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Assessing the benefits and costs of dryland forest restoration in central Chile

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ABSTRACT

Investment in natural capital restoration is increasing as a response to the widespread ecological degradation of dryland forests. However, finding efficient mechanisms to promote restoration among private landowners is a significant challenge for policy makers with limited financial resources. Furthermore, few attempts have been made to evaluate the costs and benefits of restoration interventions even though this information is relevant to orient decision making. Hence, our goal was to estimate the benefits and costs of dryland forest restoration by means of reforestation with native trees in a study area in central Chile. To determine benefits we applied a Contingent Valuation questionnaire that allowed for the calculation of willingness to pay measures. Restoration costs were calculated based on market prices following existing technical recommendations developed for the study area. The results showed that the restoration project had a negative NPV irrespective of the discount rate applied in the analysis. Thus, the NPV varied between −US$71,000 and −US$258,000. The NPV attained positive results only for negative discount rates (US$15,039 for −2%) and only when the national subsidy available for forest restoration was taken into account. This shows that landowners in Colliguay do not have incentives for carrying out restoration interventions due to a classic market failure: that in which ecosystems are mismanaged because many of their benefits are externalities from the perspective of landowners. Overall, these results stress the need for developing new compensation mechanisms and enhancing those in existence, with the aim of making restoration competitive with other land uses.

1. Introduction

Despite their global importance (Miles et al., 2006; Schimel, 2010; UNDP, 2004) dryland ecosystems are currently experiencing high rates of forest loss as a result of overexploitation and conversion of forests to other land uses (Hill et al., 2008; Millennium Ecosystem Assessment, 2005; Reynolds et al., 2007). This situation is especially pervasive in Latin America where socioeconomic problems can be severe, extreme poverty is common, and human emigration rates are often very high (Newton, 2008). For instance, Mediterranean ecosystems in central Chile —a particular type of dryland— have faced a pronounced deforestation in the last three decades: only 58% (113,605 ha) of the forest extent present in 1975 (195,773 ha) remained by 2008, representing a mean annual decline of −1.7%, one of the highest in Latin America (Schulz et al., 2010). As a response to this widespread degradation of drylands in Latin America investment in natural capital restoration has been increasing (Figueroa, 2007).

Ecological restoration is regarded as a generally effective way to increase both biodiversity and the provision of ecosystem services (Lamb and Gilmour, 2003; Rey Benayas et al., 2009). For this reason, it can now be seen as a top priority for society and a good investment in the current state of ecological overshoot (Rey Benayas et al., 2009). In developing countries, nonetheless, where poverty is concentrated and where biodiversity hotspots occur, restoration activities will only find support if they are clearly linked to sound socioeconomic research (Aronson et al., 2006). So far, few attempts have been made to evaluate the effectiveness and efficiency of restoration strategies. In a review of over 2000 restoration case studies, TEEB (2009) reports that less than 5% of them provided meaningful cost information and none assessed economic benefits. More recently, Aronson et al. (2010) reached similar conclusions through a meta-analysis of 1582 peer-reviewed papers. Cost-benefit analysis of restoration projects provides decision

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makers with information by which they can gauge the efficiency of restoration investments (Holmes et al., 2004). This is especially significant for private landowners who must balance conservation goals and economic benefits (Goldstein et al., 2008; Holl and Howarth, 2000).

In the context of landowners' incentives for carrying out restoration interventions, another issue that has been neglected in the development of strategies for restoration stems from environmental economics theory: the existence of externalities results in outcomes that are not socially optimal (Baumol and Oates, 1988; Pearce and Turner, 1990). Forest restoration produces societal benefits which far exceed those perceived by landowners who decide carrying out restoration interventions (Engel et al., 2008; Ferraro and Simpson, 2002). This problem arises because the market does not recognize these positive externalities (e.g. ecosystem services), and the landowner, therefore, has no incentive for taking into account these external benefits when deciding about land uses (Engel et al., 2008). As a result, without economic incentives seeking to internalize what would be an externality, the market failure remains and the private owners will make restoration efforts under the socially optimum level. Given that a great portion of the forest area is privately owned in Latin America, it is essential to assess the incentives that landowners have to restore their properties (Environmental Law Institute, 2003).

While social cost-benefit analysis is important to decide whether a restoration action is socially desirable, most of the time the success of a restoration project depends on a private cost-benefit analysis. Thus, the objective of our study was to estimate the net economic benefits that landowners would obtain from a restoration project aimed at recovering dryland forest ecosystem services in central Chile. Additionally, we considered the economic implications of a national subsidy recently instated which aims to restore degraded forest ecosystems. At present, the economic benefits arising from dryland forest ecosystem services restoration have been scarcely studied in Latin America (e.g. Birch et al., 2011; Rodríguez et al., 2006). In this study, we applied Contingent Valuation (CV) to analyze the economic benefits that landowners would perceive if a restoration project were implemented in Colliguay Valley, a study area that represents one of the main remnants of dryland forests in Chile. Restoration costs were estimated using market prices based on technical recommendations proposed for the study area.

2. Materials and methods

2.1. Description of the study area

The study was conducted in the Colliguay Valley (33°07′–33°14′S and 71°15′–71°00′ W, Fig. 1), which is located in the semiarid portion of the Mediterranean bioclimatic zone of central Chile (Luebert and Pliscoff, 2006; Verbist et al., 2010). Due to its great biodiversity, high degree of endemism, and critical conservation status, this region is one of the world's 34 biodiversity hotspots (Mittermeier et al., 2005), being home to approximately 2400 plant species, 23% of which are endemic (Cowling et al., 1996). Despite the rarity and global importance of Chile's Mediterranean ecosystems, less than 0.8% of them are currently protected (Lara et al., 2010). In fact, despite the fact that the Valley was declared as a protected area by the Chilean Ministry of Agriculture in 1974, and a Priority Site for Biodiversity Conservation in 2002 (CONAMA and PNUD, 2005), at present Colliguay Valley's forests are not under any kind of legal protection.

The Valley is located in the Coastal Range of the Valparaíso administrative region, covering 27,000 ha. According to Luebert and Pliscoff (2006) the Valley is located within the distribution of the sclerophyllous forest formation of the Mediterranean zone in central Chile, which can also be understood as a type of dryland forest (Fig. 1). Owing to the low accessibility to the Valley and the presence of steep slopes, the study area contains an outstanding biodiversity of dryland ecosystems that have been preserved over the last decades (Borde and Gongora, 1956; Zunino et al., 2007).

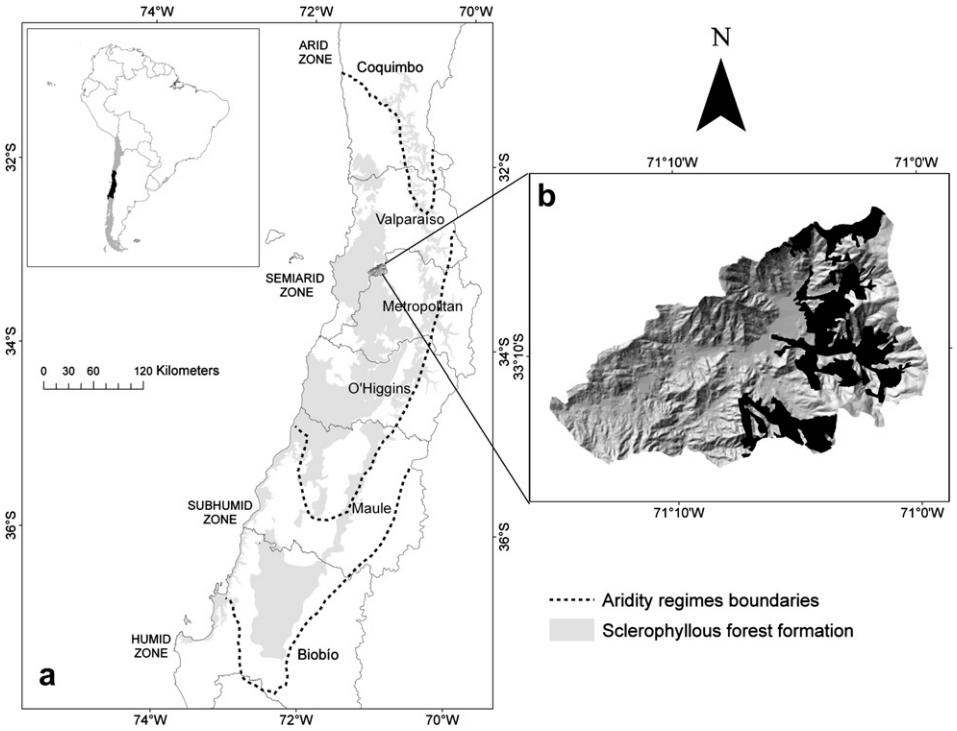

Fig. 1. Index maps. (a) Location of the study area in the Valparaíso administrative region in Central Chile; (b) Map of the Colliguay Valley depicting (in black) the area corresponding to the Priority Site for Biodiversity Conservation.