak Mushfiq, A., & Bahram, T. (2011). *Development effects of electrification: evidence from the geologic placement of hydropower plants in Brazil.* Corporación Andina de Fomento, Working paper n°2011/03.

Malla, M. B., Bruce, N., Bates, E., & Rehfuess, E. (2011). Applying Global Cost-Benefit Analysis Methods to Indoor Air Pollution Mitigation Interventions in Nepal, Kenya and Sudan: Insights and Challenges. *Energy Policy, 39*(12), pp. 7518-7529.

Mishra, V., Dai, X. L., Smith, K. R., & Mika, L. (2004). Maternal exposure to biomass smoke and reduced birth weight in Zimbabwe. *Annals of Epidemiology, 14*(10), pp. 740-747.

Mishra, V., Retherford, R. D., & Smith, K. R. (2005). Cooking smoke and tobacco smoke as risk factors for stillbirth. *International Journal of Environmental Health Research, 15*(6), pp. 397-410.

Neufeld, L. M., Haas, J. D., Ruel, M. T., Grajeda, R., & Naeher, L. P. (2004). Smoky indoor cooking fires are associated with elevated

hemoglobin concentration in iron-deficient women. *Revista Panamericana De Salud Publica-Pan American Journal of Public Health, 15*(2), pp. 110-118.

Northcross, A., Chowdhury, Z., McCracken, J., Canuz, E., & Smith, K. R. (2010). Estimating personal PM2.5 exposures using CO measurements in Guatemalan households cooking with wood fuel. *Journal of Environmental Monitoring, 12*(4), pp. 873-878.

Ochieng, C. A., Tonne, C., & Vardoulakis, S. (2013). A comparison of fuel use between a low cost, improved wood stove and traditional three-stone stove in rural Kenya. *Biomass & Bioenergy, 58*, pp. 258-266.

Oluwole, O., Ana, G. R., Arinola, G. O., Wiskel, T., Falusi, A. G., Huo, D. Z., . . . Olopade, C. O. (2013). Effect of stove intervention on household air pollution and the respiratory health of women and children in rural Nigeria. *Air Quality Atmosphere and Health, 6*(3), pp. 553-561.

Padhi, B. K., & Padhy, P. K. (2008). Domestic Fuels, Indoor Air Pollution, and Children's Health The Case of Rural India. In D. O. Carpenter (Ed.), *Environmental Challenges in the Pacific Basin*, New Jersey: Wiley-Blackwell.

Pant, K. P., Pattanyak, S., & Thakuri, M. B. M. (2014). "Climate change, cookstoves, and coughs and colds: Thinking global and acting local in rural Nepal". In Barrett, S., Mäler, K.G., & Maskin, E.S. (Eds.), *Environment and Development Economics: Essays in Honor of Sir Partha Dasgupta*, Oxford: Oxford University Press.

Pattanyak, S., Jeuland, M., Lewis, J., Bhojvaid, V., Brooks, N., Kar, A., …, & Ramanathan, V. (2014). *Designing and evaluating behavior change interventions to improve the adoption of improved cookstoves*. Duke University, Working Paper.

Peabody, J. W., Riddell, T. J., Smith, K. R., Liu, Y. P., Zhao, Y. Y., Gong, J. H., . . . Sinton, J. E. (2005). Indoor air pollution in rural China: Cooking fuels, stoves, and health status. *Archives of Environmental & Occupational Health, 60*(2), pp. 86-95.

Pearce, J. L., Aguilar-Villalobos, M., Rathbun, S. L., & Naeher, L. P. (2009). Residential Exposures to PM2.5 and CO in Cusco, A High-Altitude City in the Peruvian Andes: A Pilot Study. *Archives of Environmental & Occupational Health*, *64(4)*, pp. 278-282.

Pennise, D., Brant, S., Agbeve, S. M., Quaye, W., Mengesha, F., Tadele, W., & Wofchuck, T. (2009). Indoor air quality impacts of an improved wood stove in Ghana and an ethanol stove in Ethiopia. *Energy for Sustainable Development, 13*(2), pp. 71-76.

Riojas-Rodriguez, H., Schilmann, A., Marron-Mares, A. T., Masera, O., Li, Z., Romanoff, L., . . . Romieu, I. (2011). Impact of the Improved Patsari Biomass Stove on Urinary Polycyclic Aromatic Hydrocarbon Biomarkers and Carbon Monoxide Exposures in Rural Mexican Women. *Environmental Health Perspectives, 119*(9), pp. 1301-1307.

Rollin, H. B., Mathee, A., Bruce, N., Levin, J., & von Schirnding, Y. E. R. (2004). Comparison of indoor air quality in electrified and un-electrified dwellings in rural South African villages. *Indoor Air, 14*(3), pp. 208-216.

Rosa, G., Majorin, F., Boisson, S., Barstow, C., Johnson, M., Kirby, M., . . . Clasen, T. (2014). Assessing the Impact of Water Filters and Improved Cook Stoves on Drinking Water Quality and Household Air Pollution: A Randomised Controlled Trial in Rwanda. *Plos One, 9*(3).

Sekyere, C. K. K., Forson, F. K., & Akuffo, F. O. (2012). Technical and economic studies on lighting systems: A case for LED lanterns and CFLs in rural Ghana. *Renewable Energy, 46*, pp. 282-288.

Singh, A., Tuladhar, B., Bajracharya, K., & Pillarisetti, A. (2012). Assessment of effectiveness of improved cook stoves in reducing indoor air pollution and improving health in Nepal. *Energy for Sustainable Development, 16*(4), pp. 406-414.

Smith, K. R., McCracken, J. P., Weber, M. W., Hubbard, A., Jenny, A., Thompson, L. M., …, & Bruce, N. (2011). Effect of reduction in household air pollution on childhood pneumonia in Guatemala (RESPIRE): a randomized controlled trial. *Lancet, 378*, pp. 1717-1726.

Smith-Sivertsen, T., Diaz, E., Pope, D., Lie, R. T., Diaz, A., McCracken, J., . . . Bruce, N. (2009). Effect of Reducing Indoor Air Pollution on Women's Respiratory Symptoms and Lung Function: The RESPIRE Randomized Trial, Guatemala. *American Journal of Epidemiology, 170*(2), pp. 211-220.

Sparrevik, M., Lindhjem, H., Andria, V., Magerholm Fet, A., & Cornelissen, G. (2014). Environmental and Socioeconomic Impacts of

Utilizing Waste for Biochar in Rural Areas in Indonesia—A Systems Perspective. *Environmental Science & Technology*, *48*, pp. 4664—4671.

van de Walle, D., Ravallion, M., Mendiratta, V., & Koolwal, G. (2013). *Long-term impacts of household electrification in rural India*. World Bank, Policy research working paper n° 6527.

Wang, S. X., Wei, W., Li, D., Aunan, K., & Hao, J. M. (2010). Air pollutants in rural homes in Guizhou, China - Concentrations, speciation, and size distribution. *Atmospheric Environment, 44*(36), pp. 4575-4581.

Wei, W., Zhang, W., Hu, D., Ou, L. B., Tong, Y. D., Shen, G. F., . . . Wang, X. J. (2012). Emissions of carbon monoxide and carbon dioxide from uncompressed and pelletized biomass fuel burning in typical household stoves in China. *Atmospheric Environment, 56*, pp. 136-142.

World Bank. (2014). Mongolia: Development Impacts of Solar-Powered Electricity Services. Washington DC: World Bank.

Yamamoto, S. S., Louis, V. R., Sie, A., & Sauerborn, R. (2014). Biomass smoke in Burkina Faso: what is the relationship between particulate matter, carbon monoxide, and kitchen characteristics? *Environmental Science and Pollution Research, 21*(4), pp. 2581-2591.

Zhi, G. R., Peng, C. H., Chen, Y. J., Liu, D. Y., Sheng, G. Y., & Fu, J. M. (2009). Deployment of Coal Briquettes and Improved Stoves: Possibly an Option for both Environment and Climate. *Environmental Science & Technology, 43*(15), pp. 5586-5591.

Zhou, Z., Jin, Y. L., Liu, F., Cheng, Y. B., Liu, J., Kang, J. Q., . . . Ezzati, M. (2006). Community effectiveness of stove and health education interventions for reducing exposure to indoor air pollution from solid fuels in four Chinese provinces. *Environmental Research Letters, 1*(1).

Zuk, M., Rojas, L., Blanco, S., Serrano, P., Cruz, J., Angeles, F., . . . Masera, O. (2007). The impact of improved wood-burning stoves on fine particulate matter concentrations in rural Mexican homes. *Journal of Exposure Science and Environmental Epidemiology, 17*(3), pp. 224-232.

C3 Table: Impact evaluations for forest conservation

Reference	Source*	Country	Type of interv.	Years between interv. start&IE	Type of study **	Data collection methods	Sampling unit	Method	Used counter factual ***	Main results
Alix-Garcia et al. (2014)	No	Mexico	PES	7	Retro	*Survey/ interview *External data *Remote sensed images	House-holds	*Pre-matching *Panel regressions with property-level fixed effects	NI	5) Improve-ments in environmental conditions
Maraseni et al. (2014)	SciJ	Nepal	REDD+ pilot	3	Retro	*Focus groups *External data	Group of forest users	*Cost-benefit analysis *Before-and-after analysis	Al	1) Beneficiaries correctly targeted 5) Improvements in environmental conditions due to the intervention 9) The (monetary) costs of the policy exceeded its benefits

Yin et al. (2014)	SciJ	China	PES	10	Retro	Survey/ interview	House-holds	Multivariate regression analysis	NI	3) Improvements in income level 5) Improvements in environmental conditions 7) Positive livelihood change 12) Development activities under the project unrelated to the main goal have a bigger impact.
Duguma (2013)	SciJ	Ethiopia	Agro-forestry	15	Retro	Survey/ interview	Land use types	Cost-benefit analysis	Al	5) Improvements in environmental conditions
Naidu (2013)	SciJ	India	PAs	9	Retro	Survey/ interview	Indivi-duals	Regression analysis	Al	2) Beneficiaries not correctly targeted 7) Positive livelihood change
Weldege-briel and Prowse (2013)	SciJ	Ethiopia	Social protection program	3	Retro	Survey/ interview	House-holds	Propensity score matching	NI	8) No livelihood change

C4. Bibliography of impact evaluations on forest conservation

Alix-Garcia, J., Aronson, G., Radeloff, V., Ramirez-Reyes, C., Shapiro, E., Sims, K, & Yañez-Pagans, P. (2014). Environmental and Socioeconomic Impacts of Mexico's Payments for Ecosystem Services Program, New Dehli: International Initiative for Impact Evaluation.

Andam, K. S., Ferraro, P. J., Pfaff, A. S., & Sanchez-Azofeifa, G. A. (2007). Protected areas and avoided deforestation: a statistical evaluation, Washington DC: Global Environment Facility.

Berhane Weldegebriel, Z. & Prowse, M. (2013). Climate-Change Adaptation in Ethiopia: To What Extent Does Social Protection Influence Livelihood Diversification?. *Development Policy Review*, *31(S2)*, pp. 35-56.

Cole, R. J. (2010). Social and environmental impacts of payments for environmental services for agroforestry on small-scale farms in southern Costa Rica. *International Journal of Sustainable Development and World Ecology, 17*(3), pp. 208-216.

Duguma, L. A. (2013). Financial analysis of agroforestry land uses and its implications for smallholder farmers livelihood improvement in Ethiopia. *Agroforestry Systems, 87*(1), pp. 217-231.

Groom, B., Grosjean, P., Kontoleon, A., Swanson, T., & Zhang, S. (2010). Relaxing rural constraints: a 'win-win' policy for poverty and environment in China?. *Oxford Economic Papers, 62*, pp. 132–156.

Hegde, R. (2010). Payments for ecosystem services and farm household behaviour: The case of carbon in Mozambique"s agroforests. University of British Columbia, dissertation for PhD. degree.

Hegde, R., & Bull, G. Q. (2011). Performance of an agro-forestry based Payments-for-Environmental-Services project in Mozambique: A household level analysis. *Ecological Economics, 71*, pp. 122-130.

Huang, L., Shao, Q. Q., & Liu, J. Y. (2012). Forest restoration to achieve both ecological and economic progress, Poyang Lake basin, China. *Ecological Engineering, 44*, pp. 53-60.

Jindal, R., Kerr, J. M., & Carter, S. (2012). Reducing Poverty Through Carbon Forestry? Impacts of the N'hambita Community

Carbon Project in Mozambique. *World Development, 40*(10), pp. 2123-2135.

Maraseni, T. N., Neupane, P. R., Lopez-Casero, E., & Cadman, T. (2014). An assessment of the impacts of the REDD plus pilot project on community forests user groups (CFUGs) and their community forests in Nepal. *Journal of Environmental Management, 136*, pp. 37-46.

Naidu, S. C. (2013). Legal exclusions, private wealth and livelihoods: An analysis of work time allocation in protected areas. *Ecological Economics, 89*, pp. 82-91.

Pagiola, S., Ríos, A., & Arcenas, A. (2008). Can the poor participate in payments for environmental services? Lessons from the silvopastoral project in Nicaragua. *Environment and Development Economics*, 13(3), pp. 299-325.

Pender, J., Suyanto, Kerr, J. & Kato, E. (2008). Impacts of the Hutan Kamasyarakatan Social Forestry Program in the Sumberjaya Watershed, West Lampung District of Sumatra, Indonesia, Washington DC: International Food Policy Research Institute (IFPRI).

Robalino, J. & Villalobos-Fiatt, L. (2010). Conservation Policies and Labor Markets, Turrialba: Environment for Development.

Ross, M., Depro, B. & Pattanayak, S. K. (2007). Assessing the Economy-Wide Effects of Costa Rica's Payments for Environmental Services Program, Washington DC: World Bank.

Scullion, J., Thomas, C. W., Vogt, K. A., Pérez-Maqueo, O., & Logsdon, M. G. (2011). Evaluating the environmental impact of payments for ecosystem services in Coatepec (Mexico) using remote sensing and on-site interviews. *Environmental Conservation*, *38(4)*, pp. 426–434.

Sills, E., Arriagada, R., Ferraro, P., Pattanyak, S., Carrasco, L., Ortiz, E., …, & Andan, K. (2008). Impact of Costa Rica's Program of Payments for Environmental Services on Land Use, Washington DC: World Bank.

van Vliet, N. (2010). Participatory Vulnerability Assessment in the Context of Conservation and Development Projects: A Case Study of Local Communities in Southwest Cameroon. *Ecology and Society, 15*(2).

Walton, M. E. M., Samonte-Tan, G. P. B., Primavera, J. H., Edwards-Jones, G., & Le Vay, L. (2006). Are mangroves worth replanting? The direct economic benefits of a community-based reforestation project. *Environmental Conservation*, *33*(4), pp. 335-343.

World Bank, 2009. Republic of Niger- Impacts of Sustainable Land Management Programs on Land Management and Poverty in Niger, Washington DC: World Bank.

Yin, R. S., Liu, C., Zhao, M. J., Yao, S. B., & Liu, H. (2014). The implementation and impacts of China's largest payment for ecosystem services program as revealed by longitudinal household data. *Land Use Policy*, *40*, pp. 45-55.

Annex D. Findings from other reviews on energy and forestry

Findings from other reviews of household energy interventions

While Swartzendruber (2014) focused on evaluation methods, other systematic reviews commissioned by multilateral agencies have focused on evaluation results, for example GEF (2006, Report #30). This review synthesizes findings from evaluations of projects promoting renewable energy sources for households and a few promoting improved forest management to increase carbon sequestration. They asked whether and what type of local benefits were generated by projects to mitigate climate change and found that almost all of the projects "recognized that people need financial and nonfinancial incentives or benefits." Similar to other reviews, they note that "the complete lack or poor quality of monitoring and evaluation systems in most projects makes effective analysis difficult of the potential of the approaches adopted to mitigate climate change" and that "projects have been negatively affected by the lack of social and economic assessment in their design and implementation." Based on the information available, they conclude that affordability has been a major barrier to success in renewable energy projects, while projects designed to maintain the carbon sequestration capacities of fragile ecosystems are more likely to generate direct and material benefits for local communities. "The projects that were most effective in delivering local results, as well as environmental achievements, all contained a range of efforts that brought beneficiaries together, consulted with stakeholders, and engaged local people in determining their needs." In many other projects, the extent of "local participation" was information dissemination and training exercise, rather than real input into planning processes.

Findings from other reviews of forest conservation interventions

From the literature located at the intersection of the five domains of (1) forest conservation, (2) developing countries, (3) climate change, (4) local benefits or costs, and (5) impact evaluation, we identified

only 22 ex post, empirical impact evaluations. However, clearly there are many more studies – and potentially more impact evaluations - at the intersection of different sub-sets of these domains. To tap into this broader knowledge base, we extracted summary findings from other systematic reviews, meta-analyses, and cross-country analyses that focus on the impacts of forest conservation interventions in developing countries, i.e. reviews of the literature at the intersection of domains 1, 2, and 5. Rather than focusing on reviews motivated or interpreted in the context of climate change, we seek out reviews of similar types of interventions, including PES, PAs, and packages of incentives for local actors to conserve or restore forest or tree cover. And rather than focusing just on the local benefits and costs of interventions, we also consider reviews of their conservation effectiveness.

In the field of forest conservation, systematic reviews on different combinations of conservation interventions and outcomes have been commissioned by the World Bank, the Scientific and Technical Advisory Panel (STAP) of the Global Environmental Facility (GEF), the Collaboration for Environmental Evidence (CEE), the International Initiative for Impact Evaluation (3IE), and CIFOR's Evidence-Based Forestry Initiative (e.g., GEF 2006; Bowler *et al.* 2010; Wunder *et al.*, 2010; Samii *et al.*, 2014; Roe *et al.* 2014).

We also draw evidence from two other types of studies. First, meta-analyses are used to take stock of the literature, test hypotheses about the effects of explanatory variables on a dependent variable, and predict the value of a dependent variable across space and time (Atmadja and Sills forthcoming). There have been meta-analyses of the drivers of tropical deforestation, including potential policy levers (Ferretti-Gallon *et al.* 2014) and of the institutional factors associated with success in PES schemes (Brouwer *et al.* 2011). Elements of the systematic review process have been adapted and used to build databases for meta-analysis (e.g. Burivalova *et al*. 2014; Fedrowitz *et al.* 2014). Second, rather than synthesizing results from many independent case studies, some research teams have estimated the effects of different factors – including conservation interventions – using large N, pan-tropical datasets. These are often constructed with remote sensing (e.g. Joppa and Pfaff 2010, Nelson and Chomitz 2011, Blankespoor *et al.* 2014), but some also pool data from multiple case studies collected using a standard protocol and survey instruments (e.g. the International Forestry Resources and Institutions research

network, the Poverty and Environment Network, and CIFOR's Global Comparative Study on REDD+). These studies also aim to produce general results about the relationships between different factors and outcomes for forests and people across the developing world.

Payments for Ecosystem Services

PES systems often establish contracts with private forest landowners, who agree to conserve or restore forest in exchange for annual payments. Two recent reviews of the causal impacts of PES (Samii et al. 2014, Miteva et al. 2012 building on Pattanayak et al. 2010) conclude that the limited available evidence shows that PES systems can (a) reduce deforestation on land under contract, and (b) increase the income of forest landowners with contracts. However, both reviews also noted that there is limited evidence on causal effects, i.e. randomized or quasi-experimental studies with clearly delineated treated and control areas and some method for removing biases due to non-random assignment of the intervention, which was the screening criterion used by Samii et al. (2014). Both reviews identified 9 impact evaluations that met their quality criteria, with the majority in both cases (5 out of 9 for Miteva et al. and 6 out of 9 for Samii et al.) evaluating Costa Rica's PSA system.

In general, evaluations of PES find that the area of conserved forest that can be attributed to the payments is much smaller than the area of forest under PES contracts. Although this makes PES appear inefficient, this depends both on the costs of alternative policies (e.g. increased enforcement) and on the broader objectives of PES, which may include building political support for forest conservation (cf. Lawlor et al. 2013 on design of REDD+ initiatives). Samii et al. (2014) note that evaluations are more likely to find statistically significant positive impacts on total forest cover (including regrowth) than on gross deforestation. Both Miteva et al. (2012) and Samii et al. (2014) point out that evaluations have generally not addressed potential concerns about spillovers (impacts on lands and landowners not participating in the PES system).

Brouwer et al. (2011) conducted a meta-analysis of payments for watershed services, including 26 cases of payments to private forest landowners. They construct a binary measure of whether each PES

scheme achieved its environmental objectives and relate that to characteristics of the schemes and the sites. They conclude that 15 of the schemes were successful, while 11 were not. The probability of success was greater in schemes that established contracts with communities (rather than individual landowners), made payments in cash (rather than in-kind), involved relatively fewer intermediaries, were mandatory rather than voluntary, and received revenues from a downstream hydropower generator.

Samii et al. (2014) and Pattanayak et al. (2010) also searched for evidence on how PES affect poverty (or socioeconomic welfare). They identified one study each on the SLCP in China, showing that it shifted household labor allocation from on-farm to off-farm (Uchida et al. 2009) and increased household income by 14% on average (Liu et al. 2010). Samii et al. (2014) also consider one study on PES in Mozambique to meet their quality criteria: Hegde and Bull (2011) found that participation raised income by 4% on average. While this clearly is a very thin evidence base, it will soon expand with results from CIFOR's Global Comparative Study on REDD+, which has collected two waves of survey data from households in 23 sites across the tropics, including 15 where REDD+ proponents have offered conditional livelihood incentives (Sills et al. 2014). Based on previous studies and logic, a reasonable working hypothesis is that direct payments increase the income of households who voluntarily sign up for contracts to receive those payments. The more important questions to address in program design and evaluation are the distributional effects of selection criteria and the impacts of PES on non-participants (cf. Pattanayak et al. 2010). A recent review of PES for the GEF STAP also highlights the importance of selection criteria (and the threat of "adverse selection") for the conservation effectiveness of PES (Wunder et al. 2010). The clear lesson for donors is to require careful design of selection mechanisms and monitoring of

Protected areas

As perhaps the most traditional form of forest conservation, protected areas have been the subject of numerous impact evaluations, most using remote sensing data to estimate their effects on deforestation and a smaller but growing number considering their impacts on local populations (e.g. SAPA 2015; Pullin et al. 2013). While established protected areas do not offer additionality and therefore have not been

included in carbon offset markets, they are considered an important part of national strategies to reduce deforestation (e.g. Soares-Filho et al. 2010). Systematic reviews (Miteva et al. 2012; Geldmann et al. 2013) have found that protected areas are effective at reducing deforestation, even after controlling for the fact that they tend to be established in areas under lower threat of deforestation (e.g., because they are at high elevations and far from markets, Joppa and Pfaff 2009).

There is also a growing research consensus that multiple use and human occupied protected areas can be equally or more effective at reducing deforestation as strictly protected areas that prohibit all extractive uses (Nelson and Chomitz 2011, Ferraro et al. 2013, Blankespoor et al. 2014). If multiple use and human occupied protected areas offer more local benefits, this suggests a possible synergy between mitigating global climate change through forest conservation and supporting local livelihoods through sustainable forest use. However, these previous reviews reported only limited evidence on the local benefits of different types of protected areas, with most focusing on national parks (IUCN category II) (Pullin et al. 2013). Regarding protected areas in general, there is a rapidly growing body of evidence on how they affect local welfare (e.g., Robalino and Villa-Lobos 2014, Clements et al. 2014, Ferraro and Hanauer 2014), based primarily on studies in Latin America and to a lesser extent Asia (even though the impacts are actively debated and of great concern in Africa as well, e.g. Curran *et al.* 2009). Many of these studies find heterogenous impacts, with benefits to local people depending on background socioeconomic conditions and where they are located relative to park boundaries and entrances. In a systematic review on how terrestrial protected areas affect human well-being, Pullin et al. (2013) synthesized 34 qualitative and 14 quantitative studies and concluded that "views expressed on impacts of PAs on economic capital are generally negative, with the exception of some views on the benefits of ecotourism. In contrast the quantitative evidence of impact from three studies on livelihood strategies was neutral to positive in terms of poverty reduction." Specifically, they found credible estimates showing that protected areas increased access to forest benefits and decreased poverty (although not surprisingly, they can also lead to increased human-wildlife conflict).

Incentive-based conservation

Our systematic review identified several interventions that offer a package of conservation incentives to local land stewards. These incentives range from support for livelihoods and social development in the mode of ICDPs (integrated conservation and development projects), to sharing of control over resource management decisions and benefits in the spirit of CBC (community based conservation), to decentralization of rights and responsibilities to local governments and communities. There have been few rigorous impact evaluations of interventions anywhere on this spectrum. Two systematic reviews by Samii et al. (2014) and Bowler et al. (2010, 2010, 2011) summarize evidence on decentralization. Samii et al. (2014) found eight quantitative impact evaluations of decentralized forest management (in Bolivia, Ethiopia, India, Kenya, Malawi, Nepal, and Uganda), which all report positive point estimates (not always statistically different from zero) of effects on forest cover change and three of which also estimate a positive effect on participants' household income (from forests or in total). Using slightly different definitions and criteria, Bowler et al. (2010, 2010, 2011) found 42 evaluations of the impacts of community forest management in 13 countries in Africa, Asia, and Central America on forest condition and land cover (34 studies), resource extraction (8 studies), and livelihoods (11 studies). Of those, only 10 studies acknowledged and attempted to control for potential confounders. Eight of those studies found that community forest management results in higher forest quality, as measured by basal area and tree stem density. However, Bowler et al. found no consistent patterns in estimated impacts on other conservation or livelihood outcomes. Both Samii et al. (2014) and Bowler et al. (2010, 2010, 2011) argue forcefully for more rigorous impact evaluations of a more representative and informative sample of interventions.

While there have been few rigorous impact evaluations of these types of local incentives, there are many case studies and collectively those can suggest what types of interventions are worth testing in future initiatives. Table D1 presents some key findings from meta-analyses and analyses of the IFRI database on forest commons across the developing world.

Table D1. Key findings from analyses of forest commons

Citation	*Cases*	*Outcome*	*Findings*
Brooks et al. 2012	136 studies of community based conservation	Attitudinal, behavioral, ecological and economic outcomes	Attitudinal success more likely when the project creates or enhances social capital; communities participate in project initiation, establishment, and daily management; and benefits are equitably distributed without elite capture. Behavioral success more likely when the project invests in building capacity of local individuals and institutions; there are supportive local traditions and beliefs, effective local government, and smaller populations. Ecological success is more likely when the project engages positively with cultural traditions and governance institutions, builds capacity in communities, and when communities participate in project initiation, establishment, and daily management. Economic success is more likely when the project invests in capacity building and there are local tenure rights.
Chhatre and Agarwal 2009	80 forest commons in IFRI database	Forest carbon and livelihood benefits	Greater forest size and greater local autonomy in matching rules to resource characteristics are associated with above average carbon storage and livelihood benefits

Oldekop et al. 2010	116 studies of common resource management	Forest conservation	Internally devised resource-management rules and regulations (institutions) are positively associated with better conservation outcomes
Persha et al. 2011	84 IFRI sites in East Africa and South Asia	Livelihood benefits and biodiversity	Forest systems are more likely to have sustainable outcomes (above average tree species richness and subsistence livelihoods) when local forest users participate in forest rulemaking, and as forest size and commercial livelihoods dependence increase
Porter-Bolland et al. 2012	Studies of 33 community forests and 40 PAs	Deforestation	Community managed forests have lower and less variable annual deforestation rates than protected forests

Tenure

In the interventions reviewed in the previous section, one of the key incentives for local people to engage in forest conservation is devolution of the responsibilities and rights over forest to them, often in the form of community forest tenure. Likewise, protected areas are a form of forest tenure. Regardless of the form of land tenure, there is an important related issue of tenure security. Based on a meta-analysis of 36 publications that control for "other plausibly confounding variables", Robinson et al. (2014) find that greater security of land tenure has a consistent positive association with forest conservation regardless of the specific form of land tenure. Duchelle et al. (2014) and Lawlor et al. (2014) both find that sub-national REDD+ initiatives are improving security of forest tenure, suggesting that this may be an important pathway for REDD+ to achieve forest conservation (Barbier et al. 2012).

Other forest conservation interventions

Our systematic search of the literature on the local costs and benefits of forest conservation interventions in developing countries motivated by climate change did not retrieve studies of (i) private sector initiatives (like certification of sustainable forest management, or commitments to "deforestation free" supply chains), (ii) regulation of logging and forest management for timber, or (iii) increased enforcement of existing land use regulations. These types of initiatives have been partially credited with reducing deforestation in the Brazilian Amazon in recent years, although they are not typically considered part of REDD+. This is likely because the original concept of REDD+, including as a form of ODA, was positive incentives for forest stewards in developing countries. Thus, efforts to increase negative incentives (e.g. fines and other penalties for violating forest conservation regulations), regulate forest use, or motivate conservation through consumer demand and the supply chain are considered complementary but not central to REDD+.

References reviews on energy and forestry

Andam KS, Ferraro PJ, Sims KRE, Healy A, Holland MB (2010) Protected areas reduced poverty in Costa Rica and Thailand. Proc Natl Acad Sci USA 107(22):9996–10001.

Atmadja S, Sills E (2015) Identifying the causes of tropical deforestation: Meta-analysis to test and develop economic theory. In: Pancel L. and Köhl M (ed) Tropical Forestry Handbook. Second edition. Berlin: Springer-Verlag. doi: 10.1007/978-3-642-41554-8_252-1

Barbier, E.B.; Tesfaw, A.T. Can REDD+ save the forest? The role of payments and tenure. *Forests* 2012, *3*, 881–895

Blankespoor, B., Dasgupta, S., & Wheeler, D. (2014). Protected areas and deforestation: new results from high resolution panel data. World Bank Policy Research Working Paper, (7091).

Brouwer, R., Tesfaye, A., & Pauw, P. (2011). Meta-analysis of institutional-economic factors explaining the environmental performance of payments for watershed services. Environmental Conservation, 38(04), 380-392.

Burivalova, Z., Şekercioğlu, Ç. H., & Koh, L. P. (2014). Thresholds of logging intensity to maintain tropical forest biodiversity. Current biology, 24(16), 1893-1898.

Canavire-Bacarezza G, Hanauer MM (2011) Estimating the impacts of Bolivia's protected areas on poverty. World Dev 41:265–285.

Clements, T., Suon, S., Wilkie, D. S., & Milner-Gulland, E. J. (2014). Impacts of protected areas on local livelihoods in Cambodia. *World Development*, *64*, S125-S134.

Coad, L., Campbell, A., Miles, L., Humphries, K. (2008). The Costs and Benefits of Protected Areas for Local Livelihoods: a review of the current literature. Working Paper. UNEP World Conservation Monitoring Centre,

Curran, B., Sunderland, T., Maisels, F., Oates, J., Asaha, S., Balinga, M., ... & Roth, P. (2009). Are Central Africa's protected areas displacing hundreds of thousands of rural poor?. *Conservation and Society*, *7*(1), 30.

Fedrowitz, K., Koricheva, J., Baker, S. C., Lindenmayer, D. B., Palik, B., Rosenvald, R., ... & Gustafsson, L. (2014). Can retention forestry help conserve biodiversity? A meta-analysis. Journal of Applied Ecology, 51(6), 1669-1679.

Ferraro, P. J., & Hanauer, M. M. (2014). Quantifying causal mechanisms to determine how protected areas affect poverty through changes in ecosystem services and infrastructure. *Proceedings of the National Academy of Sciences*,*111*(11), 4332-4337.

Ferretti-Gallon, K., & Busch, J. (2014). What Drives Deforestation and What Stops It? A Meta-Analysis of Spatially Explicit Econometric Studies. *A Meta-Analysis of Spatially Explicit Econometric Studies (April 17, 2014)*.

GEF. (2006) The Role of Local Benefits in Global Environmental Programs. Evaluation Report No. 30. Global Environment Facility, Evaluation Office, Washington D.C.

Joppa, L. N., & Pfaff, A. (2009). High and far: biases in the location of protected areas. *PLoS One*, *4*(12), e8273

Lawlor, K., Madeira, E. M., Blockhus, J., & Ganz, D. J. (2013). Community participation and benefits in REDD+: A review of initial outcomes and lessons.*Forests*, *4*(2), 296-318.

Miteva, D. A., Pattanayak, S. K., & Ferraro, P. J. (2012). Evaluation of biodiversity policy instruments: what works and what doesn't?. *Oxford Review of Economic Policy*, *28*(1), 69-92.

Nelson, A., & Chomitz, K. M. (2011). Effectiveness of strict vs. multiple use protected areas in reducing tropical forest fires: a global analysis using matching methods. *PLoS One*, *6*(8), e22722.

Pattanayak, S. K., Wunder, S., & Ferraro, P. J. (2010). Show me the money: Do payments supply environmental services in developing countries?. *Review of Environmental Economics and Policy*, req006.

Pullin, A. S., Bangpan, M., Dalrymple, S., Dickson, K., Haddaway, N. R., Healey, J. R., ... & Oliver, S. (2013). Human well-being impacts of terrestrial protected areas. Environmental Evidence, 2(1), 19.

Pullin, A.S. et al. (2014). 'Assessing the Effects of Terrestrial Protected Areas on Human Well-being: A STAP Advisory Document'. Global Environment Facility, Washington, D.C.

Roe, D., Day, M., Booker, F., Zhou, W., Allebone-Webb, S., Kümpel, N., ... & Petrokofsky, G. (2014). Are alternative livelihood projects effective at reducing local threats to specified elements of biodiversity and/or improving or maintaining the conservation status of those elements?: a systematic review protocol. *Environmental Evidence*, *3*(1), 6.

Samii, C., Paler, L., Chavis, L., Kulkarni, P., & Lisiecki, M. (2014). Effects of Decentralized Forest Management (DFM) on Deforestation and Poverty in Low and Middle Income Countries: A Systematic Review. *Campbell Systematic Reviews*, *10*(10).

Sills, E. O., Atmadja, S. S., de Sassi, C., Duchelle, A. E., Kweka, D. L., Resosudarmo, I. A. P., & Sunderlin, W. D. (Eds.). (2014). *REDD+ on the ground: A case book of subnational initiatives across the globe*. CIFOR.

Soares-Filho, B., Moutinho, P., Nepstad, D., Anderson, A., Rodrigues, H., Garcia, R., ... & Maretti, C. (2010). Role of Brazilian Amazon protected areas in climate change mitigation. *Proceedings of the National Academy of Sciences*,*107*(24), 10821-10826.

Swartzendruber 2014 https://www.climate-eval.org/sites/default/files/studies/NRM-Study-Draft.pdf

Previous EBA-reports

2015:08, *Business and human righst in development cooperation – has Sweden incorporated the UN Guiding Principles?* Rasmus Kløcker Larsen and Sandra Atler

2015:07, *Making development work: the quality of government approach,* Bo Rothstein and Marcus Tannenberg

2015:06, *Now open for business: joint development initiatives between the private and public sectors in development cooperation,* Sara Johansson de Silva, Ari Kokko and Hanna Norberg

2015:05, *Has Sweden injected realism into public financial management reforms in partner countries?* Matt Andrews

2015:04, *Youth, entrepreneurship and development*, Kjetil Bjorvatn

2015:03, *Concentration difficulties? An analysis of Swedish aid proliferation*, Rune Jansen Hagen

2015:02, *Utvärdering av svenskt bistånd – en kartläggning*, Expertgruppen för biståndsanalys

2015:01, *Rethinking Civil Society and Support for Democracy*, Richard Youngs

2014:05, *Svenskt statligt internationellt bistånd i Sverige: en översikt*, Expertgruppen för biståndsanalys

2014:04, *The African Development Bank: ready to face the challenges of a changing Africa?* Christopher Humphrey

2014:03, *International party assistance – what do we know about the effects?* Lars Svåsand

2014:02, *Sweden´s development assistance for health – policy options to support the global health 2035 goals,* Gavin Yamey, Helen Saxenian, Robert Hecht, Jesper Sundewall and Dean Jamison

2014:01, *Randomized controlled trials: strengths, weaknesses and policy relevance,* Anders Olofsgård.