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Using ecosystem services to underpin cost–benefit analysis: Is it a way to protect finite soil resources?

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ABSTRACT

Urban encroachment onto versatile land is a global challenge, and as the pressure to develop this land mounts there are moves to assess the broader impacts of these decisions. One common decision support tool for policy decisions is cost–benefit analysis (CBA), and despite criticisms of the approach it enjoys widespread use. Using a case of urban development onto versatile rural land in New Zealand, two issues relating to the use of CBA are tackled – the monetisation of all values and what values to include – along with a discussion of irreversible decisions. To identify which costs and benefits to include in a CBA we provide a structured process using an ecosystem services framework early in a CBA to provide a comprehensive means to identify and justify the costs and benefits to include. Using members of the community to decide which ecosystem services are most important for a given context allows more robust deliberation of values and what to include in the CBA. To demonstrate the *value* of non-market values (e.g. regulatory services) we use soil characteristics. Our assessment demonstrates the challenges facing decision-makers and ongoing methodological shortfalls as CBA approaches are applied to non-substitutable resources and irreversible decisions.

1. Introduction

Since the 1970s the use of cost–benefit analysis (CBA) to inform decision-makers has increased, and in some places any decision must be supported by a formal CBA process (Hanley, 2001; Business Council of Australia, 2012; Murray, 2013; Australian Government, 2014). CBA, as defined by Kelman (1981), is simply systematic thinking about decision-making. It is a process for identifying, valuing, and comparing the costs and benefits of a project, policy, or decision (Buncle et al., 2013) and is used as an analytical tool around the world (Adler and Posner, 1999; Hanley, 2001; Shapiro, 2011; Australian Government, 2014; Turnpenny et al., 2014; New Zealand Treasury, 2015).

The primary objective of a CBA is to determine whether the benefits of a project, policy, or decision outweigh its costs, and by how much relative to other alternatives (Buncle et al., 2013). A CBA process forces the decision-maker to consider or identify all the related costs and benefits of a project, policy, or decision, including potential impacts on human lives and the environment (Buncle et al., 2013; Pearce et al., 2006; Hanley, 2001). Thus, CBA encourages consideration of cause and effect in relation to the project, policy, or decision (Murray, 2013).

There remains debate about the role of CBA, however. Kelman (1981) argues that the validity of CBA is based on moral philosophy, and others note that CBA has been developed based on the values of a small, not necessarily representative, sample of people, which may not be morally sound for all cultures and people (Henrich et al., 2010). It is criticised for producing morally unjustified outcomes, or for not producing morally relevant information, but Adler (1998) contends that CBA is a decision procedure, not a moral standard.

1.1. Monetisation of all values

In the early days of CBA the environment (or environmental values) was largely thought of as incommensurable, such that it could not be measured in monetary terms, and so the omission of environmental values within a CBA was not seen as a major deficiency (Pearce, 1998). Difficult-to-obtain data – especially for valuing environmental resources, human life, and other hard-to-measure goods – continues to be a problem for CBA (Adler and Posner, 1999; Baveye et al., 2016). How to incorporate different types of values has been a topic of debate. Some practitioners feel that

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CBA should be done with all costs and benefits expressed in a common measure, typically dollars (Kelman, 1981; Murray, 2013). The argument for using monetised values is that it makes it easier for decision-makers to monitor a project or policy than when qualitative information is used. Some authors argue that qualitative information on environmental values carries less weight and is likely to be ignored or excluded (Adler and Posner, 1999; Hanley, 2001; Gómez-Baggethun et al., 2010; Eppink et al., 2016). Attempting to reduce everything to monetary terms, however, means that much of the richness of the understanding of a project's or decision's effects could be lost (Murray, 2013).

Although some authors insist on the use of monetary values (Adler, 1998) to compare projects, policies, and decisions, others are opposed to putting a dollar value on things that are not normally bought and sold in markets, because these goods are intangible (Kelman, 1981; Prest and Turvey, 1965). Intangible items are "priceless", and any market value we place on these goods tells us little about their social value (Ackerman and Heinzerling, 2004). It is difficult to measure the value of the intangible aspects of ecosystems because these values belong to the cognitive and emotional realm of human beings, and individuals may be unable, or may decline, to monetise these values (Spash, 2006). As a result, these items are likely to be undervalued in analysis. Also where ecosystems are approaching critical ecological thresholds and the services provided become non-substitutable and scarce then value (i.e. willingness to pay) increases making economic valuation less meaningful (Farley, 2008). There are also challenges where unequal societal wealth distribution leads to vastly different valuations resulting in an under-provision of services to those with lower incomes (Spash, 2008), as well as the ability to aggregate values on a single scale of measurement (Wegner and Pascual, 2011; Samarasinghe et al., 2013).

While CBA practice tends to monetise all values, some CBA guides and authors (e.g. Adler and Posner, 1999; Hanley, 2001; Murray, 2013; Australian Government, 2014; New Zealand Treasury, 2015) acknowledge that not all costs and benefits are feasibly monetised, and these non-monetised costs and benefits are included in a CBA alongside the monetary values.

We agree that non-monetised costs and benefits are important and should be presented to decision-makers alongside the monetary CBA calculations (Prest and Turvey, 1965). However, the inclusion of environmental impacts in a CBA is complex. Efforts have been made to value and internalise economic impacts on the environment into decision-making (Krutilla, 1967; Gómez-Baggethun et al., 2010). However, it is often the case when considering environmental impacts in CBA that a complete list of costs can be collected but information on benefits is incomplete (Prest and Turvey, 1965; Ackerman and Heinzerling, 2004).

1.2. Irreversible decisions

Even when it is possible to obtain monetary values, there are various limitations to applying a CBA approach where costs and benefits accrue over very different time horizons (Wegner and Pascual, 2011; Baveye et al., 2016). Common practice is to discount future benefits to obtain a present value. Discounting, however, effectively renders the time beyond the discounting period invisible, and in doing so diminishes consideration of the welfare of future generations. Discounting is particularly challenging in the case of irreversible change and where there are intergenerational welfare implications (Sumaila and Walters, 2005). If we irreversibly lose an ecosystem service, then even if we invest the dollar-equivalent present value of the benefit that service provides in the future, we cannot use the invested money to recover that service in a later period (Ackerman and Heinzerling, 2004). Some even believe there is a case for the use of negative discounting when considering damage to natural capital for the gain of current generations at the expense of future generations (Goodin, 1982; Hall, 1990; Gowdy et al., 2010; Fisher and Hanemann, 2012), particularly when the value of the irreversibly lost ecosystem is likely to increase (Porter, 1982; Angelsen, 1991).

High-quality versatile soils fall into the category of ecosystems whose value is likely to increase. Given the relative scarcity of versatile land for agricultural production (particularly horticultural production) compared to the availability of land for housing, as well as increasing concerns over global food security, this is expected to lead to greater scarcity and food values in the future (Rosegrant and Cline, 2003). This means the value of agricultural land is likely to rise significantly, indicating the option value for agricultural land (Capozza and Helsley, 1990; Angelsen, 1991). Although option values are difficult to quantify, they should be acknowledged in urban development decisions.

1.3. Costs and benefits to include

There has been much debate in the literature about whether costs and benefits should be monetised, but there appears to be less attention paid to exactly what benefits or costs to include in an analysis. CBA guidance is often vague on this issue and does not provide a systematic method for selecting the most important costs and benefits (see, e.g., Asian Development Bank, 2013; Buncle et al., 2013; New Zealand Treasury, 2015). Arguably this is an important component in any analysis, because it identifies and provides a rationale for those values (either as a cost or a benefit) that are important to a decision, and where effort should be taken in collecting the relevant information. It is only at this point that any decision about whether to monetise all or some of the values should be made.

Given the time and cost of undertaking these types of analysis and the budget constraints of many agencies, focusing on the most relevant costs and benefits is also more efficient and prudent. Targeted prioritisation of key costs and benefits is important, particularly in environmental and ecological contexts, where key values are often intangible or difficult to value and therefore potentially overlooked. An ecosystem services framework (see Table 1) is a useful tool when identifying values provided by nature and ecosystems (Greenhalgh and Hart, 2015). Therefore, we propose using an ecosystem services framework in the early stages of CBA, where natural capital is affected, to identify key values relevant to the decision at hand.

The use of deliberative processes in CBA has been advocated to improve the validity of decisions and reduce reliance on potentially out-of-touch bureaucrats (Nou, 2008). Using a structured framework, such as an ecosystem services framework, becomes more helpful in deliberation, because without a guiding framework such processes are typically *ad hoc* and key values can be missed (Greenhalgh and Hart, 2015).

In this paper we use a case of urban development onto versatile rural land to tackle two critiques of and challenges to CBA – monetisation of all values and what values to include – and discuss another challenge – accounting for values related to irreversible decisions. In response to Wegner and Pascual's (2011) call for more deliberative approaches, we also offer an option for incorporating more deliberative approaches into CBA practice. To identify which costs and benefits to include in a CBA, we provide a structured process through the use of an ecosystem services framework in the early stages of a CBA to provide a comprehensive way to identify and justify the costs and benefits to include. Using members of the community to decide which ecosystem services are most important for that context allows a more robust deliberation of values and what to include in the CBA. To demonstrate the *value*