



Public investment does not crowd out private supply of environmental goods on private land



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ABSTRACT

In landscapes where private land tenure is prevalent, public funds for ecological landscape restoration are sometimes spent subsidising the revegetation of cleared land, and the protection of remnant vegetation from livestock. However, the total area treated may be unclear because such projects are not always recorded, and landholders may undertake similar activities without subsidisation. In the absence of empirical data, in the state of Victoria, Australia, a reporting assumption has been employed that suggests that wholly privately funded sites match publicly subsidised sites on a hectare for hectare basis (a so-called “x2” assumption). Conversely, the “crowding out” theory of investment in public goods such as environmental benefits suggests that public investment may supplant private motivation. Using aerial photography we mapped the extent of revegetation, native vegetation fencing and restoration on 71 representative landholdings in rural south-eastern Australia. We interviewed each landholder and recorded the age and funding model of each site. Contrary to the local “x2” reporting assumption, about 75% of the total area of the 412 sites was from subsidised sites, and that proportion was far higher for the period after 1997. However, rather than displacing unsubsidised activity, our modelling showed that landholders who had recently been subsidised for a project were more likely to have subsequently completed unsubsidised work. This indicates that, at least in terms of medium-term economic impact, the large increase in public subsidies did not diminish privately funded activity, as might be expected according to the theory of crowding out.

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1. Introduction

In parts of the world where natural habitats have been extensively cleared and fragmented, governments and conservation organisations seeking to reverse the decline in the extent and quality of those habitats must do so on private land (Saunders et al., 1993; Foreman, 2004; Chazdon, 2008; Thackway and Lesslie, 2008; Duncan and Dorrrough, 2009; Zerger et al., 2009; Hanley et al., 2012). Increasing the cover of structurally complex and diverse

native ecological communities will help protect biodiversity, and may provide more environmental benefits and ecological resilience than relatively homogeneous production landscapes (Tschamtket et al., 2005; Fischer and Lindenmayer, 2007). These benefits are a public good because, once created, they are not for the exclusive use or consumption of the owner, nor can they be attached to property rights (Hanley et al., 2012).

A range of investment types has been developed to encourage private landholders or lessees, communities or non-government and quasi-non-government organisations to participate in landscape scale restoration schemes. These include grants and subsidies, to revegetate or restore depleted vegetation types; or legal instruments to mitigate threatening processes associated with human settlements and use, or their recent withdrawal. These approaches have been discussed in the literature under such labels as Agri-environment schemes (Kleijn and Sutherland, 2003; Whittingham, 2007; De Snoo et al., 2012; Hanley et al., 2012), Payments for Environmental Services (PES) schemes (Farley and Costanza, 2010; Miteva et al., 2012), Conservation Easements

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(Fisher and Dills, 2012), and Natural Resource Management (NRM) Programs (Hajkowicz, 2009; Pannell and Roberts, 2010).

In recent decades, Government agencies have begun to adopt increasingly sophisticated approaches to conservation, collectively termed systematic conservation planning (Kukkala and Moilanen, 2012), with increasing attention on where and how public money should be spent restoring ecological systems. For example, Governments want to invest in securing the most depleted or endangered habitat types under long term arrangements (Stoneham et al., 2003; Natural England, 2010; Boykin et al., 2011; Fisher and Dills, 2012), in sites in more favourable contexts, and in 'biodiverse' plantings (DSE, 2006). However, private landholders are needed to volunteer their land, and act effectively as co-investing partners. These private landholders may have various motivations for participating in programs or undertaking specific actions (e.g., Bramston et al., 2011; Sheeder and Lynne, 2011), or anticipate net private benefits (Pannell, 2008), some of which may be at odds with Government objectives (e.g., Pannell et al., 2006; Cocklin et al., 2007; Pannell and Roberts, 2010; Sorice et al., 2013). The suite of market-like mechanisms for investing in ecological restoration, such as conservation auctions explicitly acknowledge, and seek to exploit, the private co-benefits that may exist for participants (Stoneham et al., 2003; Cocklin et al., 2007).

The degree to which Government's strategic objectives are realised cannot be ascertained unless spatial data on landholder intentions, site locations and management is available. Prior to some recent examples (Von Hase et al., 2010; Raymond and Brown, 2011; Fisher and Dills, 2012), spatial records of where public money was actually spent have typically been patchy at best (ANAQ, 2008; Bernhardt et al., 2005; Brooks and Lake, 2007; Zerger et al., 2009; Fero et al., 2013). Moreover, in addition to co-investing with government, landholders may undertake similar activities independent of direct public investment (Smith, 2008; Harris-Adams et al., 2012), and the location and amount of these activities is unlikely to be officially recorded. As a result, the evaluation of policy aimed at affecting positive landscape change is complex, as it may comprise known or unknown quantities in known or unknown locations.

In Victoria, Australia's most densely populated state, public policy to "reverse the long term decline in native vegetation extent and quality" began evolving around 1990 (East et al., 1996), as increasing grants for tree planting coincided with regulatory controls on clearing native vegetation from private land (Kyle and Duncan, 2012). Despite imperfect data, government agencies have a statutory responsibility to report on progress toward this objective within their jurisdiction (e.g., *Catchment and Land Protection Act 1994* (State of Victoria)). Agencies have little choice but to resort to extrapolation from, and interpretation of, incomplete spatial data on vegetation management activities, together with assumptions about levels of unmapped activity, to estimate expected net spatial change or impact (Brunt and McLennan, 2006; DSE, 2008a). A key reporting assumption employed in Victoria in recent years is that for every hectare of publicly co-funded (i.e., government subsidised) activity, there is another hectare of privately funded (un-subsidised) activity elsewhere. This came to be known as the "x2" assumption (DSE, 2008a; GBCMA, 2008). Relevant empirical data for testing this assumption are few, and equivocal. Ambrosio et al. (2009) concluded that the assumption was justified, if not conservative, for landholders' conservation-oriented activity. Smith's (2008) survey of revegetation projects also found a substantial amount of privately motivated and funded work, although it decreased in proportion to publicly subsidised activity to almost entirely subsidised for the latter years.

There is a considerable body of theoretical and experimental literature from environmental economics and psychology concerning the relationship between intrinsic (private) and extrinsic

motivation in the supply of public goods (Deci et al., 1999; Albers et al., 2008). This literature generally suggests a stable proportional relationship between co-funded and private activity is unlikely, because the public investment to increase the supply of restoration activity may 'crowd-out' private motivation to provide these services unassisted (Deci et al., 1999; Frey and Jegen, 2001; Bowles, 2008; Reeson and Tisdell, 2010). The possibility of crowding-out may be particularly apt in the context of this study. In 1997 the sale of a public utility led to the establishment of the Natural Heritage Trust; the largest-ever Australian investment in environmental programs, which was largely expended as small scale devolved grants to private landholders (Crowley, 2001; Hajkowicz, 2009).

In order to learn about how public and private interests had contributed to increases in native vegetation on private land – the public policy objective – we mapped extant relict/remnant native vegetation, naturally regenerating native vegetation and revegetation using native species on 71 representative landholdings in south-eastern Australia. We interviewed each landholder in order to characterise their socio-economic profile and enterprise type; and to determine the year, type, and resourcing model for each vegetation management activity carried out on their property. Our objectives were to establish who was undertaking these kinds of restorative works, particularly with respect to public and private funding; how much of different kinds of works landholders were undertaking; and how private investment may have changed over time in response to a substantial increase in public investment.

2. Material and methods

2.1. Case study areas

This study was located in three case study areas (Muckleford, Chiltern–Springhurst and Longwood Plains–Violet Town) in northern Victoria, Australia (a map is provided in [Supplementary Material](#)). These were broadly transitional, fragmented zones, which occurred between extremes of largely intact forest and relictual landscapes (*sensu* McIntyre and Hobbs, 1999) in the Goldfields, Victorian Riverina, and Northern Inland Slopes Bioregions, as defined by associations of landform, soils and vegetation (NLWRA, 2001). The socio-economic character of these areas has been broadly characterised as 'rural amenity' and 'rural transitional' (Barr et al., 2005). Formerly dominant farming practices such as livestock grazing are decreasing in area and intensity, whilst rural residential, peri-urban, wine and olive growing, and hobby farm uses are increasing, and pushing land values beyond their value for extensive grazing (Barr et al., 2005; Costello, 2007). Transitions from cropping and grazing to hobby farming and residential use via subdivisions are more common in the Muckleford and Chiltern–Springhurst case studies, whereas Longwood Plains–Violet Town retains a stronger focus on primary production.

Each of the case study areas has received considerable public investment aimed at vegetation protection and enhancement on privately owned land. Two main activities are used to increase native vegetation extent; the protection or enhancement of extant native vegetation; and the revegetation of formerly cleared land with indigenous species. Over recent decades these landscapes have also seen considerable spontaneous regeneration due to fewer producers, and a shift towards more intensive use of a smaller proportion of land area (Crosthwaite et al., 2008; Kyle and Duncan, 2012).

2.2. Selection of participants

We interviewed 71 landholders across the 3 case study areas with landholdings greater than 5 ha. We strove to include a broad

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