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Exploring the links between equity and efficiency in payments for environmental services: A conceptual approach

Unai Pascual [a,*], Roldan Muradian [b], Luis C. Rodríguez [c], Anantha Duraiappah [d]

[a] Department of Land Economy, University of Cambridge, 19 Silver Street, Cambridge, CB3 9EP, UK
[b] Centre for International Development Issues, University of Nijmegen, The Netherlands
[c] CSIRO, Sustainable Ecosystems, Australia
[d] Ecosystem Services Economics Unit, UNEP, Nairobi, Kenya

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ABSTRACT

This paper addresses the relationship between equity and efficiency in PES schemes from a conceptual point of view. Emphasis is placed on the role of the institutional setting, social perceptions about economic fairness (or distributive justice of the payments), uncertainty and interactions between agents, including power relations. We introduce the heuristic concept of the 'efficiency–equity interdependency curve' to illustrate potential combinations between equity and efficiency that may be theoretically possible. The paper argues that different types of institutional factors determine which equity–efficiency combinations may be potentially feasible, influence the actual combination that will be achieved on the ground, and condition possible changes in that combination due to exogenous factors. By stressing the role of institutional aspects in shaping the equity–efficiency relationship, the paper attempts to go beyond the dominant Coasean vision of PES.

1. Introduction

The present paper addresses the relationship between efficiency and equity in payments for ecosystem/environmental services (PES) from a conceptual point of view, aiming at clarifying and reconsidering several issues that are often neglected in the literature on PES. The dominant conceptual approach towards PES is derived from Coasean economics, and it conceives PES primarily as a way to improve economic efficiency (see for instance Engel et al., 2008 for a synthesis of the dominant approach towards PES). It interprets this policy tool as a market-based instrument to internalise environmental externalities by 'getting the price right' for environmental services in order to create a market, or at least by covering the opportunity costs of the changes to land management necessary for providing valuable environmental services.

In general, Coasean policy approaches tend to disregard equity issues since they are based on the premise that efficiency gains may be achieved independent of the allocation of property rights. From this viewpoint, what really matters is the aggregate gains and losses by different economic agents and not how they are distributed in society. However, this Coasean approach towards PES has also incorporated equity matters by means of assessing the extent to which PES may become 'pro-poor.' That is, analysing the factors conditioning the eligibility, ability, and willingness of the poor to participate in PES programs (Grieg-Gran et al., 2005; Pagiola et al., 2005; Proctor et al., 2008; Wunder, 2008). From this viewpoint, the issue is then whether poor stakeholders can become efficient providers of environmental services, so that a win–win situation may arise in terms of the provision of the environmental services and the reduction of poverty (a situation generally associated with the providers of the service).

We argue nevertheless that the analysis of pro-poor effects of PES that takes efficiency as the core concern and adopts the assumption that the poor should participate only if they are efficient providers oversimplifies and precludes a better understanding of the relationship between equity and efficiency in PES. As Landell-Mills and Porras (2002: 61) note "the literature (on PES) is virtually silent on the issue of distribution." This is problematic because PES programs that aim at obtaining efficient outcomes are likely to change (and sometimes reinforce) existing power structures and inequalities in access to resources, with significant equity implications (Corbera et al., 2007).

In addition, the dominant PES literature has a normative vision of efficiency improvement as a guiding principle that may be creating a mismatch between theory and practice, especially since equity issues are normally an important aspect taken into account by practitioners when designing PES schemes due to legitimacy concerns (Rosa et al., 2004; Swallow et al., 2007).

What are the key factors conditioning the relationship between equity and efficiency in PES schemes? What is the role of social perceptions of fairness in the performance of PES? In order to answer

* Corresponding author. Tel.: +44 1223 337151.
E-mail address: up211@cam.ac.uk (U. Pascual).

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these questions, the paper is structured as follows: the rest of this section clarifies what we mean by efficiency and equity in PES. The next section introduces some definitions that underpin the conceptual model presented later. Section 3 introduces alternative economic fairness (or distributive justice) criteria that affect the assessment of the efficiency and equity impacts of PES, as well as a brief discussion about the evaluative space that can be used to analyse these impacts. Section 4 discusses in more detail the relevance of adopting a particular economic fairness criteria. Section 5 turns to addressing the factors determining the boundaries and shape of the 'efficiency–equity interdependency curve' using a formal approach. The paper finishes with some concluding remarks and ideas for future research.

1.1. Efficiency in PES

The conditions (e.g., targeting) needed to achieve efficient interventions in a Paretian sense are analysed and discussed at length in the Coasean PES literature (Wunder, 2007; Engel et al., 2008). Of course, since the environmental outcome (i.e. provision of environmental services) may be in principle achieved by a variety of other interventions (e.g., command and control, taxes, subsidies, etc.), the PES efficiency effect ought to be evaluated relative to the cost of achieving the same outcomes by any alternative policy means (Ferraro and Simpson, 2002).

Notwithstanding the academic emphasis on economic efficiency, a problem for practitioners is that in most cases efficiency cannot be measured or demonstrated. This is because the contexts in which PES operate are normally characterised by high uncertainty about environmental additionality (the positive effect on the environmental service flows). The relationship between land use change and the provision of ecosystem services is often context-dependent and hard to demonstrate, particularly in the case of water-related ecosystem services and biodiversity. This is because ecosystem services result from complex ecological processes and functions of many biotic and abiotic components over a wide range of spatio-temporal scales. As the recent TEEB ('The Economics of Ecosystems and Biodiversity') assessment exercise has noted, the existing scientific knowledge of these interactions, including non-linear dynamics and regime shifts, is still scarce (TEEB, 2008).

Important challenges also exist in the valuation of ecosystem services. For instance, assessing the value of changes in service provision at scales other than local ones poses great challenges as non-constancy of marginal values need to be taken into account. In addition, an important problem when valuing changes in ecosystems services is the use of forecasting models that frequently fail to anticipate important social and technological developments that can influence their long-term value (Gowdy, 2007).

The level of uncertainty about the nature, level and value of non-marginal changes in the provision of ecosystem services may only be reduced by gathering further ecological and economic information at the expense of further scientific research which in turn raises transaction costs (e.g., data collection, monitoring, modelling, etc.). Therefore, there typically exists a trade-off between the need to better ascertain the actual costs and gains (or level of efficiency) from implementing any PES scheme, and its feasibility, which is critically associated with the level of transaction costs (Vatn, 2010-this issue).

High levels of uncertainty surrounding PES schemes under incomplete information constitute a problem for Coasean PES designs, since two critical conditions for achieving efficiency improvements cannot be met with confidence by stakeholders: namely that parties must be able to reap benefits associated with measuring the level of environmental additionality from trade and that providers are able to supply a service that buyers cannot procure at a lower cost (associated with the problem of valuation).

1.2. Equity in PES

Human societies differ on and continually change the principles for allocating resources among their members, as well as their sense of satisfaction with such allocation (Leventhal, 1980). This implies that the meaning of equity and fairness are not only specific to each society but also change over time. The concept of equity is strongly associated with the ideas of fairness and justice (Konow, 2001), and sometimes it is hard to differentiate them.

Equity can refer to either procedural justice (participation in decision making) or to distributive justice (allocation of outcomes) (Konow, 2001; Corbera et al., 2007; Proctor et al., 2008). We follow the proposition of Corbera et al. (2007: 589) that "equity relates to the distribution of socio-economic factors and goods in a society according to an agreed set of principles or criteria," and we focus the present paper particularly on equity in outcomes. That is, the focus on equity is with regards to the distribution of benefits and losses and the notions of economic fairness or distributive justice used for steering the allocation of resources in a given PES scheme. We therefore do not deal with the dimension of procedural justice in terms of the design and implementation of PES (see Corbera et al., 2007 for an exposition and application of these terms).

We consider that equity in the PES context should take into account the multiple dimensions of poverty. Poverty is a multidimensional concept that goes beyond economic and protective dimensions (e.g. income, vulnerability) to include socio-cultural aspects such as status and dignity, as well as political dimensions like empowerment. For example, the distribution of benefits from the provision of ecosystem services is not only a matter of who participates in PES programs, but also of the conditions of participation and the underlying empowerment among involved and left out agents. This in turn is largely determined by agents' bargaining power under the institutions and power relationships underpinning PES schemes. Moreover, PES might contribute to modifying accountability or legitimacy issues. For example a water-related PES program might contribute to changing historical inequities between the upper and lower areas of a catchment, increasing the bargaining power and status of poor providers of environmental services in the upland areas. On the other hand, it may also legitimise large-scale water consumption downstream through a payment scheme.

The main claim of this paper is that the interdependency between efficiency and equity effects should be considered as a key feature of PES schemes. From a conceptual point of view, efficiency and equity concerns should not be tackled in a piecemeal way. We expect this will bring theory of PES schemes closer to practice, especially in developing countries where they tend to be part of broader rural development interventions (Vatn, 2010-this issue). As Muradian et al. (2010-this issue) and Norgaard (2010-this issue) also point out, there is no *a priori* reason why efficiency concerns should prevail over other societal goals such as equity with this kind of policy instrument.

2. Establishing Background Definitions

In order to introduce a conceptual framework of the links between efficiency and equity in PES, it is useful to introduce a few concepts that will be employed later. We refer to 'environmental additionality' as the net impact of the biophysical provision of ecosystem services, in comparison with the baseline scenario or hypothetical situation where the PES scheme is not in place. Environmental additionality is a necessary (but not sufficient) condition for any positive sought-after improvements in economic efficiency. Clearly if a PES scheme is unable to induce environmental additionality, then it will have a negative effect on efficiency, since both buyers of ecosystem services would be paying for something that is not being delivered and operational and opportunity costs of the program would have been already incurred.

The 'efficiency effect' of a PES scheme is understood here as the difference between the gross welfare effects induced by the scheme on society (limited at the appropriate scale depending on the nature of the environmental service) and the total costs incurred to implement it. The efficiency effect, following a benefit–cost approach, may be typically assessed through income measures. With regard to the 'equity effect' of PES, we interpret it generally as the net impact that the scheme has among a reference set of participants, given a fairness criterion, compared to a baseline scenario. The result of PES in terms of the combined efficiency and equity effects depends on ecological, economic, and institutional factors. As a simple heuristic exercise, it is possible to describe the combination of effects of any PES scheme by locating it as a point on a so-called 'efficiency–equity interdependency curve' (IC henceforth).

Fig. 1 comprises two orthogonal axes that allow us to define four quadrants associated with theoretical combinations of positive and negative effects regarding both efficiency and equity. This figure depicts one potential IC among a myriad of other possible ICs. For illustrative purposes, it is located in quadrant I, where both effects are positive. The IC illustrated in Fig. 1 is made of different segments where movements along the curve, bounded by points *a* and *d*, may show synergies and/or trade-offs between equity and efficiency effects.

We return to the IC later in the paper, but first it is important to discuss some of the key determinants of the equity and efficiency effects, as these provide information about the potential location of a PES scheme or point in any of the four quadrants in Fig. 1 as well as about the factors affecting their potential movement along the IC (illustrating their interdependency). In the next section we discuss some economic fairness criteria as well as reflect on what welfare evaluative criteria may be applied to assess the interdependency between equity and efficiency in PES schemes.

3. Equity, Fairness and Welfare Evaluative Criteria under PES

In the PES context, we refer to economic fairness as the shared view of a given social group of the nature of distributive justice of the payments. It can more broadly be associated with the social notion of what distributive rule (for both outcomes and procedure for allocating costs and benefits) and associated contractual rights and obligations are deemed just, given particular cultural norms.

Alternative local perceptions of what is fair may significantly alter the legitimacy of and decisions about the allocation of resources within any PES scheme and hence their efficiency and equity effects. Since fairness is a social construct, manifold fairness criteria may exist in the context of PES. Further, within each culture and social group, the concept of fairness is dynamically constructed based on local meanings of what is fair, equitable or just (Konow, 1996, 2003; Schokkaert, 1998; Schokkaert and Devooght, 2003), and different social groups participating in a given PES scheme may differ on the fairness criteria they support. Depending on what particular fairness criterion is adopted, a PES design may enhance or jeopardise the participation rate of the target population, generate alliances or conflicts between agents, and play an important role in legitimising the process. Although the selection of an explicit fairness criterion is rarely a condition considered in the design of PES, every scheme has its own implicit criterion with regard to the way payments are designed and implemented.

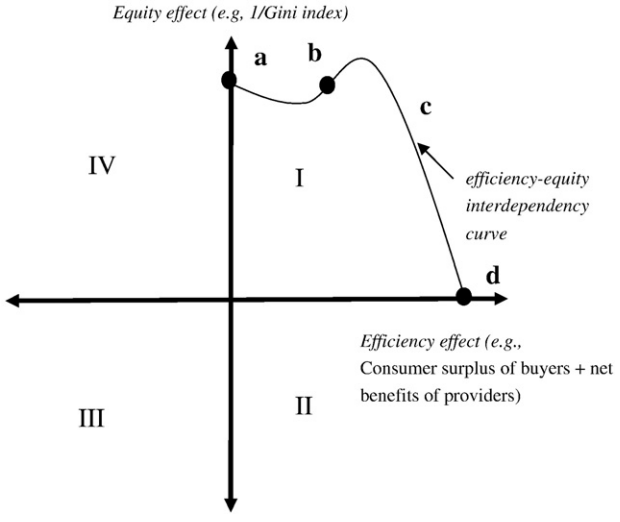

Fig. 1. The efficiency–equity interdependency curve.

Therefore, a salient issue is who has the power to decide on the prevailing fairness criterion, especially when alternative criteria may compete with each other, and what types of stakeholders share these particular notions of fairness. Whose criteria prevail within the set of PES stakeholders will depend on power relations and the critical role of the intermediary, as we discuss below.

3.1. Economic Fairness in PES

Fairness in outcomes and distributive justice has traditionally been associated with equality or an egalitarian vision, whereby all recipients receive an equal share of the total reward and this equity rule dictates that all rewards should 'be divided equally' (Leventhal, 1980; Konow, 2003). However, philosophical discussions have permeated economics to provide justification for departure from such egalitarian distribution (Yaari and Bar-Hillel, 1984). Two such considerations include the principles of accountability and basic needs.

The accountability principle states that rewards (and 'punishments') should be distributed in accordance with a recipient's inputs or contributions (e.g., level of production) and that merit determines equity (Konow, 2003). In a PES context the accountability principle would be associated with the effort or input that a landowner provides to generate the desired environmental additionality through land management. This is akin to a 'contributions rule' (Leventhal, 1980) and is associated with various fairness criteria that can be adopted, such as the 'compensation' and 'actual provision' criteria (as discussed in more detail below). Within a multidimensional view of distributive justice, the 'needs rule' is often also called for in order to ensure the equal satisfaction of basic needs (Leventhal, 1980; Yaari and Bar-Hillel, 1984; Konow, 2001). The basic needs rule would instead be concerned with the welfare of those in society who are least advantaged. By contrast to the contributions rule, the needs rule dictates that those recipients with the greatest needs should receive a higher reward to ensure that the position of the least advantaged individuals is as high as possible. This is akin to a Rawlsian principle of justice and the 'maxi–min' principle spelled out below.

Here we summarise some of the economic fairness criteria that could be applied in PES schemes and illustrate the application (even if in an implicit way) of some of them as observed in various PES schemes in developing countries. It should be noted that here we consider the distributional effects among providers of ecosystem services for the sake of exposing the argument. The analysis can be extended to a wider set of agents including buyers and potential providers, among others.

There is no rational way to prefer, a priori, one fairness criterion over another because all of them are equally justifiable both in ethical and operative terms. However, different fairness criteria have different implications in PES schemes. Table 1 illustrates a set of different economic fairness criteria (related to equity in outcomes) and their associated implications in the design of PES schemes. The table contains the definitions and the way the payments are differentiated under each criterion.

Table 1
Fairness criteria for PES programs.

Fairness Criterion	Design implications
Compensation	Payments should compensate landholders for the forgone benefits related to the provision of environmental services. Payments are differentiated according to the cost of provision.
Common goods	Payments should be invested in common goods, so all providers benefit indirectly and according to their relative use of the common goods in question. Payments are not differentiated (no direct payment).
Egalitarian	Design should distribute the fund equally among all the providers (per unit of land area, for example), independently of the level and cost of environmental service provision. Payments are not differentiated.
Maxi–min	Payments aim to maximise the net benefit to the poorest landholders, even at a cost of efficiency loss. Payments are differentiated according to the income of providers.
Actual provision	The allocation of funds among landowners corresponds to the *actual* outcome level of provision of environmental services. Payments are differentiated according to the actual provision of the service.
Expected provision	Payments to landholders depend on the *expected* level of provision of services for a given land use. Payments are differentiated according to the expected provision of environmental services. These payments compensate landholders to particular land use changes or practices expected to enhance the provision of environmental services.
Status quo	Payments should maintain the previous level of relative distribution of income among providers. Payments are differentiated according to its impact on income inequality.

Despite the fact that the use of a specific fairness criterion is rarely explicitly considered in the design of PES, these programs operate within a set of rules for the distribution of the payments that hold implicit fairness criteria. For example, in the nationwide PES scheme for carbon sequestration in Mexico, the *common goods* criterion is used by means of collectively deciding about rewards in the form of investments in common pool resources (infrastructure, education, health, etc) for the community as a whole. In this case, the application of this criterion is facilitated by the communal nature of the land and because the funds are not distributed by the government to individuals directly but to the communities (Corbera and Brown, 2008).

By contrast, in the well-known nationwide forest conservation PES scheme in Costa Rica run by FONAFIFO, an equal payment per hectare is implemented, independently of the spatial variability in the provision of environmental services or the costs of the required management practices by different landholders (Pagiola, 2008). This implies the adoption of an *egalitarian* fairness criterion. Yet in the watershed-protection PES scheme implemented in Jesus de Otoro, Honduras, the *expected provision* criterion was used insofar payments were differentiated according to the type of forest and the type and number of water-quality improvement practices adopted by farmers (Kosoy et al., 2007). Another example is the PES program run by the PROFAFOR project in Ecuador, where the *actual provision* criterion was preferred since that the amount of funds allocated to each landholder was estimated based on the evaluation of the quantity of carbon sequestrated in their land (Wunder and Alban, 2008).

Each group of stakeholders is "motivated to construe justice in their own favor" (Konow, 2001: 162). However, whose notion of fairness prevails in a given PES scheme depends not only on the institutional setting, technical aspects, and the power relations among the stakeholders, but also on practical considerations (whether the application of a particular criterion is compatible with existing constraints). Some criteria, such as the *compensation* and *actual provision*, although they are possibly more appropriate from an efficiency point of view, may still face serious limitations when applied in PES schemes. This is because of the biophysical difficulties of estimating the provision of ecosystems services associated with a particular land use or the challenge of estimating the adequate level of compensation for landholders in a context of incomplete information (for example about costs of provision). Also, other criteria may be hard to apply due to the power imbalance among the social groups involved, as in the case of the *maxi–min* one, or due to potential conflicts between societal goals and the overall objective of the PES scheme, e.g., the *egalitarian* criterion.

3.2. Capabilities as Welfare Outcomes

It is also essential to make clear the type of 'evaluative space' that it is used to judge the final welfare outcomes of the respective stakeholders, both in terms of efficiency and equity effects. By this we mean the type of indicators selected to evaluate the impacts on human well-being. It is now well recognised that evaluating equity impacts using only income may be misleading (MA, 2005). This observation is also valid for PES schemes. While the efficiency effect of PES may be assessed in terms of the average increase in income, clearly this does not translate automatically to an increase in well-being. An increase in income generated by a PES may be associated with livelihood changes that may result in negative welfare effects in the long run. For example, putting aside land for reforestation may cause a decrease in the local supply of food provisioning services, increasing locally the risk of food insecurity.

The concept of capabilities may offer an alternative approach to referring to well-being. This approach emphasises the importance of freedom of choice, heterogeneity of livelihoods and the multidimensional nature of welfare, considering a set of basic principles and the real opportunities to achieve them based on personal and social circumstances (Sen, 2006). It considers that a person's life can be seen as constituted by various 'doings and beings' or 'functionings' (Sen, 2006). PES can affect the functioning of individuals and society. For example, at the individual level, the conditions associated with PES (e.g. adoption of specific management practices, restrictions in the use of the land) affect the 'doings and beings' of the beneficiaries, while on the other hand the increased income might allow beneficiaries to overcome entry barriers to other economic activities, thus incorporating new 'doings and beings' into their set of capabilities.

The links between ecosystem services and different types of capabilities is documented by the Millennium Ecosystem Assessment (MA, 2003). Underlying the links lays the notion of trade-offs. For example, let us assume that a conservation agency offers compensation for excluding livestock from larger parcels of land among pastoralists in East Africa in order to conserve wildlife. A pertinent question is then the following: does the monetary or in kind compensation for the exclusion of livestock provide a substitute for the reduction in non-economic values (social identity, cultural aspects, degree of dependency on own resources adapted to local conditions, etc.) associated with the pastoralist livelihood? The answer to this complex question would depend on a variety of social expectations, conditions and opportunities, which may be better grasped by a livelihood or capability approach than by short-term economic calculations.

4. Implications of the Choice of Fairness Criteria

The implicit fairness criterion adopted by a PES scheme reflects and also affects the relative weighs given to equity and efficiency concerns during the design of the program. For example, at one extreme, a PES scheme adopting a *maxi–min* criterion would primarily be designed to increase the net benefit of the poorest eligible landholders even if the environmental additionality is negligible. However, this kind of PES might be competing with other poverty relief programs (Turpie et al., 2008) or 'conditional cash transfers' which are not linked to conservation efforts or environmental considerations (Wunder, 2008). By contrast, PES schemes designed under an *actual provision* criterion

could induce positive efficiency effects and potential negative equity effects when those individuals providing the services in the most cost-efficient way are the better-off landholders (see Scheer et al., 2004). Likewise, when applying the *status quo* criterion there is a risk that the agreed distribution of payments represents the voice of the most powerful groups among the providers, legitimising very biased allocations (Ishihara and Pascual, 2009).

Alternative criteria such as *compensation*, *actual provision* and *expected provision*, place more emphasis on efficiency effects since they apply environmental meritocratic principles that mainly focus on the level of environmental additionality rather than equity concerns for the determination of the payments. By contrast, as mentioned above, other criteria such as the *maxi–min* or *common goods* criterion, place more emphasis on the social distributive effects favouring the poor, rather than environmental additionality considerations.

Fig. 2 draws on a proposition regarding where the different fairness criteria identified in Table 1 are positioned in relation to their relative emphasis on equity and efficiency concerns at the design stage of PES schemes. For drawing Fig. 2 we have adopted the income evaluative space and assumed that, in general, better-off landowners have better access to and control over larger and better quality land in terms of ecosystem service provision (see e.g., Umali-Deininger and Shapouri, 2002). Of course, when this assumption does not hold for a give PES scheme, Fig. 2 ought to be adapted accordingly.

5. The Efficiency–Equity Interdependency in PES

Given the prevailing fairness criteria and the chosen evaluative space, multiple institutional factors influence the final outcome regarding equity and efficiency effects. Three main sets of factors can be distinguished in terms of the conceptual framework developed here. The first one includes those which set the position of a PES scheme in the quadrants in Fig. 1. In other words, it broadly identifies the sign of the equity and efficiency effects. The second set of factors set the shape of the interdependency curve (IC), thus constraining the *potential* combination between the equity and efficiency effects by the IC. The third group of factors includes those that influence the *actual* combination of equity and efficiency effects (and possible paths for changes) *given* an IC. That is, it determines a point on the IC characterising a particular PES scheme in terms of its efficiency and equity effects. This section identifies and addresses the importance of these factors in turn.

5.1. Factors Setting the Sign of the Equity and Efficiency Effects

There are factors that define, *ex-ante*, the conditions that determine the quadrant (in Fig. 1) where a PES scheme may be positioned. They basically condition the sign of the efficiency and equity effects.

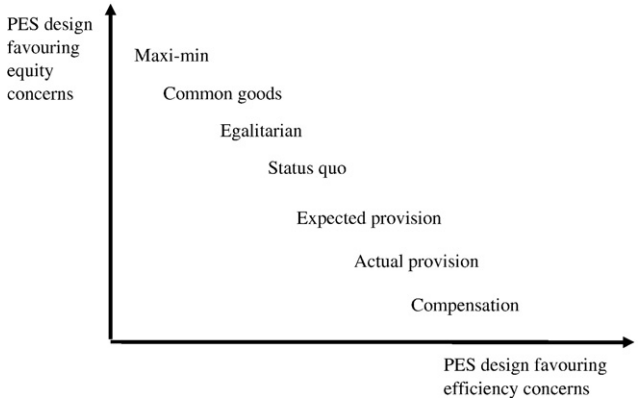

Fig. 2. Economic fairness criteria and the emphasis of equity and efficiency concerns in PES design.

Regarding the equity effect, there are two main factors besides the evaluative space chosen that *a priori* affect its sign. The first one is the original position or *ex-ante* level of the endowment among agents. This sets the baseline against which the equity impacts of the intervention need to be compared. This would define the position of the horizontal (x)-axis along the vertical (y)-axis in Fig. 1. The second one has to do with the relevant stakeholders or reference set of participants in the PES scheme to which equity effects are to be evaluated.

Likewise, the sign of the efficiency effect is dependent on at least three factors. Firstly, the level of environmental additionality influences the efficiency effect in PES schemes when compared to the 'business as usual' scenario. The evaluation of the environmental additionality needs also the definition of a baseline scenario, which may change over time. Secondly, the sign and level of the efficiency effect requires knowledge about the economic value of the service provided. Thirdly, the cost of implementation, including all types of transaction and opportunity costs, needs to be identified and valued accordingly (Ferraro, 2008). This includes the sum of the amounts paid by buyers as well as all the additional costs (covered by external agents, for example). In principle, both calculations (benefits and costs) would need to be carried out considering the net present value of the program. This brings also the additional challenge of identifying a discount rate, which inevitably implies adopting an inter-generational fairness criterion about the distribution of costs and benefits.

These points can be illustrated with the example of the PES scheme for the water-related services of forests implemented in Mexico described by Muñoz-Piña et al. (2008). This scheme mainly targets indigenous communities for forest conservation. While there are doubts about its associated environmental additionality, as most forest land under the scheme is not highly threatened, the scheme appears quite effective as an income redistribution mechanism because most of the participant communities are considered very poor according to the Mexican government's classification. In this example both positive efficiency and negative equity effects would simultaneously be excluded, implying that the IC associated with this PES program could only be located in quadrant IV in Fig. 1.

5.2. Factors Conditioning the Transfer and Distribution of Resources

The IC illustrates the outcome of any potential PES design in relation to the combinations or interdependency of efficiency and equity effects. As such, the IC depends on variables affecting the size of the transfer of resources between buyers and providers of the ecosystem services and their final distribution. Based on the income evaluative space, one can find at least three key factors that determine the size of transfers. One is the service providers' willingness to accept (WTA) compensation for the level of services they provide. Another one is the willingness to pay (WTP) of buyers of the ecosystem services. Additionally, the implementation cost of the program should also be taken into account.

Providers' WTA compensation for the services they provide is largely determined by the degree of their livelihood dependency on the land under the program. This in turn affects the opportunity cost of supplying the services, which may also involve non-tangible costs as there may be ancestral land use practices no longer allowed due to the PES contract. In addition, WTA is also a function of the potential on-farm benefits derived from the promoted land use change. The WTA compensation also depends on the social perceptions about liability, property rights and reputation of other agents.

Buyers' WTP mainly depends on the cost of alternative policy options to secure the services, as well as their ability to pay. Similarly, the social perceptions about liability, property rights, and reputation of other agents and the degree of uncertainty about the actual provision of the services are key factors in setting the WTP.

Lastly, implementation costs largely depend on the amount and quality of the information that needs to be gathered and managed in the PES program as well as the difficulty of the negotiation and contracting process. The latter in turn also depends on both the number and heterogeneity of stakeholders involved in the PES program as well as the structure and nature of the intermediary organisation. Added to this is the cost of post-contractual activities, including enforcement and monitoring actions on the ground (Ferraro, 2008).

Fig. 3 represents various hypothetical PES-ICs, each associated with a different underlying fairness criterion. For the sake of illustration, as in Fig. 1, the equity effect on the service providing community (e.g., the upland farmers in a watershed) may be based on the income Gini coefficient. Similarly, one may measure the efficiency effect of PES by the aggregate change in the consumer and producer surplus, net of transaction costs. It should be noted that no indicator appears explicitly in Fig. 3 to indicate that alternative ones could be applied instead.

Following a simple heuristic example, let's assume that the local fairness criterion is based on the *maxi–min* rule. The intersection of the IC with the vertical (equity effect) axis would represent the maximum equity effect that could be achieved regarding the redistribution of income within the community of service providers. This extreme point might illustrate a situation whereby a maximum number of buyers of the service would be charged according to their maximum WTP for its provision. However, this point may be achieved at the expense of gains in efficiency since a maxi–min rule may not be associated with the highest potential environmental additionality. Also, a point on the intersection between the IC and the efficiency effect (horizontal) axis would describe a situation where buyers of the environmental service exert their maximum market power in order to pay providers their minimum WTA compensation. Often PES would create equity and efficiency effects that lay somewhere on the between these two extreme intercept points of the IC. This is because the intermediary tends to mediate between the conflicting interests of buyers (aiming at maximising additionality at lowest possible cost) and providers' social goals (in this case following the maxi–min rule aiming at maximising equity effects — i.e., minimising the Gini coefficient). An intermediate situation that may arise may be that of point A (Fig. 3).

Of course, while in Fig. 3 a clear trade-off between efficiency and equity is depicted, this is for simple illustrative purposes only. The shape of the IC could in fact be very different, including non-linearities. The shape of the IC would depend on many factors. One such factor is the fairness criterion applied in the PES design. Fig. 3 illustrates how different fairness criteria may determine different interdependency curves thus also showing the trade-offs (or synergies) between the efficiency and equity effects. While the shape of the ICs depicted in Fig. 3 are for illustrative purposes only, the point is that the effects of using different fairness criteria could be tested with data.

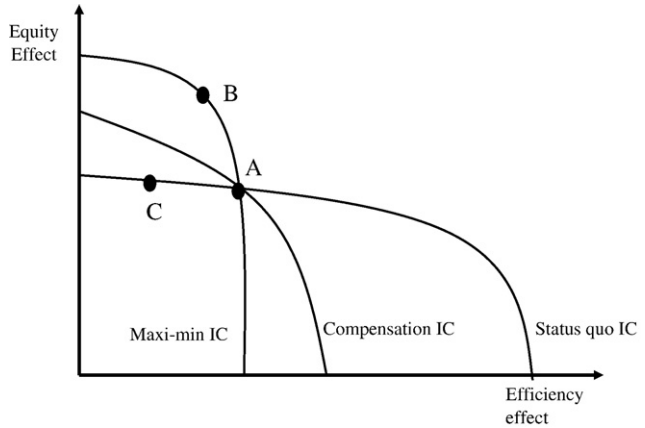

Fig. 3. Economic fairness criteria and the shapes of the efficiency–equity interdependency curve.

5.3. Positioning PES Schemes on the Equity and Efficiency Interdependency Curve

Within a given IC, the outcomes of a PES scheme may be positioned in a variety of points regarding the combination of the achieved levels of the efficiency and equity effects. A *maxi–min*-based IC and a *status quo*-based IC, may be expressed as $m(x,y;\Phi^m)$ and $s(x,y;\Phi^s)$, respectively, where $m(\bullet)$ and $s(\bullet)$ are functions of x (efficiency) and y (equity); the function would then be shaped by a vector of exogenous factors, Φ, that might be determined through policy.

For instance the bargaining power of buyers and providers and the role of the intermediary between them is considered to critically influence the performance of PES schemes. The vector Φ in this case would be comprised of two subvectors $\Phi=(\Omega,\Psi)$ where $\Omega=(\alpha_1,\alpha_2,\alpha_3\ldots\alpha_n)$ might be associated with n factors affecting the bargaining power of agents, e.g., their level of social capital, socio-economic status, market concentration, and political influence or empowerment. The subvector $\Psi=(\beta_1,\beta_2,\beta_3\ldots\beta_k)$ would in turn be comprised of k factors which are more closely associated with the role of the intermediary, including among others, its ability to manage information and uncertainty, strategies to tackle free-riding among beneficiaries, negotiation ability and reputation (trust).

The role of intermediary agents in shaping the performance of PES has been rather neglected in the literature. However, having control over information and holding an important relational role confer to the intermediary significant ability to steer the transfer of resources, select the beneficiaries and set the 'rules of the game,' which determine to a large extent the efficiency and equity performance outcomes. In addition, intermediaries (NGOs for example) often have a particular agenda, normally linked to international cooperation agencies, which increasingly are important players in the implementation of PES in developing countries. Access to external resources also grants them considerable power to set a particular fairness criterion. Furthermore, a very key role of the intermediary is to coordinate actions between stakeholders and deal with the asymmetric information between stakeholders in the design and implementation stage of any PES scheme.

Such a role may be incorporated in the above-mentioned equation by means of including variable β_i. This may be associated with the effect of asymmetric information given the potentially pervasive levels of uncertainty surrounding the value of the provision of the environmental service. For instance, it can be hypothesised that the more pervasive the level of uncertainty about the level of environmental additionality, the closer the point reflecting the efficiency–equity effect within a given IC will be to the horizontal x-axis along the IC curve. This is because uncertainty reduces the capacity of intermediaries to introduce sizable fees among buyers, due to likely negative strong correlations between buyers' WTP and the degree of uncertainty about the benefits derived from the transaction. If the (per capita) payments by buyers are reduced, the total amount of resources to be distributed among the sellers of the service is also reduced, thus possibly tending to negatively impact the equity effect.

Theoretically, different ICs (due to being based on different fairness criteria, *ceteris paribus*) may still theoretically generate the same efficiency and equity effects. For the sake of exposition, assume that point A in Fig. 3 represents the intersection of different interdependency curves. At point A, the combination of efficiency and equity effects of a given PES designed using either the *maxi–min* or *status quo* criterion (just to name two criteria arbitrarily) is the same and in consequence should be feasible to find the combination of values in the policy vectors Φ^m and Φ^s that make possible that $(x,y)_m=(x,y)_s$. By contrast, this also implies that if

each IC has a unique shape determined by the fairness criterion used, the same policy intervention, ($\Phi^m = \Phi^s$) on a PES scheme would generate different efficiency–equity outcomes, i.e., $(x,y)_m \neq (x,y)_s$. Fig. 3 illustrates this situation. The message is clear. The different efficiency–equity effects are not just due to different potential interventions on the $\Phi = (\Omega,\Psi)$ vector but due to the alternative implicit fairness criteria being applied in the design of PES in the first instance.

Let us illustrate this point by taking one hypothetical policy factor that is often part of PES schemes: the level of expenditure to increase the quality and scale of diffusion of the information regarding a payment scheme among potential participants (buyers and sellers). This type of intervention usually aims at increasing the bargaining power of agents with less access to information. Let us call this intervention 'type α_1 intervention.' *Ceteris paribus*, under different ICs (due to different fairness criteria), the intersection point A where $(x,y)_m = (x,y)_s$ implies that the level of such informational expenditure is different ($\alpha_1^m \neq \alpha_1^s$) when different fairness criteria are applied. Further, the same absolute change in information expenditure under the two hypothetical ICs, i.e., $\Delta\alpha_1^m = \Delta\alpha_1^s$ would make $(x,y)'_m \neq (x,y)'_s$ thus generating a different combination of equity and efficiency effects across PES.

The message is that, given an evaluative space, it is the applied fairness criterion that ultimately influences the relative outcome of a policy intervention. In the case of the hypothetical *maxi–min* IC, $m(\bullet)$, $\Delta\alpha_1^m$ would be associated with a movement from point A to a new outcome combination, e.g., point B in terms of the new outcome combination $(x,y)'_m$. In this case, the opportunity cost of trying to increase the equity effect through the informational program is relatively low (in terms of the level of foregone efficiency effect of the intervention). By contrast the same absolute change in the policy variable, now termed $\Delta\alpha_1^s$, could well be associated with a point such as C on the hypothetical *status quo* IC, implying a higher opportunity cost in terms of efficiency gains at the expense of only being able to increase equity marginally.

This rather abstract exercise suggests that using a particular fairness criterion may be critical for determining the potential interdependency between equity and efficiency effects in any PES scheme. This heuristic exercise falls short of being able to provide specific testable hypotheses. However, we think that there is important work to do in this regard to generate specific hypotheses regarding the role alternative fairness criteria have on the interconnectedness between efficiency and equity effects in PES. This may open up a fruitful avenue into PES research that inescapably needs the expertise of the practitioners in terms of understanding what fairness criteria may be applicable under different PES contexts.

6. Concluding Remarks

In this paper we have argued that there are interdependencies between efficiency and equity effects and thus that this should be considered as a key feature of PES schemes. Whether efficiency and equity ought to be weighed similarly or not is a normative question which we have not addressed. However, we have argued that it is important to focus the attention on the fairness criterion adopted by a PES scheme as this reflects and also affects the relative weighs given to equity and efficiency concerns during the design of the program.

Schilizzi (2003: 35) has posed the following question: "Should equity impose limits over and above efficiency?" Practitioners usually face this question when designing PES. While the Coasean approach to PES would give 'no' as an answer, we argue that the answer largely depends on the real bargaining power that stakeholders in any PES scheme may have, which determines the prevailing fairness criterion to be used in the design of PES. This has considerable theoretical implications, since from this perspective PES are no longer understood uniquely as an instrument to solve environmental externalities. We have stressed our view that that there should not be a pre-defined relationship between efficiency and equity in PES, since it depends on a large variety of factors, which we have tried to systematise.

Some key issues have been identified that may merit further investigation with regard to the interdependency between efficiency and equity effects of PES. First, it is important to further analyse, both theoretically and empirically, the potential context-dependent impacts of applying different fairness criteria and the social reasons explaining why a particular criterion prevails over others and how this may change over time. Second, PES programs need to take into account the institutional backdrop affecting the power relationships between buyers and sellers of environmental services.

Lastly, we think that the effect of the uncertainty derived from the complex links between ecosystem processes, services and values on the role of the intermediary merits more careful investigation. In this regard, close collaboration between ecologists, economists and other social scientists needs to be forged.

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