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Methodological and Ideological Options

Increasing Conservation Efficiency While Maintaining Distributive Goals With the Payment for Environmental Services

Long Chu[a], R. Quentin Grafton[a,*], Rodney Keenan[b]

[a] Crawford School of Public Policy, The Australian National University, Australia
[b] School of Ecosystem and Forest Sciences, The University of Melbourne, Australia

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ABSTRACT

A key challenge in designing Payment for Environmental Services (PES) programs is to balance conservation efficiency with equity where, typically, decision makers do not have practical and quantitative tools to consider the possible trade-offs. Here, we propose a policy-relevant and implementable 'win-settle' model that allows PES decision makers to maximize efficiency while considering the distributive equity associated with beneficiary payments. To demonstrate our approach, we calibrate the model to a current PES program in Vietnam that has one of the world's most comprehensive and self-sustained payment schemes for forest conservation. The results indicate that our approach could generate a substantial improvement relative to current methods. In other words, for the same expenditure and identical horizontal equity in payments to beneficiaries, more forest could be conserved, and with a lower administrative burden.

1. Introduction

Payment for Environmental Services (PES) is a tool to engage economic and social incentives to achieve environmental goals (Naeem et al., 2015) and include many forest-related programs in developing countries (Schomers and Matzdorf, 2013; Calvet-Mir et al., 2015:t1). PES was first defined as a voluntary transaction (Wunder, 2005) to promote environmental benefits in a market-based approach. Nevertheless, in many PES programs service providers and users are not linked via markets, but rather via governments who act, with their political powers, as the intermediary (Engel et al., 2008:666; Milne and Adams, 2012; Raes et al., 2016b). In practice, therefore, many PES schemes have become governmental programs with a focus on both conservation efficiency and social objectives (Bulte et al., 2008; Ingram et al., 2014; Pagiola et al., 2005).

An efficient PES program should target the most cost-effective outcome in terms of conservation benefit per each dollar invested (Alix-Garcia et al., 2008). In addition, as PES may also be used to achieve social objectives, PES design often also places a strong emphasis on equity outcomes. To date, there has been little analysis of quantitative tools that help policymakers address the possible trade-offs between efficiency and equity.

Three relevant dimensions of equity (McDermott et al., 2013; Brown and Corbera, 2003) include: (i) distribution of net benefits (distributive); (ii) stakeholders' participation in decision-making (procedural); and (iii) pre-conditions or status quo (contextual). Efficiency and equity are not independent (Nathan and Pasgaard, 2017) because a perceived lack of equity of a PES may undermine its efficiency (Pascual et al., 2014; Redpath et al., 2013; To et al., 2012; Leimona et al., 2015; Corbera and Pascual, 2012). While the financial payment should be cost-effective in promoting the provision of environmental services (Raes et al., 2014), consideration of how payments affect the long-term behavior of the rural poor (Van Hecken et al., 2017) and of whether they are sensitive to political and social realities helps determine the sustainability of PES programs (Van Hecken et al., 2015).

Here, we propose a so-called 'win-settle' model to balance efficiency and distributive equity in PES (Barrett et al., 2011). Our approach helps policymakers to identify whether it is possible to improve efficiency without diminishing equity objectives (distributive goals) and how to achieve this win-settle improvement (also referred to as Pareto improvements). In other words, our model and the proposed method to calculate PES payments seek to maximize efficiency within a chosen equity objective that fits with contextual social and political realities. The value added of the model is that it provides policymakers with a readily usable tool to quantify their optimal efficiency-equity frontier (Pascual et al., 2010) where it is not possible to either improve conservation outcomes or increase equity without a direct trade-off. Quantifying this practical frontier is critically important and beneficial for policymakers because the conservation efficiency of many existing

* Corresponding author.
E-mail addresses: long.chu@anu.edu.au (L. Chu), quentin.grafton@anu.edu.au (R. Quentin Grafton), rkeenan@unimelb.edu.au (R. Keenan).

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PES programs could be improved without reducing equity (Narloch et al., 2013).

Our approach focuses on distributive equity or the differences in payments to beneficiaries because of its measurability and direct impact on the equity perception of participants within a PES program (Miller, 1999; Konow, 2003; Proctor et al., 2008). Our contribution is to explicitly show how to practically design PES for efficiency while considering equity across payment beneficiaries. While Wu and Yu (2017) also quantify an 'efficiency-equity trade-off', we incorporate a number of new features that provide a readily applicable tool to assist decision makers in designing PES programs (Wright et al., 2017).

The features we incorporate in our model take into account important factors in the PES design that involves the rural poor (Paudyal et al., 2017). First, PES designs should facilitate communications with beneficiaries (Adhikari and Agrawal, 2013), especially when payment rates differ across forest types or conditions and when many of the beneficiaries are the rural poor. Consequently, payment rules should be simple, allowing beneficiaries to verify their own payments and relative positions within their groups (Narloch et al., 2013). Second, payment rules should be designed to minimize the administrative burden of managing PES programs that may arise from unnecessary appeals by beneficiaries. This practice in policy making should be considered in PES designs especially when the administrative costs of PES are relatively high (Wittman et al., 2015; Wittman and Caron, 2009) and transaction costs may pose an obstacle for the efficiency of PES (Scheufele and Bennett, 2017). Third, when determining PES payment rules, contextual factors such as location, recreational values, characteristics of households and community should be considered (Adhikari and Agrawal, 2013) so as to provide flexibility in implementation because perception about fairness is highly context-dependent, and some contextual factors may justify differentiation in payments (Narloch et al., 2013).

To demonstrate how our model can be applied, we evaluate the trade-off between efficiency and distributive equity in a PES program for forest conservation in Vietnam. We show that it is possible to improve environmental outcomes in Vietnam under the chosen distributive equity goal. We do not assess whether the chosen distributive equity goal (such as an equal payment for all beneficiaries) is socially and politically optimal, nor do we examine whether PES payment rates need to reflect more or fewer contextual factors than those currently employed. Our purpose is, simply, to demonstrate that the model-suggested design conserves more valuable forest than the current approach and it does so in a way that the equity goal that is reflected in the social and political realities remains unchanged. We formalize the model in Section 2 and provide an overview of PES and forest management in Vietnam in Section 3. Section 4 presents an application of the model. Section 5 discusses the implications of the model, and Section 6 concludes.

2. PES Design for Conservation Efficiency and Distributive Equity

In this section, we describe the quantitative model for PES design for conservation efficiency and distributive equity, or how payments differ across beneficiaries. Approaches to quantify PES efficiency include the environmental benefit achieved with a certain outlay (Wu and Yu, 2017; Ferraro, 2003), social welfare benefits (Segerson, 1988; Wu et al., 2001), and the rate of return per each unit of risk (Raes et al., 2016a). Here, we follow the first approach and measure the conservation efficiency as the environmental benefit achieved per unit of funds expended. Thus, the more forest protected, or equivalently the less forest loss, the more efficient is the PES.

Consider N types of forest, each with environmental benefit d_n per hectare ($n \in \{1..N\}$). This environmental benefit can be measured with any relevant indicator, e.g., carbon sequestration capacity, carbon stock, or indicators for watershed services or biodiversity. PES design may also consider contextual factors or attributes such as forest location or recreational values. While these contextual factors may not necessarily change the risk to the environment, decision makers may weigh the payment rate to recognize these aspects.

To mitigate the risk of loss of forest environmental benefits, PES participants are paid to protect the forest and reduce the risk probability, which is denoted as $p(d_n, R_n | \gamma_n) \in [0, 1]$ where R_n is the payment rate (i.e., per hectare) and γ_n represents factors that influence the risk of loss for type n. If a loss of environmental benefits occurs (e.g., the forest is burnt, unsustainably logged or cleared), the expected loss per hectare for type n, denoted as $E(L_n | R_n)$can be calculated as in Eq. (1). The expected total loss is the sum across all forest types and can be calculated in Eq. (2), with s_n being the size of type n (measured in hectares or in a percentage of the total forest size).

$$E\{L_n \mid R_n\} = d_n \times p(d_n, R_n \mid \gamma_n) \tag{1}$$

$$L = \sum_{n=1}^{N} E\{L_n \mid R_n\} s_n = \sum_{n=1}^{N} p(d_n, R_n \mid \gamma_n) d_n s_n \tag{2}$$

In our model, the objective of PES design is to determine the payment rate for each forest type (R_n) to minimize the loss in Eq. (2) subject to four conditions: the total budget that comprises payment weighting, equity, conservation incentives, and avoiding step effects between payments classes to beneficiaries.

2.1. Payment Weights and Total Budget Condition

The budget or the fund available for PES is a key constraint in designing a PES program. In the model, the limited budget (indicated by B) cannot be exceeded by the sum of payments for all forest types. The payment rate may also vary for each type of forest or with the environmental benefit and the context. We formalize this variation with a contextual weight w_n applied to type n. The total allocation is the product of the area and the payment rate. The actual payment rate equals the contextual weight times a benefit-adjusted base rate $r(d_n | \gamma_n)$ as in Eq. (3). The total budget condition is given by Eq. (4).

$$R_n = r(d_n \mid \gamma_n) w_n \tag{3}$$

$$\sum_{n=1}^{N} R_n s_n = \sum_{n=1}^{N} r(d_n \mid \gamma_n) w_n s_n \le B \tag{4}$$

2.2. Distributive Equity Condition

Distributive equity refers to whether there are differences in payments offered to beneficiaries within a PES program, and there are multiple ways to evaluate distributive equity in PES. For example, Martin et al. (2014) evaluate equity in a Rwanda's PES program by surveying how many participants support a particular distribution principle (i.e., equal, need-adjusted, or opportunity cost-adjusted payment). Börner et al. (2010:f6), in a spatial analysis of the benefit and opportunity cost for PES in Brazil, visualizes how the net benefits vary across different groups of beneficiaries with three payment rules: per carbon ton, per hectare, and payment via auction. Quantitative researchers have also evaluated distributive equity using the GINI coefficient, a measure that allows them to compare distributive equity across different PES schemes (Pascual et al., 2010:f1; Wu and Yu, 2017:898; Alix-Garcia et al., 2004).

While the GINI coefficient is a common inequality index that can quantify distributive equity, its technical derivation might not be appropriate for communicating non-technical PES stakeholders or participants. Further, it is mathematically possible that even though the GINI coefficient for a payment distribution is lower (less overall inequality), the gap between the highest and lowest payments is higher. For this reason, we quantify distributive equity goals as the range ratio, i.e., the difference between the lowest and highest payment rates in the