Markets for ecosystem services: Applying the concepts[#]

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Abstract

In recent times, use of market-based instruments to facilitate enhanced protection or production of ecosystem services has achieved a high public profile. However, much work remains to apply these tools in practice. Particular issues include definition and measurement of ecosystem services, development of institutions and mechanisms to facilitate trade and integration of these instruments into the broader natural resource management agenda and toolbox. In this paper these issues are explored with respect to pilot markets for ecosystem services in three case study catchments. Emphasis is placed on pilot selection rationale and identification of key facilitative mechanisms and institutions.

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1. Introduction

Ecosystems provide many 'services' from which humans benefit. Recent research undertaken by the Ecosystem Services Project at CSIRO has identified the importance of these values generated to Australian communities. However, the systems generating many ecosystem services are degraded, poorly managed or subject to a variety of threats resulting in a reduction in our quality of life or increased production costs. Most ecosystem services are public goods within the current institutional structure and thus cannot be bought or sold. As a result there are few incentives for landowners to invest in their production and maintenance.

As with other public goods, a traditional response has been to turn to governments for continued supply of ecosystem services through regulation, cost sharing and other mechanisms driven by government redistribution of resources. However, the same issues that make many ecosystem services public goods mean that many of the services are not easily amenable to prescriptive regulatory approaches. These issues include how to define and measure property rights, monitor outcomes and design regulations or exchange mechanisms to achieve these outcomes. Moreover, the roles and values of ecosystem services are context dependent, varying from place to place, and monitoring is expensive. Given the difficulties governments face in ensuring production of ecosystem services, and the importance of ecosystem services, many policy alternatives should be examined. One option is to explore the use of market-based instruments (MBIs).

Markets are used to supply many essential items in our lives including food, clothing and shelter and are the mechanism by which landowners are rewarded when their land produces valuable ecosystem goods such as food and fibre products (even when their production reduces the production of other ecosystem services such as water quality protection). Markets work well at providing rewards – and markets for ecosystem services may prove to be one way of rewarding and encouraging land managers to protect and produce ecosystem services.

The paper is structured as follows. In the next section a definition of ecosystem services is provided together with further discussion of the policy context and research problem. The third part of the paper is focused on the economic concepts that frame consideration of MBIs. The development and application of a framework for applying the theoretical concepts within a regional case study context is described in section four. The resultant 'best bet' market opportunities for the 'Markets for Ecosystem Services' project are briefly described in the fifth part of the paper. A set of conclusions drawn from the preliminary application of these processes is summarised in the final part of the paper along with an overview of future research.

2. Background

2.1 What are Ecosystem Services?

The importance of ecosystem services goes back to the time of Plato and likely well before that. Only recently, however, has the concept gained traction with the broader research, policy and natural resource management community. An 'ecosystem' is defined as the array of organisms, found in a definable space where interactions among the organisms and with their non-living surroundings take place (Heal et.al. 2001). A potted plant, a paddock and a rainforest are all examples of ecosystems in different places and at different spatial scales. Interactions amongst system components produce outputs, many of which are inputs to other ecosystems and beneficial to humans. The concept of services literally means doing work for the direct or indirect benefit of another; or transformations of raw products into products of greater value (Binning et.al. 2001). [1]

Ecosystem services represent the transformations of natural assets (soil, water, biota) into 'products' of value to humans. A widely accepted definition of ecosystem services is "the conditions and processes through which ecosystems, and the species that make them up, sustain and fulfil human life" (Daily 1997 p.3). While the anthropocentric nature of ecosystem services may seem arrogant, it is this explicit emphasis on benefits to humans that helps to identify their importance in a policy context. Examples of important ecosystem services in Australia include:

- provision of clean water;
- maintenance of liveable climates and atmospheres (carbon sequestration);
- pollination of crops and native vegetation;
- fulfilment of people's cultural, spiritual, intellectual needs; and,
- provision of options for the future, for example though the maintenance of biodiversity.

The fact that ecosystems are continually in flux complicates the identification and management of an optimal ecosystem (as perceived by humans). It can also be difficult to identify the scale at which one considers ecosystem services. For example, interactions between bacteria and minerals contribute to the development of soil (local scale), while plants photosynthesising the suns rays help to maintain the atmosphere within limits tolerable by humans (planet scale). To help address this issue, various researchers around the world have provided classifications of ecosystem services. (Daily 1997) provides a widely accepted classification that has been adapted and applied by researchers in Australia (See Box 1). As the scale or breadth at which an ecosystem is analysed narrows, the number of interactions and resulting emergent properties and outputs are reduced, thus simplifying analysis.

Box 1: The Ecosystem Services Project

The Ecosystem Services Project was instigated in 1999 by CSIRO with funding from The Myer Foundation. The goal was to 'change Australia's thinking about natural resource management'. The goal is being achieved through: increasing awareness and understanding of ecosystem services amongst decision makers and society in general; exploring the economic and other values of ecosystem services in natural resource management; and, investigating possible mechanisms and new institutional arrangements that better recognise, use and protect ecosystem services.

[1] Despite the acceptance of ecosystem services being based on the economic concept of services they are not equivalent. Services in an economic concept generate direct values to recipients – for example, a lawn mowing business. However, ecosystem services are the transformations or processing of raw products by ecosystems that may eventually lead to an outcome of value to humans.

The Ecosystem Services Project (due for completion in mid 2003) involves collaborators and participants from all over Australia, and international collaborators from around the World, and consists of four main elements. Taking a case study approach, the process involves:

- conducting a semi-quantitative 'inventory' of the full range of ecosystem services present in an area, a catchment for example, and ranking their relative importance;
- identifying a set of plausible future scenarios closely tied to real decisions and challenges facing decision makers;
- completing quantitative and qualitative economic and ecological analysis of the various scenarios and their impacts on key ecosystem services identified in the inventory; and,
- analysing the institutional arrangements and beginning the process of exploring new institutions for protecting and securing greater value from ecosystems.

For more information see: www.ecosystemservicesproject.org

2.2 The policy context and research problem

Given their significance, one might expect that ecosystem services would be prized by markets and explicitly protected by the law. With few exceptions, however, neither has been the case. Despite their obvious importance to our wellbeing, ecosystem services have largely been ignored in both domestic and international law and policy. Ironically, our major environmental laws' inability to protect ecosystems is intentional, for protection of ecosystems was not a primary objective when the laws were drafted. For example, pollution laws generally rely on human health-based standards (focusing on pollutant levels in air or water). Conservation laws are either species-specific or must accommodate multiple and conflicting resource uses. Of course, parts of these laws, such as restrictions on clearing native vegetation, clearly can conserve ecosystem services. The point, though, is that these laws were not primarily intended to provide legal standards for conservation of natural capital and the services that flow from it and, in practice, they usually do not.

While specialised governmental institutions do pay attention to many services provided by ecosystems, their focus is primarily on the provision of these services through extensive modification of the landscape or construction of specialised facilities – that is, through 'built structures' rather than managed landscapes. For example, local officials have historically built dikes and levees to minimise flood damage rather than provide the same service through protecting or restoring wetlands. Water suppliers have generally built purification plants rather than conserve and restore forested watersheds. With the growing recognition of the threats posed by dryland salinity, greater attention is now being paid to the role of vegetation in regulating water table levels, but in many respects this is the exception that proves the rule.

Why has so little political attention been paid to conservation and protection of ecosystem services? The main reason is that the value of natural capital is unrecognized by most people. The carbon cycle, the role of wetlands as fishery nurseries, and countless other benefits provided by the natural environment are taken for granted. Even when recognised, ecosystem services tend to be ignored by policy-makers because historically they could be. They have been 'free'. Markets explicitly value and place dollar figures on 'ecosystem goods' (such as timber) that are perceived as important and limited in supply. Yet the services underpinning the production of these goods (such as soil maintenance and nutrient recycling) almost without exception have no market value – not because they are worthless or because their interruption is cost-free, but rather, because there is no market to capture and express their value directly. Until fairly recently, they were so abundant relative to human demands that such markets were not needed. As a result, no efficient price mechanisms exist to signal scarcity or deterioration of most ecosystem services. In economic terms, they are classic public goods. Their use cannot be exclusively controlled.

In some cases, it should be noted, built provision of services will prove a preferable delivery strategy, providing greater social benefits at a lower cost than investing in natural capital. In other instances, however, the net value of the joint products yielded by ecosystems will exceed that of built structures. The joint products of a wetland, for instance, can include flood control, water purification, recreation, scenic beauty, and habitat conservation. Yet with rare exception, local, state, and national governments simply do not consider ecosystems as valuable providers of services. Without explicit comparisons between natural and built provision of services, we will continue to miss opportunities where reliance on natural capital provides the lowest cost services for human welfare.

Despite the promise of investing in natural capital, there are key challenges that remain. We must develop robust methodologies for the valuation of services. Without these, how can we compare the costs of degrading an ecosystem and its service provision with the benefits of the offending activity? If ecosystem services have real but uncaptured value, what are the necessary conditions for market creation to exchange valuable services? And, critically, is the science good enough to tell us how to manage ecosystems for reliable service provision? The focus in this paper is on the conditions for market creation including whether sufficient scientific information is available.

In considering the practical implications of an ecosystem services approach, the key point to keep in mind is that land planners make decisions *at the margins*. While press reports have trumpeted the immense value of ecosystem services (up to $33 trillion for the globe) (Costanza et.al. 1997), such calculations are largely irrelevant to decision makers. Few policy decisions, thankfully, will involve obliterating an ecosystem service. Rather, such decisions are incremental. Where, along the continuum of development, land use, and pollution impacts are ecosystem services degraded and by how much? Given the complexity of ecosystem services, the responses are almost certainly non-linear. But local and regional officials must act on planning requests; it is no good to refuse to grant permits because we need more information. For example, what are the impacts of allowing 50 hectares to be cleared rather than 10 or 100 hectares? What are the impacts, instead, of clearing 50 hectares 25 kilometres away? Indeed regional land managers in Australia have been asked these or similar questions at a broad scale as part of the development of regional natural resource management plans. If, as is generally the case, we cannot provide robust answers to these important questions, then reliance on markets may provide a useful means to proceed where the can be designed to reflect community demands. Hence, the primary focus in addressing the potential for market creation is at the regional level where many of these decisions are being made.

3. Conceptual framework

Answers to questions about the research problem – namely the conditions for market creation including the level of scientific information required – should draw on and be embedded in a strong theoretical context. In this section such a conceptual framework is developed. The dominant paradigm drawn on is the field of new institutional economics.[2] It is assumed throughout this section that the community would derive a net benefit from increased production of ecosystem services. Thus the most important underpinning economic concept driving policy consideration is comparison of the alternative policy options to achieve. As will be shown, this decisions hinges on the transaction costs of the alternative policy options including MBIs, regulation and doing nothing.

The section is structured as follows. Initially a definition of essential terms is provided including property rights, markets and market-based instruments, and transaction costs. In the second part of this section a conceptual framework for the application of transaction cost concepts to MBIs is developed. This discussion is focused on the fixed and variable costs of setting up a market and the nature of the trade-offs between market scope and transaction costs. Two key interrelated areas for MBIs are definition and measurement of ecosystem services and development of structures and mechanisms to facilitate trade. These are discussed in more detail in the final part of this section.

3.1 Definitions

Property rights

Property rights over the ecosystem service(s) to be traded form a pre-requisite to market exchange. Property rights are defined as "a claim to a benefit (or income) stream that the State will agree to protect through the assignment of duty to others who may covet, or somehow interfere with, the benefit stream" (Bromley 1991 p. 2). Barzel (1997 p. 3) provides an identical, albeit refocused, definition based on the degree of protection afforded the property right holder: "*the individual's ability, in expected terms, to consume the good (or the services of the asset)* directly or to consume it indirectly through exchange." That is, the stronger the property rights, the larger the proportion of the benefit stream the individual can access and potentially trade.

To be effective, property rights must be excludable, divisible (in both space and scope), and alienable (or transferable) (Kasper and Streit 1998). Well-defined property rights can reduce transaction costs by clearly defining benefit streams thus facilitating reduced negotiation costs over the extent of rights and correlated duties (Binning and Young 1997). Property right conditions are further discussed in Section 3.2.

[2] Particularly useful references in this field include Williamson (1985, 1998), Coase (1937, 1960) and North (1992) among others.

Markets and market based instruments

A *market* is defined as is the bringing together of a buyer and a seller so that they can voluntarily trade property rights. The simplest of markets involves a bartering system while more sophisticated markets have prices and monetary exchanges. A negotiated exchange between a buyer and seller reveals a price for the commodity. This simple definition reflects the broad diversity of market structures that can exist and can be applied to a market for ecosystem services. Some important market types are described in Box 2. The strengths and weaknesses of alternative market structures will differ according to the characteristics of the ecosystem commodity being traded and the degree of market power that can be exercised by a single participant or small group of participants.

Box 2: Basic market characteristics

Some market types

Monopoly: One seller and many buyers. The single seller may be able to exert market power to discriminate between buyers.

Freely competitive market: many buyers and sellers none of whom are able to exercise market power alone or in combination.

Monopsony: One buyer and many sellers. The single buyer may be able to exert market power to discriminate between sellers.

Transaction characteristics (following Murtough, Aretino and Matysek 2002)

Non-tradeable: The property right can only be exchanged once within a specified time period.

Tradeable: Property rights may be repeatedly exchanged unless they are exhausted or otherwise consumed.

No-offsets: A specified total quantity of property rights is defined and allocated that may then be traded according to the rules of the market.

Offsets: Additional units (and thus property rights to those units) can be created by the actions of ecosystem managers according to specified rules. These units are then available for use within the rules of the market.

Market-based instruments are broadly defined as mechanisms within which property rights are voluntarily exchanged, generally using a monetary numeraire, and in which participants may be differentiated between according to the property rights exchanged or the monetary payment or both. They are intended to achieve behavioural change in a flexible manner avoiding use of prescribed behaviour or technology (National Action Plan for Salinity and Water Quality (NAPSWQ) 2002). They are generally applied where an efficiency or equity dividend over alternative mechanisms is envisaged.

Transaction costs

Allocation of property rights to ecosystem services facilitates the basis for exchange in markets. Assuming no costs of exchange, the final outcome of exchange is not dependent on the initial ownership of the property rights and full information will be revealed through trades (Coase 1960). However, the assumption of no costs of exchange is not tenable and transaction costs are pervasive in market institutions. Transaction costs can be defined as those costs that are attributable to:

i. codifying property rights, and identifying and enforcing ownership over property rights;
ii. seeking out buyers or sellers of property rights;
iii. negotiating a sale;
iv. measuring the quality and quantity of goods; and,
v. contracting specifications about the transfer of property rights. Contracting issues include when delivery will occur and the uncertainty about any intervening period and incomplete aspects of the contract.

Transaction costs are important because they consume resources that could be used for other purposes (Wills 1997). The concept of transaction costs is embedded within the new institutional economics.

3.2 Underpinning economic concepts

The initial step in policy development is to establish the goal of the policy. As indicated in the introduction it is implicitly assumed that the policy goal is to increase the production of specified ecosystem services. Only once the policy goal is established that can one assess the most efficient means of achieving it. The concept of transaction costs is vital to understanding the efficiency tradeoffs in considering the potential development of markets for ecosystem services. Markets for ecosystem services will generate net benefits to the community (over alternative measures) where their transaction costs are lower than existing mechanisms or the additional ecosystem services supplied outweigh the full costs of provision.[3] The concept of transaction costs is most commonly applied to the ongoing variable or marginal transaction costs associated with market exchanges. For example, the search, time and administrative costs associated with purchasing a property at auction. However, a major obstacle to developing markets for ecosystem services are the fixed or set-up costs associated with establishing a market for a new commodity.

Fixed or set-up costs of markets

Fixed or up-front transaction costs are primarily those associated with designing and setting-up institutions and organisations that facilitate a market. Fixed institutional transaction costs relate to the gathering of information, definition of a property rights framework and design of exchange institutions (through contract law or enactment of legislation). Fixed organisational or bureaucratic transaction costs are those incurred in setting up structures to manage and monitor market exchanges.

A set of desirable property right and exchange institution characteristics for creating markets for ecosystem services developed by Murtough, Aretino and Matysek (2002) is shown in Table 3.1. Potential market participants will incur additional set-up costs not defined in Table 3.1 in developing the required physical and intellectual infrastructure to participate in the market. In many cases the costs of defining, verifying and enforcing property rights will be prohibitive under current technologies

[3] Government and the private sector incur transaction costs. Government transaction costs comprise of information gathering, legislation actions, and implementation and administration through the bureaucracy. Private sector costs comprise direct fees or charges and costs involved in protecting and exchanging property rights. Future costs under alternative policies may be strongly influenced by the dynamic attributes that facilitate or restrict innovation.

and thus markets will fail due to high property right transaction costs. For example, the costs involved in defining and enforcing property rights associated with the role of vegetation management in regulating water tables have proven too high to date. In other cases additional transaction costs introduced by uncertainty, difficulty in identifying buyers and sellers and in exchanging the property right separately from other bundles may induce market failure. For example, who benefits from flood mitigation? How can flood mitigation be defined as a property right and exchanged separately from other land management property rights?

The fixed transaction costs associated with markets for ecosystem services are in a sense costs associated with providing a public good. This is because many fixed transaction costs are incurred in developing institutional and organisational structures that are non-rival or which have low or negligible marginal costs associated with their use by additional market participants. Therefore, while it may be theoretically possible for potential market participants to define property rights and exchange mechanisms using existing institutions (such as contract law) the upfront costs are likely to outweigh individual benefits.

Table 3.1: Desirable institutional characteristics for creating markets

Characteristic	Description
1. Clearly defined	Nature and extent of the property right is unambiguous
2. Verifiable	Use of the property right can be measured at reasonable cost.
3. Enforceable	Ownership of the property right can be enforced at reasonable cost.
4. Valuable	There are parties who are willing to purchase the property right.
5. Transferable	Ownership of the property right can be transferred to another party at reasonable cost.
6. Low scientific uncertainty[a]	Use of the property right has a clear relationship with ecosystem services.
7. Low sovereign risk[a]	Future government decisions are unlikely to significantly reduce the property right's value

[a] Low in the sense that it does not prevent a market from forming. Moderate levels of risk and uncertainty are not necessarily insurmountable barriers to the operation of a market.

Source: Murtough, Aretino and Matysek (2002) Table 2, p. xii

Variable or on-going costs of markets

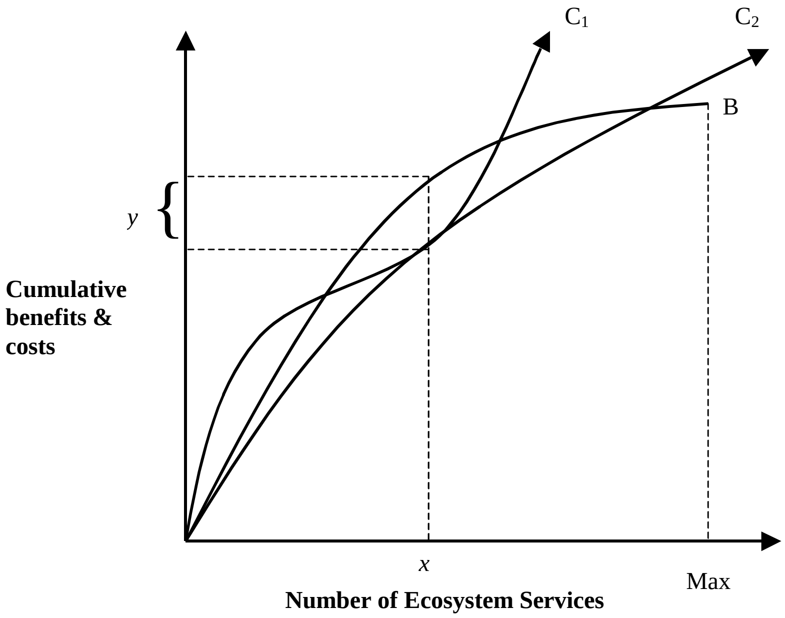
Markets for ecosystem services are subject to the same range of on-going or variable transaction costs as other markets including search, negotiation and contracting costs. Variable transaction costs are the additional transaction costs incurred in each market exchange. To some extent fixed and variable costs may be traded off. Higher fixed costs can reduce search, negotiation and contracting costs through improved property right definition and more efficient market exchanges. However, higher fixed costs may also raise the cost of market entry and thus reduce the number of participants and transactions thus raising the average transaction cost per unit exchanged.

Brokers or agencies may reduce the variable transaction costs in markets through specialisation and economies of scale across multiple exchanges in both scale and scope (see for example Binning et.al. 2002). As an example consider the role played by land trusts who effectively broker their donors demands to purchase conservation covenants over sub-sets of the ecosystem services provided by forests in the United States of America.[4] Other mechanisms can also be employed to reduce variable transaction costs such as standardised contracts and measurement systems and agreed meeting places for buyers and sellers (which may be physical or electronic).

Bundling ecosystem services and transaction costs

The concept of ecosystem services encompasses the full range of outputs from which people benefit (as discussed in Section 2.1). A common misconception is that markets for ecosystem services should correspondingly encompass the full range of ecosystem services because such services are jointly produced. However, this fails to take into account the relationship between the marginal benefits and marginal costs (including transaction costs) of including an additional commodity within a single market structure. In some senses this is a discussion of the relationship between the completeness of property right definitions and relative market efficiency.

Figure 3.1:Possible relationships between costs and benefits of markets



This concept is demonstrated in Figure 3.1. For a given joint production function (not shown), the measurement and inclusion of additional benefits is likely to increase the total benefit to society at a decreasing rate such as demonstrated by the benefit curve 'B'. Two possible cost functions associated with including additional benefits within a single market mechanism are shown as 'C_1' and 'C_2'. For simplicity the optimal number of ecosystem services included within the market is '*x*' in each case delivering a net benefit '*y*'. Only if the net benefits ('*y*') were maximised at the maximum number of ecosystem services ('Max') would all services be included. Furthermore, the net benefits may well be higher if the services were marketed in separate markets. This would be dependent on management flexibility to change the

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[4] These deals have involved easements that eliminate logging as well as those that change management practices to ensure ecosystem services are protected. See for example the New England Forestry Foundation at http://www.newenglandforestry.org/home/index.asp.

jointly produced output mix and the additional transaction costs incurred in separate markets versus the costs of brokering buyers together within a single market.

3.3 Commodity definition, measurement and internalisation mechanisms

Definition and measurement of ecosystem services

A basic question in all MBIs, though often too obvious to be asked, is very simple – what is actually being exchanged? If one considers cap-and-trade programs, for example, they all seem to share a basic feature. CFC, fisheries, and proposed greenhouse gas trading programs, for example, all exchange commodities that appear to be fungible. One molecule of CFC, kilo of halibut, or ton of carbon dioxide seems much the same as another, both in terms of identity and impact. Thus environmental markets are considered a type of commodity market, where environmental credits go to the highest bidder. Indeed environmental markets must assume fungibility – that the things exchanged are sufficiently similar in ways important to the goals of environmental protection – otherwise there would be no assurance that trading ensured environmental protection. While the precondition of fungibility may seem self-evident, this core assumption turns out to be problematic.

As an example of why fungibility matters, consider wetlands mitigation banking in the United States. This policy permits developers, once they have taken steps to avoid and minimize wetland loss, to compensate for wetlands that will be destroyed through development by ensuring the restoration of wetlands in another location. The regulations mandate trades that ensure equivalent value and function between destroyed and restored wetlands. In practice, however, most trades are valued in units of acreage. Within very loose guidelines, trades between productive (though soon to be destroyed) wetlands and restored wetlands are approved on an acre-for-acre basis. More sophisticated banks require ratios, trading development on one acre of productive wetlands for, say, restoring four or five acres of wetlands somewhere else. Counting acres may make for easy accounting, but it is poor policy.

Why? The social value of the habitat is absent from the transaction. The ecosystem services provided by the wetlands – positive externalities such as water purification, groundwater recharge, and flood control – are largely ignored. Trading acres for acres provides an inadequate measure to capture the significance of what is really being traded. To be sure, such a simple metric allows trades, but other important, unaccounted trade-offs are occurring. The program can suffer from a lack of accountability (or, more accurately, a lack of countability).

In fact, upon close inspection, it turns out that most environmental markets involve commodities and trades that exhibit a range of fungibilities. To achieve the optimal outcome from MBIs, we need to understand and account much better for the qualities being traded. To do so requires careful consideration of the measure of exchange – the currency – since in the final analysis the currency forms the very basis of the transaction. The trading currency superficially makes the commodities fungible, determining what is being traded/purchased and, therefore, protected.

Definition and measurement of ecosystem services (also known as 'currency adequacy') is an inescapable aspect of implementing any MBI. In paying farmers for the service of evapotranspiration (i.e. for planting trees to lower the water table and reduce soil salinity), for example, should the proper measure for payment be trees planted, water released by the vegetation, reduction in water table level, or soil salinity? While each of these measures is relevant, they send different signals to the farmer. Thus project design must carefully consider selection of the currency unit – and determine whether the metric can capture the significant values exchanged or whether some important features remain external to the trades.

Internalisation mechanisms

Assuming one can adequately define and measure the ecosystem service in a fungible currency, how can this be incorporated within a market-based framework? A broad overview of the mechanisms that have been used to increase the internalisation of ecosystem service benefits is provided in Table 3.2. These do not describe the full range of potential mechanisms for creating MBIs with the characteristics described in Table 3.1 and actual schemes in operation may involve combinations of differing mechanisms (with higher resultant transaction costs but potentially increased flexibility). For example, a cap and trade mechanism may also permit creation of additional credits through mitigating offset arrangements. While taxes and subsidies are considered MBIs they are not further discussed in this paper.

Table 3.2: Potential market-based internalisation mechanisms

Market mechanism	Description
Transferable permits (new or improved property right definition)	
Baseline and credit or offset schemes	Credits are created by the difference between agreed performance (which may be the status quo) and actual performance. These schemes are generally non-tradeable in the sense that any created credits can only be sold once. One example is development offsets such as wetland mitigation banking.
Cap and trade	A total number of permits are allocated specifying the right to a particular action over a specified time period. These permits are generally tradeable subject to the rules of transfer in the market. One example is the Hunter River Salinity Scheme in NSW. These schemes can also be applied to consumptive use of natural resources in which case they are often termed usage or abstraction rights.
Reducing transaction costs in markets	
Lower administrative burden	Many production systems are highly regulated with the goal of reducing the impacts of externalities. Unfortunately in some cases this can also have the impact of significantly increasing transaction costs associated with creating a market. An example is the administrative burden involved in placing a conservation covenant over parts of land units.
Improve information flows	Environmental Management Schemes (EMS) and eco-labelling schemes are designed in part to supply additional product information with the goal of including the ecosystem services impacts of production. For example, labelling on

	Banrock Station Wines is designed to market the benign influence of wine production on neighbouring wetland ecosystems.
Specialised brokerage services	Many ecosystem service markets are subject to high transaction costs that may be reduced by specialised brokerage services. An example is the revolving fund operated by the Victorian Trust for Nature that seeks to link buyers and sellers of properties supplying high levels of some ecosystem services.
Directly influencing market outcomes	
Taxes and Subsidies	Taxes and subsidies act by directly altering the prices of goods and service in markets through payments to or from government. For example, solid waste charges and load-based licensing schemes operated by the New South Wales (NSW) Environment Protection Agency.
Extended property rights	
Liability provisions	In some cases liability provisions may be extended to ensure protection of ecosystem services either directly or indirectly. One example is mining reclamation bonds held until mine sites are fully restored. A related example is deposit refund schemes where they are linked to product life-cycle liability provisions.

Note: The division between mechanisms broadly follows that used by the National Market-Based Instruments Pilots Program.

Sources: Godard (2001), Hockenstein, Stavins and Whitehead (1997) and Murtough, Aretino and Matysek (2002).

MBI implementation mechanisms vary considerably depending on the extent of change from the existing regime. While this issue is further discussed in Section 4 three areas are briefly mentioned in the remainder of this section: allocation mechanisms, exchange mechanisms and flexibility issues.

Where new property rights are created through transferable permit mechanisms an issue of how to allocate these property rights arises because of equity considerations and the impact of transaction costs.[5] As a general rule, the equity-based arguments for granting property rights based on existing use strengthen as the mechanism moves from new property rights over previously unknown commodities through definition of open access rights towards de-facto property rights and common property.

The nature of the exchange institution is important because alternative institutional structures may reduce the scale of some transaction costs and thus potential sources of market failure. As an example consider the Victorian Bushtender program. The potential market for biodiversity conservation suffers from two major problems: spatial heterogeneity of outcomes; and, asymmetric information about conservation costs. Use of an auction mechanism with appropriate information support provides incentives to potential participants to reveal information about conservation costs. Transaction costs are also reduced by limiting complete measurement and prediction of conservation outcomes to a subset of submitted bids.

[5] Transaction costs are important because they change the outcome and welfare consequences compared to a no transaction costs environment.

The efficiency dividend that is sought through use of MBIs primarily results from increased flexibility in achieving the desired policy outcome. Increased flexibility can take three forms: technological, spatial and temporal flexibility. Technological flexibility relates to the nature of the mechanisms that comply with the rules of the particular MBI. Spatial flexibility can be restricted while retaining some MBI benefits through the use of regional ceilings (termed 'bubbles') that require compliance with a regional ceiling as well as with an aggregate MBI outcome. Temporal flexibility at the individual scale can be achieved through use of banking and borrowing procedures and at the aggregate level through development of futures exchanges in conjunction with other market mechanisms. The potential importance of these mechanisms for reducing transaction costs is an important consideration in mechanism design.

4. A framework for applying the concepts

As previously described, our goal is to apply the MBI conceptual framework to potential policy applications at the regional level. The focus in the first part of the section is on identifying potential MBI policy targets at a regional level. In the remaining two parts the focus is on selection of appropriate policy options given existing regulatory frameworks and geographical, political and capacity constraints. Combining these aspects produces a MBI opportunity matrix that completes the section.

4.1 Community values and MBI policy opportunities

The concept of ecosystem services is based on the benefits generated to humans. This principle also underpins MBIs because market mechanisms can only function where there are potential gains from trade. Put simply: no value then no trades and no possible MBI. Incorporating the concept of transaction costs generates the conclusion that trades will only occur where the value of the relevant ecosystem service outweighs the transaction costs incurred in the market process. Thus MBIs are only a practical option where ecosystem services generate sufficient values to encourage trade and where transaction costs can be sufficiently minimised to facilitate market exchange. The potential for MBIs is thus likely to be maximised where the recognised values associated with ecosystem services are highest. This approach is sometimes referred to as 'picking the low hanging fruit'. However, this approach also has other advantages in that the lessons learnt in developing appropriate MBIs for these ecosystem services may reduce the fixed transaction costs associated with MBIs for less valued or widely appreciated ecosystem services.

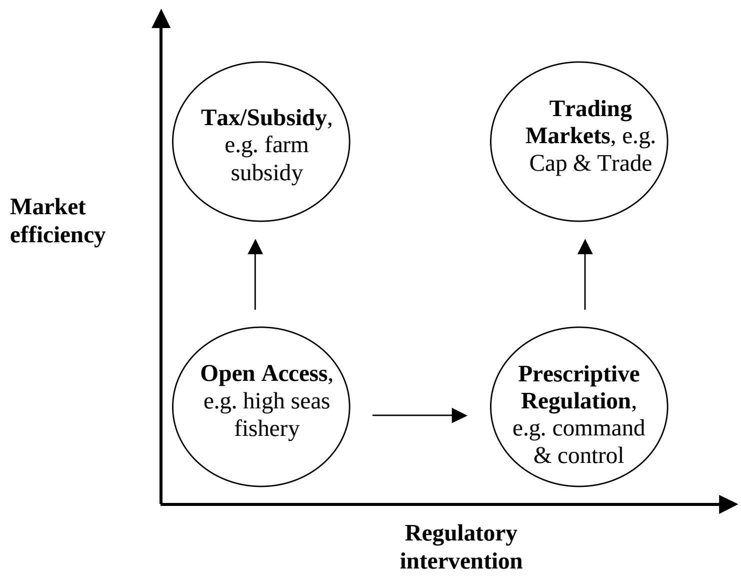
What is needed is a method for identifying the 'low hanging fruit'. Ideally the method would involve a bio-economic modelling procedure that would estimate the scale of benefits from increasing the provision of the relevant ecosystem service(s) and comparing these to the costs of production. Ecosystem services that are likely to generate the highest benefits to the community could then be selected for further research. However, such an approach is costly in terms of the time and other resources consumed. This approach may be avoided where communities have already identified priority ecosystem services using other decision mechanisms.[6] For example, most regional communities in Australia, particularly target regions under the NAPSWQ, have undertaken extensive natural resource management planning processes. Others have even more extensive information resources as the result of compiling an ecosystem services inventory.[7] The outputs from these processes include targets for a wide range of outcomes that are provided by continued or increased production of ecosystem services. These targets are a starting point for identifying potential MBI opportunities at the regional level.

4.2 Policy options and nature of policy problem

Policy is not implemented in a vacuum. No policy instrument or reform is truly ‘new’ since it must be superimposed over existing rules, regulations and customs. Thus in crafting policy instruments, it is helpful to think of them as complementing the *status quo*. One must consider not only the proposed policy instrument (e.g., a cap-and-trade pollution market) but the current state of affairs, as well, for this will dictate the policy opportunities. In this paper the *status quo* refers to the existing regulatory environment.

To make this clearer, think of policy instruments operating along two axes – increasing market intervention and increasing regulatory intervention. In this context (depicted in Figure 4.1), one can identify four archetypal cases, each of which suggests different policy opportunities.

Figure 4.1: Relationship between regulation and market interventions



Open access: This situation is found in the bottom left of Figure 4.1, and represents the case of minimal market and regulatory intervention. Think of an open access ocean fishery where fishers can harvest as many fish as they are able, or groundwater, or oil. This is often known as the setting for the ‘tragedy of the commons’, where ever-increasing pressure on the resource will eventually lead to its over-use. A full

[6] Using the output from other decision mechanisms may carry costs because less information is available about the nature, scale and distribution of the values generated to the community.
[7] See for example Binning et.al. (2001) for the Goulburn-Broken Catchment in Victoria.

range of policy instruments can be used to address this problem, ranging from direct government regulation (e.g., restricting fishing capital) and taxes (per boat) to property rights (fencing the resource to facilitate individual management) and markets (creating tradeable rights to fish).

Prescriptive regulation: This category is found in the lower right part of Figure 4.1, and is characterized by government rules that set out what, when, and how much of an activity a regulated party is allowed to undertake. Sometimes called 'command-and-control regulation', this approach can always include more regulation, but often at a cost of efficiency. It can also be coupled with taxes and subsidies (such as load based licensing in NSW) or form the basis for an environmental trading market (moving to the upper right of the graph).

Tax/Subsidy: This policy approach is found in the upper left of Figure 4.1, where behaviour is modified by direct economic incentive. The greatest MBI potential here lies in more tightly linking payments with performance, as in the NSW load based licensing scheme.

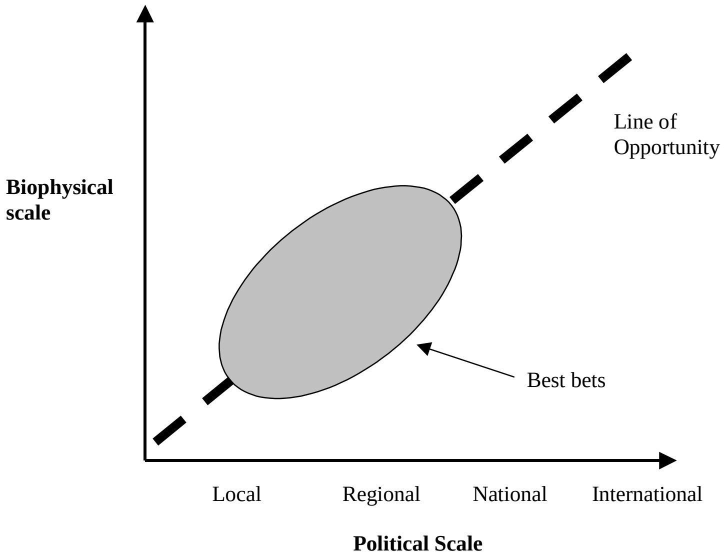
Trading Markets: This strategy is found in the upper right corner, where regulation and market instruments are combined to create a market for an environmental good (or bad). The basis for trading environmental commodities is a regulatory proscription of behaviour followed by regulatory permission of the behaviour under controlled conditions. In establishing a market, the government first creates a new form of property - legal entitlements to emit pollutants, catch fish, develop habitat - and then imposes a set of rules governing their exchange. All trading programs therefore take place within carefully constructed markets. Absent legal restrictions on pollutant emissions, fish landings, or wetlands development, and the creation of alienable entitlements to these activities, few if any trades would take place. Put another way, one cannot move directly from the left (either from tax/subsidy schemes or open access) to the upper right part of the graph. One must set in place prescriptive regulations before creating a trading market for the simple reason that regulations create the demand from which scarcity flows.

4.3 Matching scale, scope and capacity

Policy is not only generated within existing rules, regulations and customs but also within constraints and opportunities provided through existing political structures, biophysical constraints and physical, financial and social capitals. Thus one must consider these contextual attributes in assessing whether the policy opportunity and the policy instrument can be adapted to achieve the desired outcome.

As a two-dimensional example of the trade-offs involved, consider the political and biophysical constraints trade-offs shown in Figure 4.2. The 'line of opportunity' shows where political structures and the physical extent of the ecosystem services under consideration are aligned. Hence, the 'best bets' for regionally or locally driven MBIs that are the focus of this research will be located in the shaded area. As an example, consider management of the service of water purification. The biophysical scale is the watershed. If, as in most cases, the political authority over land use exists at a smaller scale (such as cities and towns within the watershed), then management will be made difficult by the transaction costs of reaching agreement among these authorities. If there are no local authorities and the political power rests at a national or state level, management might be easier but the problem will be one of focus, as parties vie for the attention and resources of the central body. Success will be most likely where the political boundaries track the watershed boundaries, as is the case to some extent in catchment management authorities in Victoria and New South Wales.

Figure 4.2: Matching geographic and political opportunity



Similar lines of opportunity can be drawn for trade-offs between other contextual attributes and a zone of ‘best bet’ opportunities can be conceived in a multi-dimensional space. Opportunities that lie outside the ‘best bets’ zone will have higher transaction costs associated with MBI development but may remain viable if the target ecosystem service is sufficiently valuable. For example, despite global warming being an international problem, a sub-set of the international community is currently pursuing an independent solution (with associated transaction costs likely to be higher).

The success of MBIs at the local or regional scale is likely to be particularly dependent on trade-offs involving local capacity and willingness to participate (which may be interrelated). The costs involved in overcoming local opposition to MBI solutions may be large, particularly if the community is not ready to trial new solutions. Furthermore, costs involved in overcoming such opposition can be viewed as dead-weight losses because they do not directly contribute to the institutions required to facilitate MBIs such as definition and measurement of property rights (which can be viewed as investments in institutional capital). Local community capacity constraints can also be critical where they lead to poorly managed or flawed MBI solutions and desired outcomes are not achieved.

4.4 MBI opportunity matrix

Combining the conceptual framework discussed in section 3 with the application issues discussed in previous parts of section 4 yields an opportunity matrix such as that shown in Figure 4.3. The opportunity matrix allows potential MBI opportunities to be described and compared in a qualitative fashion in order to select ‘best bet’ or 'low hanging fruit' opportunities for further research in an environment of limited resources.

Figure 4.3: MBI opportunity matrix

Opportunity	Outcome Potential	Prop. Rights Issues	Exchange Institutions	Constraints

Based on criteria such as: impact/effectiveness/efficiency compared to current programs and value of ecosystem service(s).

5. 'Best bet' MBI opportunities

The 'Markets for ecosystem services' project is currently being undertaken in three case study regions:

- The Goulburn-Broken Catchment in Victoria;
- The Murrumbidgee Catchment in New South Wales; and,
- The Blackwood Basin in Western Australia.

In each of these regions the MBI opportunity matrix is being applied in conjunction with the case study partners to identify potential 'best bet' MBI opportunities. Several additional opportunities are also being considered within the boundaries of the project in collaborative arrangements with other researchers.

While the process of identifying 'best bet' MBI options is not yet complete, the initial opportunities have been highly prioritised and are being further investigated. In Table 5.1 two 'best bet' MBI opportunities are described for each case study area including the location of the pilot, the ecosystem service being addressed and some important considerations in MBI selection and design.

Several generalisations can be drawn from the 'best bet' options. The biophysical information about the relationship between management and outcomes is a major deficiency in most cases with consequent uncertainty about potential outcomes. Information asymmetry is also a feature of many of the potential pilot opportunities. Identifying where these concerns preclude use of MBIs and the nature and cost of obtaining additional information will be an important aspect of the research undertaken in the 'Markets for ecosystem services' project.

Table 5.1: Potential 'Markets for Ecosystem Services' pilot projects

Location and target	Possible mechanism	Important considerations
Goulburn-Broken Catchment		
Murrindindi Shire Council – targeting ecosystem services impaired by development on rural lands.	Baseline and credit applying to specified impacts of rural development such as water quality and biodiversity impacts.	• Allowing offsets could increase flexibility in meeting goal of retaining services – especially if specialised 3rd parties involved. • Offset targets will be explicitly linked to regional targets thus integrating the MBI into a regional process. • Offsets will induce increased transaction costs in the development application process could delay or reduce other benefits of development to the community – especially in competition with neighbouring shires. • Difficult to define appropriate currencies.
Mid-regions of Goulburn-Broken catchment – targeting external salinity impacts of on-farm water management.	Still being considered – must facilitate private sector contributions and likely government co-payment. Likely to involve a combination of market structures such as an auction and annuities.	• There may be complex trade-offs between differing forms of market failure (for example differential discount rates and externalities) making identification of external impacts difficult. • Only near viable management tool is deep-rooted perennial vegetation with highly uncertain long-term market outcomes. • MBI will need to deal with significant information asymmetries relating to costs of abatement and outcomes from change.
Murrumbidgee Catchment		
Coleambally Irrigation Area – targeting common property problem from irrigation induced salinity	Cap and trade applying to net recharge of groundwater aquifers from irrigation.	• Uses scientific information to apply a point-source solution. • Transaction costs of implementing and managing system may be high due to measurement and monitoring costs. • Water market familiarity means lower transaction cost trading mechanism. • Coupling with an offset framework would increase flexibility and may encourage innovation in net recharge management.
Mid-regions of catchment – targeting external in-stream salinity impacts of on-farm water management.	Still being considered – likely to involve a combination of market structures such as an auction and annuities.	• Known sub-catchment salt sources but increased complexity and costs to identify specific sites. • MBI will need to deal with significant information asymmetries relating to costs of management change and outcomes from change. • Spatial heterogeneity of salt sources means relatively few participants. • Only near viable management tool is deep-rooted perennial vegetation with highly uncertain long-term market outcomes.

Blackwood Basin		
Road infrastructure - targeting protection of road segments from salinity impacts.	Baseline and credit via individual negotiated payments for desired management change.	• Can future salinity impacts be identified with sufficient certainty to facilitate protection measures being taken? • What is the certainty associated with the protection measures? • What is the cost of obtaining sufficiently detailed information? • Mechanism design will need to take into account the significant costs of bilateral negotiations.
Basin wide review of existing incentives to identify MBI opportunities	Unknown – could involve a baseline and credit mechanism facilitated through an auction.	• How do MBI transaction costs compare with current allocation methods? • Is sufficient information available to facilitate an MBI over an input subsidy or flat side-payment? • Is the market sufficiently large enough to facilitate a MBI solution?
Other potential opportunities – indicative information provided only		
Desert Uplands (Central Qld) – corridor retention following clearing	Multi-stage auction process likely to be combined with bilateral negotiations.	• Facilitated by the Desert Uplands Build-up and Development Committee in collaboration with QLD EPA, Central Queensland University and CSIRO. • Critical issue is how to best manage bids whose values are in part dependent on neighbouring bid characteristics. • Difficulty defining appropriate measures of biodiversity impact given information constraints.
Fitzroy Basin Qld – Regulation/MBI tradeoffs in nutrient management	Not an MBI as such but will provide information on how best to structure MBIs.	• Facilitated by The Central Queensland University in partnership with several regional organisations and CSIRO. • What information is required to design an appropriate policy framework? • At what combinations of regulation and participant heterogeneity do MBIs become the most efficient means of achieving specific outcomes?
Location yet to be fixed – reducing market failure due to risk and knowledge gaps	Fund to leverage private investments via an individual negotiation process.	• Facilitated by Greening Australia. • Where do gaps between perceived and real risks occur? • What is the availability of information about risks? • How should risks be split for appropriate private management incentives?

6. Conclusions

Ecosystems produce a range of services that benefit individuals both directly and indirectly. With few exceptions, though, these ecosystem services are neither prized by markets nor protected by the law because they have been taken for granted or are not amenable to market commodification. Many potential markets for ecosystem services have not emerged in this environment because of the high transaction costs – particularly where many of the desirable institutional characteristics for creating markets are not met. In particular the fixed or up-front costs of market creation which have public good attributes are a major obstacle to market creation. Identifying ways of minimising these transaction costs is an important consideration in developing markets for ecosystem services.

In this paper a framework for applying the concepts underpinning MBI creation at the regional level has been described. The framework involves identifying the 'best bets' or 'low hanging fruit' to which MBI mechanisms may be suited. These 'best bets' will be those ecosystem services that generate a high value to the community or a subset of the community. They are likely to lie in a zone of opportunity determined by the trade-offs between political structures, biophysical constraints and physical, financial and social capital. Finally, the characteristics of the 'best bet' ecosystem services will need to be such that other causes of market failure such as information asymmetries and inadequate biophysical information to link cause and effect can be overcome.

A number of preliminary 'best bet' opportunities are identified in section 5 of this paper. These opportunities have been selected based on the available information about ecosystem services in the target regions and discussions with partner community organisations. The immediate steps in the 'Markets for Ecosystem Services' project are to:

1. gather additional information about the value and function of the targeted ecosystem services;
2. identify potential policy mechanisms available including market creation and other options; and,
3. develop potential MBI mechanisms to 'proof of concept' stage. This phase will include identifying important sources of transaction costs and whether these are likely to be overcome at reasonable cost. Funding to implement potential pilot projects that remain likely to succeed will then be sought.

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