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Incentives for climate mitigation in the land use sector: A systematic review of the effects of payment for environmental services (PES) on environmental and socio-economic outcomes in low- and middle-income countries

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Background

The issue

Around a quarter of all anthropogenic greenhouse gas emissions originate from the agricultural, forest and other land use sector (AFOLU), driven primarily by deforestation, forest degradation and emissions from unsustainable livestock, soil and nutrient management practices (IPCC, 2014). However, there is also a large potential for climate change mitigation in the sector through removal of greenhouse gases in the atmosphere (carbon sequestration) and the potential reduction in emissions from reduced forest and vegetation removal and improved agricultural practices.

Moreover, climate regulation is just one of many eco-system services provided from the AFOLU sector[1]. Forests and land provide clean water, regulate soil and provide food, fuel, fiber and fresh water (MEA, 2005). Agriculture provides directly and indirectly for the livelihoods of billions of people, in addition to providing food for all the world's population (FAO, 2016a). The sector also offers livelihoods for an estimated 750 million of the world's extreme poor (FAO, ibid). Finally, forests provide paid employment for at least 100 million people and support the livelihoods of many millions more (FAO, 2016b).

The links between climate change, agriculture, forests and human wellbeing are complex. The world's forest area declined from 4128 million hectares of forest in 1990 to 3 999 million hectares in 2015 (FAO, 2016c). Agriculture, both commercial and subsistence, was the main driver of this global deforestation, accounting for 73 per cent of forest clearance worldwide (FAO, 2016b). This is partially driven by an increasing global demand for food from increasing incomes and growing populations, which is expected to rise 60 per cent from 2006 levels by 2050 (FAO, 2016a). At the same time, climate change is expected to negatively affect all dimensions of food security, including agricultural production of food, quality, food access through the impacts on livelihoods, and food price stability (IPCC, 2014).

These complex relationships make sustainable preservation and management of forests and land, while at the same time ensuring food and livelihoods for the world's population, one of the biggest policy challenges facing the world (FAO, 2016a; FAO, 2016b). But there are concerns that climate change mitigation programming may have negative knock-on effects on human wellbeing, especially for the poor (Stickler 2009; Larson 2013; Lawlor et al. 2013; Mutabazi 2014). It is therefore important to identify strategies that reduce trade-offs between environmental protection and human wellbeing, and ideally programmes that offer win-win solutions.

[1] The value of eco-systems services to humans was concretised in the Millennium Ecosystems Assessment report published in 2005 (MEA, 2005). They define eco-systems services as the benefits that humans get from eco-systems.

The intervention

The United Nations Framework Convention for Climate Change (UNFCCC) have recognised the critical importance of reducing emissions from deforestation and degradation for climate mitigation (UNFCCC, 2010). In addition, the IPCC highlights the importance of preservation and restoration of other eco-systems such as peatlands and mangroves for maintaining carbon stocks and reducing emissions (FAO & IPCC, 2017; IPCC, 2014). Improved livestock and crop management also represent practices with mitigation potential (FAO & IPCC, ibid). Economic incentives-based programmes, which aim to preserve or restore eco-systems services through financial incentives, have grown in popularity in the last two decades (Pirard, 2012; GEF, 2014; Ezzine-de-Blas et al., 2016). One such incentive-based mechanism is Payment for Environmental Services (PES). PES are a market-based approach, where users of an environmental service pay the owners or managers of the service, conditional on changes in behaviours that are likely to effect the provision of environmental services (Wunder, 2015). PES may be conditional on commitments to protect or restore forest areas or sustainable forest management, such as management of forest fires (Jayachandran et al., 2016; Alix-Garcia et al., 2014). Payments may also be tied to agricultural practices associated with reduction in GHG emissions or increase of carbon stocks, including introduction of agroforestry, silvo-pastoral or integrated crop systems, which combine crops, grazing lands and trees on agricultural land, improved tillage practices such as conservation agriculture, and reduced use of fire in rangeland management (Hedge & Bull, 2011; Garbach et al. 2012).

There is some debate on the definition of PES (Wunder, 2005; 2015; Muriadian et al. 2010; Engels et al. 2008). At the most simple level, PES is a voluntary transaction between service users and service providers, conditional on agreed rules for natural resource management that aims to generate environmental services or benefits that are felt off-site, for example carbon sequestration (Wunder et al. 2015). In practice, the service "user" is typically a government or NGO acting on behalf of beneficiaries of the environmental service and the service "providers" are individuals, households or community organisations that own or manage the land or forest areas in the programme.

There are a number of long-standing PES programmes in existence around the world, for example the Pago por Servicios Ambientales-Hidrologico (PSAH) in Mexico and the Sloping Land Conversion Programme in China. The PSAH in Mexico makes payments to landowners conditional on maintenance of certain level of forest cover, according to five-year contracts (Alix-Garcia et al., 2014). If forestland is converted to another land use such as agriculture, the landowner is removed from the programme. In addition to these long-standing programmes, the number of new PES programmes has grown rapidly in the last decade (Börner et al., 2017). They increasingly also include goals around poverty alleviation. While the original goal of the PSAH for example was to maintain the provision of hydrological services from Mexico's forested land, in 2006 the objectives were extended to alleviating poverty (Alix-Garcia et al., ibid).

Because of the restrictions around land use from participating in the programme, PES

programmes are sometimes combined with other activities to support behaviour change, such as awareness raising activities around environmental conservation or capacity building in sustainable resource use (Sharma & Pattanayak, 2015). They are also sometimes combined with more extensive support for livelihoods development. For example, a REDD+ pilot programme in Nepal made incentive-based payments to Community Forest User Groups (CFUGs) (Sharma et al., 2015). Alongside efforts to encourage forest carbon monitoring, it also included awareness raising and capacity building for improving local livelihoods and improving the use of alternative fuel and cooking technologies (Sharma et al., 2015).

Why it is Important to do the Review

It is estimated that additional global investments of US$35 billion in the agriculture sector and US$21 billion in the forestry sector will be needed by 2030 to mitigate the effects of climate change (UNFCCC 2009). At the landmark United Nations Climate Change Conference (COP 21) in 2015, countries agreed to conserve and enhance sinks of greenhouse gases, including forests (UNFCCC, 2015). To ensure resources are used effectively to achieve agreed mitigation objectives it is important to ensure that decision-makers have access to reliable evidence.

The United Nations Reducing Emissions from Deforestation and Forest Degradation mechanism (REDD+) is one of the main frameworks for making payments to L&MICs to preserve and sustainably manage forests. There are significant resources pledged to the REDD+ initiative. At the COP21, Germany, Norway and the UK announced that they would provide US$ 5 billion between 2015 and 2020 to forest countries if they could demonstrate verified emissions reductions (xx, 2015). The UN-REDD Programme currently supports 64 countries across Africa, South and East Asia and Latin America and the Caribbean to enable their participation in REDD+, and 47 so far have qualified (UN-REDD, 2016).

PES are promoted as an important tool by REDD+ and are supported by a range of actors, from national governments to multi-national institutions such as IFAD, UNDP and the World Bank (GEF, 2014). The number of PES programmes operating in L&MICs has rapidly increased. A recent global review of PES identified hundreds of programmes mentioned in the literature, with 55 programmes currently in operation around the world that clearly fit the classic definition of PES (Ezzine-Blas et al., 2016). The Global Environmental Facility (GEF) alone has supported 57 projects containing elements of PES since its inception, totalling investments of over $225 million, in addition to $1.59 billion leveraged from co-financing (GEF, 2014).

Despite their popularity, key policy questions around the effectiveness of PES remain unanswered (Samii et al., 2014; Ferraro, 2017; Le Velly & Dutilly, 2016). One of these questions is the extent to which the environmental and poverty reduction goals of such a programme conflict or present strategies that can generate both environmental and poverty reduction benefits. A second, and equally important question is if PES generate environmental benefits that are additional to 'business as usual'. To meet UNFCCC emissions

targets, governments implement PES programmes on the assumption that by compensating some groups to reduce their emissions, emissions in other sectors are offset (Nhantumbo & Camargo, 2015). However, if PES programmes are included in offset mechanisms, but do not in practice lead to additional reduction in emissions, effects may be an actual increase in emissions overall.

Evaluations of PES programmes finding small effects have led some to dismiss it as an important mechanism. Indeed, a recent FAO-IPCC (2017) report on climate change and land use following the Paris Agreements stated that "*[PES] effectiveness, however, is limited and they are more readily applied in some sectors (e.g. forest management) than in other emerging concerns (land restoration, soil health and soil carbon*)" (FAO-IPCC, 2017: 28). The report concludes that for PES programmes to be effective, they must be better designed and informed by meta-analysis of the effects of previous programmes.

Given the resources dedicated to PES and the global importance of effective climate change mitigation activities, it is essential that rigorous and comprehensive evidence is available to policy-makers and implementers. To help inform decisions about how to use available resources most effectively we will provide a comprehensive review and synthesis of the evidence on the effects of PES, including an assessment of how intervention design, implementation and contextual factors moderate outcomes and cost-effectiveness.

Objectives

The objective of this review is to assess the effects of PES programmes on environmental and socio-economic outcomes in low- and middle-income countries (L&MICs). This will include identifying and synthesising evidence on how effects varies by programme design, implementation, context and by sub-groups of people participating in PES programmes. We will also attempt to assess the cost-effectiveness of PES programmes.

To address these objectives, we will answer the following questions:

1. What are the average effects of PES programmes on environmental and socio-economic outcomes in L&MICs?
    a. Do PES programs simultaneously deliver positive environmental and social effects, or do they only deliver positive effects on one of the goals?Do effects vary by sub-group of people participating in PES programmes, including low-income groups, women and indigenous people?
    b. Do effects vary by type of environmental services targeted?
2. Which design and implementation features influence the effects of PES programmes?
3. What are the contextual factors that moderate effects of PES programmes?
4. What is the cost-effectiveness of PES programmes?

Existing reviews

There is an emerging impact evaluation literature on payments for environmental services (PES) programmes. A 3ie evidence gap map (EGM) published in 2016 identified 41[2] experimental or quasi-experimental evaluations of PES programmes globally, with most taking place in Low-and Middle Income Countries (L&MICs). We are only aware of one systematic review on the effectiveness of PES, published in 2014 (Samii et al., 2014). There have also been a large number of non-systematic literature reviews, either presenting narrative discussions on the effectiveness of PES (Börner et al., 2017; Pattanayak et al., 2010; Alix-Garcia & Wolffe, 2014) or presenting a range of effect sizes for PES programmes (Ferraro, 2017).

There are several reasons that warrant an update and extension of the Samii et al. (2014) systematic review. Firstly, the search for the review was completed in August 2013. 3ie's Evidence Gap Map of land use and forestry programmes (Snilstveit et al., 2016) identified at least six new evaluations of PES programmes that have been published since then, including studies from Uganda, Ecuador, Tanzania and new evaluations of long-term programmes in China, Mexico and Costa Rica. Secondly, Samii et al. (2014) were unable to do a meta-analysis for income and poverty related outcomes and for forest condition due to lack of data and heterogeneity between studies. Given the increase in the evaluation evidence base since then, we hope to be able to undertake additional meta-analyses.

Thirdly, Samii et al.'s review focused on PES for forest areas, while we will expand the scope of the reviews to include PES in other settings such as farmland, mangroves and grasslands. A number of PES programmes target other important environmental behaviours of relevance to climate change mitigation programming, for example payments to incentivise farmers to take up agroforestry on their farmland (Hedge & Bull, 2011). This will be the first review that we are aware of to systematically cover the literature on the effectiveness of PES in these areas.

Finally, this review answer new questions around design, implementation, context and costs of programmes, in addition to assessing programme effects. In doing so we will look at a broader range of literature, including process evaluations, programme documents and associated qualitative studies for the programmes evaluated in included impact evaluations.

Intervention

We will include studies of PES programmes, defined as those providing payments to owners or managers of land, conditional on some minimum environmental/ ecosystems service

[2] This number is quite high as it is inclusive of a broad range of study designs, including cross-sectional studies with identification strategies considered to be at a very high risk of bias.

provision. Payments can be either cash or in-kind material transfers, such as seedlings, apiculture and fencing. Ecosystems services are defined as the benefits that humans get from ecosystems (MEA, 2005). In ideal type PES programmes, payments are conditional on the provision of the ecosystem service itself, for example payments for increased carbon sequestration in forests (Le Velly & Dutilly, 2016). However, in practice most PES program payments are conditional on changes in behaviours that are likely to affect the provision of the ecosystem service, for example reducing deforestation or planting trees on agricultural land.

We will include payments tied either to the provision of an ecosystem service or to any of the following practices related to climate-regulating ecosystems services: forest protection or regeneration; sustainable forest management practices; sustainable watershed management; sustainable agricultural practices; sustainable livestock management.

The payments can be made to an individual, household, community or organisation and can either be conditional on a specified environmental commitment, for example on the fulfilment of an obligation to maintain a certain forest cover on land, or paid in advance of the PES programme. We will not limit inclusion of these programmes by the funder/ implementer (private versus public for example) or status of land (private land or state-owned/ protected land). Finally, we will include programmes that study PES alone or in combination with other intervention activities, for example interventions supporting alternative livelihoods.

Population

We will include studies of programmes in countries classified by the World Bank as lower income, lower-middle income, or upper middle income (L&MICs). We use the classification of the country in the year of the initiation of the program under study. There are several reasons why we decided to focus on L&MICs only. Some scoping of the literature suggests that the impact evaluation literature on PES from high income countries is significantly smaller and does not typically use methods that would be included in the review (Snilstveit et al., 2016; Schomers & Matzdorf, 2013). It does not typically self-identify as PES (Schomers & Matzdorf, 2013; Ezzine-de-Blas et al., 2016) and would likely result in a need to search a separate literature. This is likely to add a significant amount of work to the searching and screening with only a potentially very small number of included studies. In addition, L&MICs contain most of the world's tropical forests, which offer the greatest potential for climate change mitigation in the AFOLU sector, such as climate regulation, watershed protection and carbon sequestration (Pattanayak et al., 2010). Similarly, the findings from the High Income Country (HIC) literature will be less relevant for mechanisms such as REDD+. Finally, given that one of our main objectives is understanding the potential for PES to offer "win-win" environmental and poverty alleviation solutions, L&MIC settings offer a more likely setting for answering this.

We will include studies targeted at populations living in or near to forests, farmland areas, wetlands, grasslands and mangroves. Studies of programmes in high income countries will be excluded.

Outcomes

We will include studies that assess the impact of PES either environmental, socio-economic or intermediate outcomes, as defined below. PES programmes often have multiple objectives, related to both the preservation or restoration of environmental services and human welfare, and there is a considerable literature on the potential trade-offs or complementarities between these objectives. By looking at both sets of outcomes, we hope to be able to shed some light on this debate.

We will also include studies that assess intermediate outcomes such as changes in agricultural, forest or land management practices. This will allow us to report on effects at earlier stages of the PES causal chain.

Intermediate outcomes
We will include studies that assess changes in land or forest management practices, defined as measures of the type, frequency, intensity or adoption of such practices at the household or community level. We will also include studies that assess the adoption of sustainable agricultural practices or technologies, for example incorporating trees into agricultural or grazing lands. We will also assess measures of forest dependence, for example resource extraction.

Environmental outcomes
We will include environmental outcomes that are related to greenhouse gas emissions or carbon storage/ sequestration. This includes both direct measures of emissions (CO_2, CH_4, N_20) or carbon storage/ sequestration and proxies for such outcomes. Based on previous mapping work in this area, we know that there are few evaluations that measure provision of environmental services such as carbon sequestration (Snilstveit et al. 2016). Proxy outcomes include deforestation rate, forest cover, forest condition/ degradation, forest fires, soil quality, and so on. We will accept whichever measure is used by the study authors.
We will also include outcomes related to the spillover effects of PES programmes on to land or forests not enrolled in PES programmes.

Socio-economic outcomes
We will include any measures of socio-economic outcomes, including income, consumption, well-being, livelihood security and assets of communities / households / individuals participating in PES programmes. We will also include measures of food security across the four dimensions of food availability, access, utilisation and stability included in the

Declaration on Food Security (FAO 2009). These include food consumption, food expenditure, prevalence of undernourishment and nutritional status (FAO 2013). We will accept whichever measure is used by the study authors.

Study designs

We will include studies in two stages, in a similar approach to Snilstveit et al. (2015). In the first stage, we will include studies that assessed the effects of interventions using experimental designs or quasi-experimental designs with non-random assignment that allow for causal inference (to address primary research question 1).

Specifically we will include the following:

- Studies where participants are randomly assigned to treatment and comparison group (experimental study designs);
- Studies where assignment to treatment and comparison group is based on other known allocation rules, including a threshold on a continuous variable (regression discontinuity designs) or exogenous geographical variation in the treatment allocation (natural experiments);
- Studies with non-random assignment to treatment and comparison group that include pre-and post-test measures of the outcome variables of interest to ensure equity between groups on the baseline measure, and that use appropriate methods to control for selection bias and confounding. Such methods include statistical matching (for example, propensity score matching, or covariate matching), regression adjustment (for example, difference-in-differences, fixed effects regression, single difference regression analysis, instrumental variables, and 'Heckman' selection models).
- Studies with non-random assignment to treatment and comparison group that include post-test measures of the outcome variables of interest only, and use appropriate methods to control for selection bias and confounding, as above.

Ferraro and Miranda (2014; 2017) argue that combining panel data with baseline observations and statistical matching is the most effective quasi-experimental method at reducing bias when evaluating conservation sector programmes. However, given the expected small size of the evidence base, we will include studies with post-intervention outcome data only as long as they use some method to control for selection bias and confounding. To account for the differences in the quality of study designs and analysis methods, we will appraise the risk of bias in all included studies and do sub-group analysis by risk of bias status.

Before-after studies and observational studies without control for selection bias and confounding will be excluded. Additionally, modelling based studies, commentaries and literature reviews will be excluded.

To address questions 2 and 3 on programme design, implementation and context, we will extract descriptive and qualitative data from the included experimental and quasi-experimental studies. In addition, we will conduct a targeted search for additional papers on the programmes covered by the included impact evaluations to provide additional detail on these areas. In order to be included, these papers must be related to the programmes in the included impact evaluations and also be one or more of the following types of studies:

- A qualitative study collecting primary data using qualitative or quantitative methods of data collection and analysis, and reporting some information on all of the following: the research question, procedures for collecting data, sampling and recruitment, and at least two sample characteristics.
- A descriptive quantitative study collecting primary data using quantitative methods of data collection and descriptive quantitative analysis and report some information on all of the following: the research question, procedures for collecting data, sampling and recruitment, and at least two sample characteristics
- A process evaluation assessing whether a programme is being implemented as intended and what is felt to be working more or less well, and why (HM Treasury, 2011). Process evaluations may include the collection of qualitative and quantitative data from different stakeholders to cover subjective issues, such as perceptions of intervention success or more objective issues, such as how an intervention was operationalised. They might also be used to collect organisational information;
- A project document providing information about planned, ongoing or completed programmes. They may describe the background and design of an intervention, or the resources available for a project for instance. As such, these documents do not typically include much analysis of primary evidence, but they provide factual information about interventions. The purpose of including them in our review is to ensure we had sufficient information about the context and interventions in included studies

To address question 4 on cost-effectiveness we will include economic evaluations. We will also use any economic evaluation or cost data provided in any of the studies included under the criteria above.

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Name: John Eyers
Title: Information Specialist
Affiliation: International Initiative for Impact Evaluation (3ie)

Name: Paul Ferraro
Title: Bloomberg Distinguished Professor of Water and Environmental Economics
Affiliation: Johns Hopkins University

Roles and responsibilities

- Content: Professor Paul Ferraro is a leading expert on environmental economics, including PES. Birte Snilstveit, Laurenz Langer and Jennifer Stevenson have previously worked on evidence gap maps including PES.
- Systematic review methods: Birte Snilstveit, Laurenz Langer, Jennifer Stevenson, Josh Polanin and Ian Shemilt have substantial expertise in systematic review methods, including mixed methods systematic reviews. They have all been co-authors of systematic reviews published in the Cochrane and Campbell libraries.
- Statistical analysis: Birte Snilstveit, Laurenz Langer, Jennifer Stevenson, Josh Polanin and Ian Shemilt all have experience of using meta-analysis in systematic reviews. Dr. Josh Polanin is a research methodologist with significant expertise in statistical analysis, frequently providing expert advice on statistical analysis. Professor Paul Ferraro is an environmental economics with significant expertise in econometrics, including applying econometrics in impact evaluations.
- Information retrieval: John Eyers is an information specialist with experience developing and peer reviewing search strategies for over hundred systematic reviews. He is the information specialist for the Campbell International Development group.

Funding

The systematic review is funded by the Children's Investment Fund Foundation (CIFF). The deadline for completion of the project is June 2018. The team plans to submit the protocol in October 2017 and the draft report in February 2018.

Potential conflicts of interest

Birte Snilstveit, Laurenz Langer, Jennifer Stevenson and Paul Ferraro have published literature reviews, systematic reviews and evidence gap maps including PES interventions. Paul Ferraro has been involved in several quasi-experimental studies of environmental management programmes, including PES.

Preliminary timeframe

The deadline for completion of the project is June 2018. The team plans to submit the protocol in October 2017 and the draft report in February 2018.

AUTHOR DECLARATION

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