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Analysis

When to Pay? Adjusting the Timing of Payments in PES Design to the Needs of Poor Land-users

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ABSTRACT

A neglected issue in the design of payments for ecosystem services (PES) is the timing of payments to ecosystem service providers over the course of the year. We hypothesise that timing should matter to poor land-users with limited options to save money in regions dominated by subsistence farming, seasonal fluctuations of food supply, and peaks in expenses during the year due to cultural events such as circumcisions and funeral ceremonies that occur in specific months. If land-users value payments differently at different time points throughout the year, the provision of ecosystem services can be increased for the given financial resources if payments are made at a point in time when land-users need those most. We conducted a choice experiment in the Mahafaly plateau in Southwestern Madagascar, an area which meets the aforementioned criteria, to test the importance of the time of receipt of payments. We found that respondents are willing to accept less money if they receive it in months of food shortage unlike if they receive it at the time of cultural events. We conclude that the cost-effectiveness of PES in regions with the above-mentioned characteristics can be increased by selecting the appropriate timing to pay ecosystem service providers.

1. Introduction

Payments for ecosystem services (PES) have become prominent policy instruments to conserve endangered biodiversity and secure the provision of ecosystem services in developing countries (TEEB, 2010). Many authors also point out that PES may alleviate poverty and promote local development in rural areas (Corbera and Pascual, 2012; Pascual et al., 2014; Tacconi et al., 2013). Meeting the criterion of cost-effectiveness, which is typically understood as maximising the conservation of biodiversity or the provision of ecosystem services for the given financial resources, is a key concern in the research into the optimal design of PES (Engel et al., 2008; Wätzold and Schwerdtner, 2005).

Studies on how to design PES so that they are cost-effective have addressed a number of issues. Several authors have dealt with the question of how PES schemes should be spatially optimised taking into account that costs and benefits of land-use measures to be incentivised by payments differ spatially (Duke et al., 2015; Ferraro, 2011; Wätzold and Drechsler, 2014; Wünscher et al., 2008). Other authors (García-Amado et al., 2011; Vedel et al., 2015) addressed the issue of additionality, i.e. designing PES schemes in a way that they provide additional ecosystem services compared to a situation where no scheme is established. Further design themes include whether to pay in cash or in kind (Hossack and An, 2015), whether to subsidise ecosystem service enhancing land-use measures or related economic activities directly (Groom and Palmer, 2010), and whether to include distributional goals in PES design (Markova-Nenova and Wätzold, 2017; Muradian et al., 2010; Pascual et al., 2014).

The purpose of this paper is to explore a design issue whose analysis has been neglected although it has been identified as important (Adhikari and Boag, 2013; Zabel and Engel, 2010). This relates to the timing of the payment within the year. As Zabel and Engel (2010, p. 407) succinctly point out: "The timing of the payment disbursement can be customised so that it aids the participants in overcoming periods of the year that tend to be economically tight, e.g. prior to the main crop harvest". If adjusting the timing of payments to the needs of local land-users lowers the payment they are 'willing-to-accept' to provide ecosystem services (Wang et al., 2017), the cost-effecttiveness of a PES scheme can be increased as more ecosystem services or biodiversity can be provided for the same financial resources.

The starting point of our analysis is the assumption that the timing of the payment is important if a PES scheme addresses a poor society with the following characteristics: Most households depend on the availability of locally grown food for their survival, and the availability of food fluctuates during the year with periods of food abundance and food shortage. Additionally, the need for money may fluctuate during the year due to cultural events (e.g. circumcisions and funeral ceremonies) that occur in specific months and have a substantial impact on

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households' expenses. Saving food is difficult due to storage problems, and a lack of a reliable banking system implies that saving money is difficult. Our supposition is that land-users place a higher value on payments received at times when they need money most (due to food shortage or cultural events) than at other time points during the year.

To analyse the issue of the timing of payments we conducted a survey in a case study region that exhibits the above-mentioned characteristics: the Mahafaly region in the southwest of Madagascar. The survey was a choice experiment (CE) designed to elicit the local land-users' willingness to trade off the size of a potential payment they receive for optimal timing of that payment. As local land-users are unaware of the concept of PES and we are only interested in whether land-users value a payment differently depending on when they receive it during the year, we did not mention the concept of PES in the CE survey. Instead we framed the survey in a way that it relates to remittances from temporary migrant relatives, as temporary migration is common in the region, especially among average income and poor households, as a way of dealing with food or money shortages (Neudert et al., 2015).

2. Material and Methods

2.1. Case Study Description

The Mahafaly plateau is located in the administrative unit area of Atsimo Andrefana in the southwestern part of Madagascar. The Mahafaly plateau is characterised by a semi-arid climate, with an average rainfall ranging between 300 and 600 mm per year. Rainfall is seasonal and usually occurs between December and April (SULAMA, 2011).[1] Atsimo Andrefana is among the regions with the highest poverty rate in Madagascar (INSTAT, 2011). Of the rural households in the Mahafaly plateau, 88% live below the poverty line, i.e. have an annual income below 468,800 ariary (roughly 163 euros) (INSTAT, 2011; Neudert et al., 2015). The local population relies mostly on subsistence farming, where agriculture is seasonal and depends largely on rain availability due to the absence of irrigation systems (SULAMA, 2011). Rainfall, and thus agricultural production, fluctuates between years, exposing the local population to food shortages in years with low rainfall. In cases of food shortage, the local population often sells a part of their livestock to obtain money to buy food, or looks for other non-farm income generating activities such as temporary migration, and, to a lesser extent, charcoal production (Neudert et al., 2015; SULAMA, 2011).

Besides crop production, livestock keeping is common in the region. The local population raises mainly goats and sheep, poultry and zebus. Livestock keeping serves primarily to accumulate wealth and social status (SULAMA, 2011). On the other hand, selling part of the livestock can also serve as a buffer strategy during lean periods (Hänke, 2016). Nevertheless, the ownership of farm animals is normally restricted to rich and above-average income households. As a result, adapting to lean periods becomes especially difficult for poor households which do not own livestock, or even poultry. Moreover, there are no banks or similar institutions in this region making saving difficult, especially for poorer people.

Cultural events are also deeply rooted in the region. They often involve significant expenses for households, especially if they are related to important events in life such as circumcisions, marriages or death. These expenses mainly involve sacrificing some cattle, or buying the animals required for the ritual sacrifice (SULAMA, 2011). Some cultural events such as circumcisions and funeral ceremonies are typically carried out in specific months.

The Mahafaly plateau is part of the dry spiny forest ecoregion, which covers part of southern and southwestern Madagascar and is considered one of the 200 most important ecological regions worldwide (Olson and Dinerstein, 2002). This region provides a habitat for many endangered and endemic species, among them the radiated tortoise and the giant-striped mongoose (Ferguson et al., 2013; Ganzhorn et al., 2015). Deforestation mainly through slash-and-burn agriculture has led to a substantial decline in the forest area from approximately 30,000 km^2 in 1970 to about 21,000 km^2 in 2000 (Harper et al., 2007).

It has been suggested that a PES scheme be set up to preserve the remaining and continually threatened spiny forests in the region (Markova-Nenova and Wätzold, 2017; Randrianarison and Wätzold, 2017). The principle idea of such a PES scheme is that local land-users are compensated for refraining from slash-and-burn agriculture in areas with spiny forests. Land-users could use the compensation to purchase food or enhance the productivity of agricultural land, for example by applying fertiliser. Here, we are not interested in how such a PES scheme could be designed in detail (see Engel (2016) for a review of PES design issues), but rather focus on the specific design issue of the timing of the payment, which should correspond to the time within the year when the local population needs the payment most.

2.2. Choice Modelling and Estimation Procedures

In discrete choice models, decision makers are assumed to be utility maximisers. The utility function for a specific choice or alternative is derived following the random utility framework (McFadden, 1973) and the new consumer choice theory developed by Lancaster (1966). In this setting, a decision maker n faces a choice among J alternatives, where the level of utility U_n he/she will obtain varies from alternative to alternative. More precisely, utility is assumed to depend on a set of attributes X shared by all available J alternatives with the level of each attribute being different from alternative to alternative. Furthermore, the individual characteristics of a decision maker n – which are assumed to be constant across choice situations – could affect the level of utility he/she obtains from a particular choice and can be added to the model specification. An alternative i is thus chosen over an alternative j if the level of utility derived from that alternative U_{ni} is higher than the utility level obtained from the other alternative U_{nj}.

Typically, any choice made depends on (1) characteristics of the alternative and the decision-maker which are observable to the analyst, and (2) characteristics of the decision maker and the decision situation which are unobservable to the analyst (see Train, 2009 for details). To account for these unobservable factors, a random component $\mathcal{E}_{ni}$ ($i = 1, 2 \ldots J$) specific to the decision maker n and associated with each alternative i is introduced into the utility function. For each alternative i, the indirect utility function U_{ni} will be then decomposed into two elements: a deterministic component V_{ni}, which is a linear function of the attributes X of the J alternatives, and a random component $\mathcal{E}_{ni}$. The occurrence of the random component $\mathcal{E}_{ni}$ in the utility function allows one to predict in terms of a probabilistic function the choice behaviour of the decision maker n. Thus, the probability Pr that he/she will choose alternative i over any available alternative j ($j \in J$) is given by (Train, 2009):

$$\begin{aligned} \Pr\left[\mathrm{U}_{ni} > \mathrm{U}_{nj}, \forall i \neq j\right] &= \Pr\left[(\mathrm{V}_{ni} + \mathcal{E}_{ni}) > (\mathrm{V}_{nj} + \mathcal{E}_{nj}) \forall i \neq j\right] \\ &= \Pr\left[(\mathcal{E}_{nj} - \mathcal{E}_{ni}) < (\mathrm{V}_{ni} - \mathrm{V}_{nj}) \forall i \neq j\right] \end{aligned} \quad (1)$$

In order to estimate this probability, an assumption has to be made concerning the distribution of the error terms $\mathcal{E}_n$ in Eq. (1). A common assumption is that the error terms are independently, identically, distributed extreme values (iid) (McFadden, 1973). Assuming that the

[1] The SULAMA (Sustainable Land Management in the Mahafaly plateau) project was a large multidisciplinary participatory research project aimed at understanding the relationships between ecosystems, biodiversity and land uses under the continuous pressure of population growth, extreme poverty, and uncertain climate change (http://www.sulama.de/index.php/en/index.html). One of the authors participated in a participatory rural appraisal shortly after the start of the project to assess the situation in the study region, particularly the prevailing economic conditions. SULAMA (2011) contains the results of this participatory rural appraisal.