Draft

Market for Ecosystem Services in Australia: practical design and case studies[#]

Dr Stuart Whitten*; Mr David Shelton*

Abstract

The use of market-based approaches to provide and protect ecosystem services in has gained significant attention in Australia. Unfortunately the novelty of market-based approaches has seen them proposed for all manner of environmental problems for which they may or may not be appropriate. In this paper we detail three emerging MBIs in Australia, representing a typology of market-based approaches, and the factors we consider critical to their success. In particular, we focus on the analysis that underpins effective market-based instrument design and implementation. Market-based approaches to ecosystem service provision are not about a market for every service, or the case of right market, right time, right place, but rather the careful selection and design of an appropriate instrument given the ecosystem service outcomes desired, while meeting the needs of participants.

1 Introduction

Market-based instruments (MBIs) as applied to ecosystem services are relatively new mechanisms in the Australian and the international policy context. The novelty of MBIs has seen them proposed for all manner of environmental problems for which they may or may not be appropriate. In particular, MBIs have been promoted as being lower cost, more flexible, able to source new investment, and more focused on ecosystem service outcomes than existing instruments. The apparent success of measures such as the SO_x and NO_x markets in the US appears to validate these claims. However, other markets have not been so successful such as the Sydney Futures Exchange foray into carbon markets.

In this paper we detail some emerging MBIs in Australia and the factors we consider critical to their success. Our view is that the MBI success is largely dependent on the rigour with which MBIs have been designed and implemented. That is, MBI success is not simply the right instrument at the right time in the right place. Rather, MBIs are not always appropriate and they must be carefully designed to meet the needs of all participants. In particular, it is important to identify the presence of participant heterogeneity as the key driver of gains from trade that underpin any MBI application and to identify the range of market failures present for which effective solutions must be designed. That is, selection of MBIs and consequent shaping of broad MBI structures to detailed application will require careful consideration of the underpinning theory.

* CSIRO Sustainable Ecosystems
[#] Funding Acknowledgement: CSIRO Sustainable Ecosystems; Rural Industries Research and Development Corporation; Joint Venture Agroforestry Program.

In this paper we report on the design process for three Australian MBI applications that are in the process of implementation or being considered for implementation. These applications are a competitive tender to reduce salinity in the Wimmera catchment in Victoria, development offsets to manage the ecosystem services impacts of rural residential and hobby farm development in Murrindindi Shire in Central Victoria, and effective mechanisms to improve the Australian native seed market via reduced information failure and improved market place. In each case substantial attention has been paid to identifying the suitability of a MBI solution and in mechanism design to apply the MBI in practice.

The paper is set out as follows. In the next section the background to broader MBI application is set out via a description of the broad policy issue and a typology of the MBI solution. The third section contains a brief synopsis of the tools and techniques that we have applied to the investigation, selection, and finally the design of an appropriate MBI in each of the case studies. A description of the case studies and the process involves follows in section four in some detail for the competitive tender application in the Wimmera catchment. Space constraints limit the discussion of the remaining two case studies to a brief summary of the important selection and design elements. A brief discussion of the importance of care and attention to detail in the MBI selection and design process completes the paper.

2 Background

2.1 Poor Provision of Ecosystem Services.

Starting with European settlement and continuing today, Australia has been undergoing a long period of land clearing and other forms of development. The clearing of native vegetation to establish pastures and European-based agriculture has degraded ecosystem service provision, with negative impacts including salinisation, soil acidification, biodiversity loss, reduced water quality and erosion. One cannot begin to understand dryland salinity, for example, without realising the impact that widespread tree clearing has had on the ecosystem service of evapotranspiration and regulation of water table levels. Despite their obvious importance to our wellbeing, ecosystem services have largely been ignored in both domestic and international market, law and policy.

Most laws and policies were simply not designed to protect ecosystem services, although some have indirectly. Existing markets have ‘failed’ to conserve of ecosystem services because they do not send signals that encourage participants to use and manage natural resources sustainably. That is, the full costs of production decisions are not reflected in the market price paid for most products. A simple example is producing a ton of wheat, the price paid for the wheat does not include any costs of using up environmental resources or causing environmental degradation.

The overarching causes of market failure can be categorised into three types:

- **Incomplete property rights** – Individuals or other actors do not bear the full costs, or receive the full benefits, of their actions (often termed negative/positive externalities).
- **Public Goods** – Public goods are characterised by two features. Firstly, my consumption of the good does not diminish your consumption of the good (termed non-rival). Secondly, public goods are non-exclusive, that is, I can’t prevent you from using the good. Many ecosystem services are either classic public goods, or exhibit public good attributes.
- **Information** – This form of market failure is the result of a lack of important information such as knowledge about ecosystem services production processes, or the information needed for efficient management being held by only one party (termed asymmetric information).

2.2 Markets for Ecosystem Services

The historical abundance of ecosystem services has led to little practical or political attention being devoted to their protection until recently. As a result, few mechanisms exist to signal scarcity or deterioration of most ecosystem services. One potential mechanism for signalling the importance of ecosystem service provision is via market mechanisms. Efficient markets signal the relative importance or scarcity of ecosystem services relative to other goods and services through the price mechanism (Wills 1997). Market signals in the form of prices also provide an incentive to potential producers about the relative value of ecosystem services compared to other outputs they could produce.

A *market* is simply defined as the bringing together of a buyer and a seller so they can engage in voluntarily exchanges (such as money for produce – termed exchanges in "rights" or "property rights"[1]). 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. 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.

Internationally, these markets have been termed "markets for ecosystem services", "payments for ecosystem services (PES)" and "market based instruments (MBI)" among other terms. In Australia, the term MBI is dominant and refers to the broad application of market approaches in a natural resources context. While not necessarily always using the language of ecosystem services, or operating like a true "market", the underpinning goal is usually enhancing service provision or ensuring protection. For the purposes of this paper, the term MBI will be used to refer to ecosystem service markets in Australia.

MBIs applied in a natural resource management (NRM) context have received increasing attention recently as they have the potential to deliver improved NRM outcomes at lower costs than alternative instruments. MBIs achieve these efficiency gains in three ways:

1. Allowing flexibility in the way participants choose to respond to the instrument and thus encouraging innovation;
2. Encouraging change amongst those who can achieve change most cheaply, as opposed to broadly levelling change requirements on all; and
3. Placing positive incentives on better NRM, as compared to the negative incentives evident in regulatory approaches, thus driving innovation and continual improvements in NRM management.

Typical markets are driven by the gains to participants from voluntary exchange – the "gains from trade", to participants. Gains from trade are derived from differences, or heterogeneities, amongst the participant's preferences, resources or production opportunities. MBIs leverage the heterogeneity between participants by facilitating trades that leave both parties better off because of their relative starting points. In the case of natural resources, these gains from trade may depend on different personal values and cost structures between farming units, or different biophysical capacities to contribute to a particular natural resource management or ecosystem service outcome. Clearly then, from a practical implementation point of view, a MBI is only appropriate where heterogeneity amongst participants exists and can be effectively harnessed. Heterogeneity may exist in several dimensions across landscapes and communities. Thus, before considering the application of an MBI, it is important to determine if the level of heterogeneity, thus the gains from trade, warrant

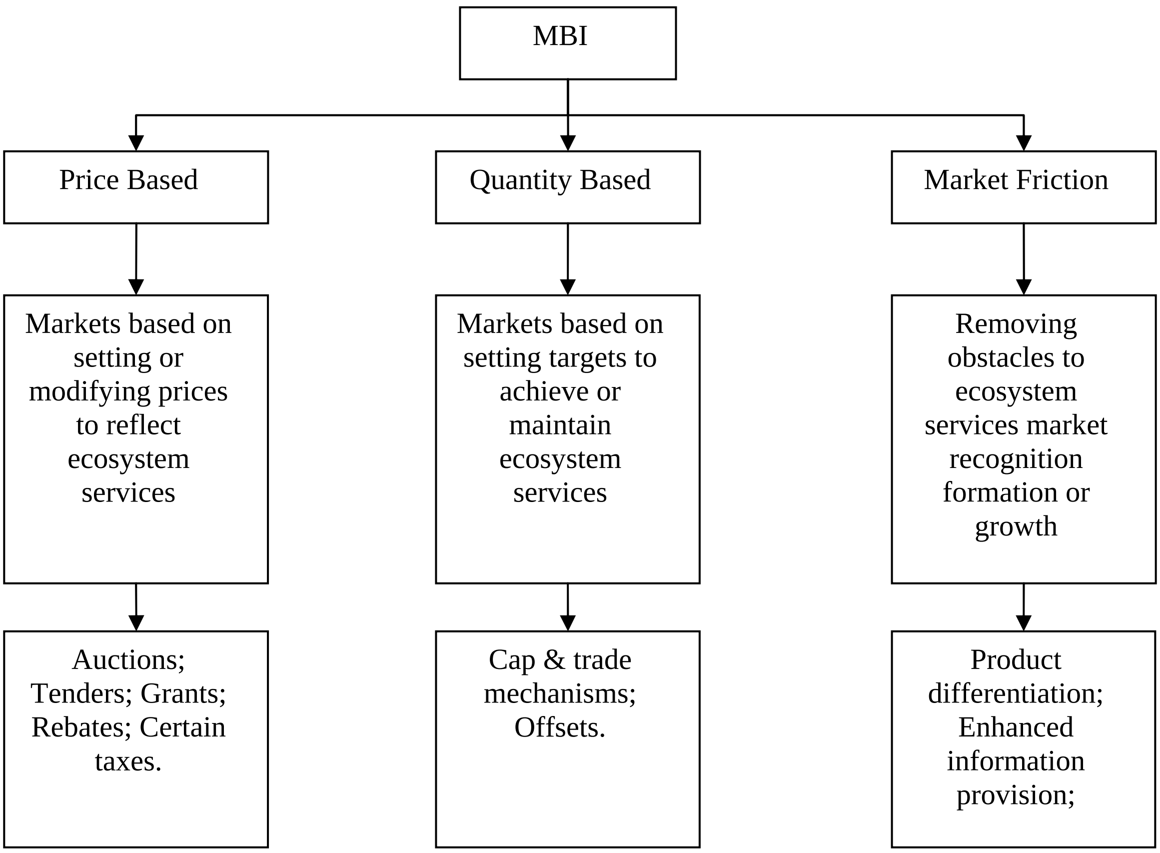
[1] Rights that govern the use and ownership of a resource – most commonly associated with the use and ownership of land. Property rights should be: well defined; freely transferable; enforceable; and secure over the long term.

development of an MBI over alternative policy approaches. We discuss a practical approach to address this issue later.

2.3 Market Typology: price based, quantity based and market friction based

Markets for ecosystem services can be created via a number of interventions depending on existing markets, the nature of the ecosystem services for which a market is being considered along with their production process, and who the potential market participants are. There are at least three common interventions to market creation as shown in Figure 1 (NMBIPP 2004). Price based instruments either directly create a price signal for ecosystem services (such as purchasing ecosystem services in an auction) or modify existing market prices to reflect the impact on ecosystem services (such as via taxes and subsidies). Quantity based instruments are designed to create scarcity for the desired ecosystem service with the resultant market creating signals and incentives via prices for the now scarce ecosystem service. Market friction instruments are designed to remove or reduce impediments to existing or potential markets for ecosystem services and thus improve the flow of signals and incentives therein. In all cases markets are reliant on appropriate property right structures to the resources underpinning ecosystem services production.

Figure 1: Characterisation of market based instruments.



Within the above characterisation, different market types require differing levels of supporting regulations or past experience. Some MBIs can be relatively easily implemented within existing legislative frameworks, such as auctions for biodiversity conservation.

However, anecdotal evidence suggests the chances of success in establishing a MBI is increased in regions familiar with programs involving some "market" like elements. For example, auctions for biodiversity are likely to benefit from learning generated through cost sharing or competitive grants programs. Other MBI schemes require changes to legislation for implementation. For example, a cap and trade scheme would require establishment of the quantity "cap" to signal scarcity of an ecosystem service. Therefore it is often difficult to implement these forms of MBI at a regional scale. In the case of many Australian NRM organisations, the focus is on the most efficient allocation of scarce resources to deliver maximum NRM outcomes. An un-stated objective in establishment of any such scheme is to do so in a timely fashion. Given this, the most desirable MBIs for establishment in the short to medium term for many Australian regions are those that operate within existing legislation, can deliver relatively rapid outcomes, and provide lessons and experience in running MBIs at the regional scale for future MBI development and implementation.

3 MBI Design Tools and Considerations

Markets exist for many goods and services, some produced through highly complex systems (such as satellite launches), or which require considerable investment a long time before any return is received (agroforestry and truffles). Yet markets do not exist for many ecosystem services. It follows that we should ask ourselves why these markets do not exist. Is it because the underlying "gains from trade" driver does not exist? Or is it because other market failures have prevented the establishment of a market? If so, how do we go about designing effective markets? Answering these questions is the focus in this section.

3.1 Market Potential - Heterogeneity

The initial cost effectiveness and efficiency claims surrounding MBIs are based on leveraging differences, or heterogeneity, between landholders and land management units. Given this impact on MBI operation and success, it is clearly important to understand heterogeneity in more detail.

We have defined three dimensions of heterogeneity (biophysical, management options, and socio-economic) that are important to the operation of MBIs at the regional scale (Whitten, Shelton and Langston, 2004):

1. Biophysical heterogeneity within a given landscape: how does the productive potential of resources for generating the desired ecosystem service vary across the landscape? That is, is production of the ecosystem service concentrated in highly specific areas (hotspots)[2], or is the potential evenly spread across the landscape?
2. Management option heterogeneity: are there many possible management options that deliver the same biophysical outcomes? Does cost of production differ across the landscape? For example, how many options are available to manage saline aquifer recharge and is their implementation across the landscape uniform in terms of cost?
3. Social and economic heterogeneity of landholders: what are the differing capacities, preferences and enterprise resources and goals of individuals in a

[2] In this report – we define a "hot-spot" as a highly desirable area for targeted management activities. We may also use hot-spot in reference to areas where multiple natural resource management issues occur on the same parcel of land – that is – a desirable area of management activity that may deliver multiple benefits.

particular region? Do all landholders have similar goals and preferences and thus possess similar capacity to undertake NRM works?

If a number of ecosystem services are desired the issue of joint production also arises. Joint production occurs when land can be managed to produce a number of ecosystem services simultaneously. Joint production is particularly important when the ecosystem service potential of the landscape for multiple jointly produced outcomes overlaps, and the potential management actions that can be undertaken jointly generate these desired outcomes.

Heterogeneity at one or more of these scales drives any potential market. Hence, we have developed a rapid assessment approach tool to identify and qualitatively assess the presence or absence of heterogeneity at each of these scales and potential for joint production of ecosystem services. In brief, the approach is based on: establishing the spatial heterogeneity of the biophysical problem being addressed; identifying the management options available and their heterogeneity; and finally, determining the extent to which landholders have different cost structures and farm management goals. These three layers are then combined to determine the overall level of heterogeneity. Where joint ecosystem service production is desired, the potential is assessed via the correlations across the relevant biophysical and management action layers.

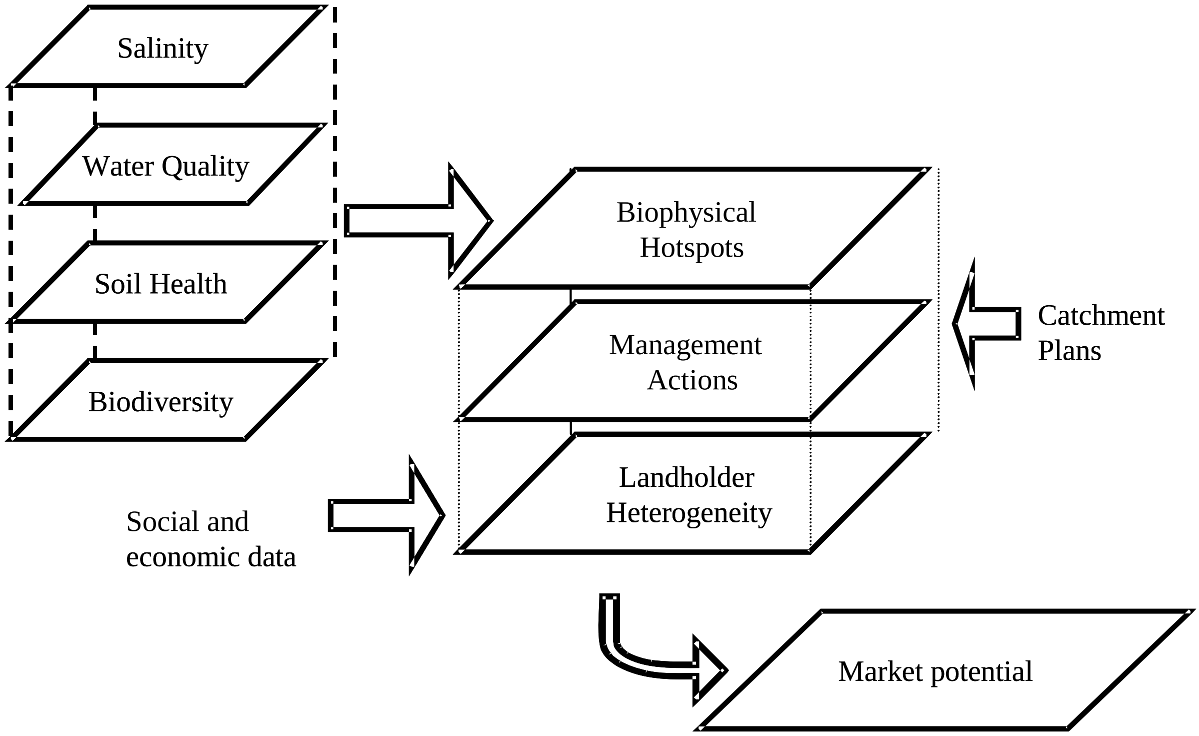
Figure 2 outlines the approach schematically. Inputs are considered at each of the scales identified above. For example, ecosystem service targets are identified and input at the scale the market is being considered. For the regional scales we have considered to date, targets are drawn from existing strategic plans and are input using the best available biophysical data. Four such potential targets are shown in Figure 2: salinity; water quality; biodiversity; and soil health. The range of available management inputs is then considered along with their likely relative contribution achieving ecosystem service targets. Finally, a social and economic assessment of landholder profiles and the implications for likely variation in implementation of management change is input.

This approach was trialled in 2003, when the Murrumbidgee Catchment NRM Authority of the time[3] had a desire to establish a MBI within two sub-regions to address the biophysical issues identified in Figure 2. Regional planners initially desired the establishment of a single MBI instrument to encourage delivery of a number of ecosystem services across various subregions of the catchment. Space constraints prevent a lengthy discussion but the analysis of heterogeneity at the three scales indicated a lack of heterogeneity at the sub-catchment scale for soil health, and to a large degree, water quality. Further, our analysis indicated a lack of correlation for the two remaining issues, salinity and biodiversity, and thus a multiple outcome MBI was not considered appropriate[4]. Importantly, the analysis was conducted quickly using pre-existing NRM targeting and expert opinion.

[3] Department of Land and Water Conservation, Murrumbidgee Region.

[4] Under certain circumstances a multiple outcome market may be appropriate – but this was entirely dependant on institutional and funding characteristics.

Figure 2: Conceptual approach to rapid assessment methodology



The conclusions for MBIs that resulted from the Murrumbidgee case study and broader MBI research are summarised in Figure 3. Only where ecosystem services production potential (as represented by biophysical hotspots) and management actions with multiple outcomes overlap should a multiple outcome MBI be considered. It should also be noted that the conclusions from this matrix help determine the specific attributes that an effective MBI is likely to possess and are applicable to any policy instrument being considered, not just MBIs.

Figure 3: Framework for assessing the characteristics of a policy instrument under differing management options and biophysical "hotspot" combinations

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Management Options Overlapping</td></tr>
<tr><td>Yes</td><td>No</td></tr>
<tr><td rowspan="2">Biophysical Hotspots Overlapping</td><td>Yes</td><td>1. Multiple outcome market – site and management actions reasonably specific</td><td>2. Programs/Markets with biophysical sites specified, but greater flexibility in management actions</td></tr>
<tr><td>No</td><td>3. Programs/Markets with management actions specified, but greater freedom in spatial location</td><td>4. Separate single outcome markets – relatively greater freedom in sites and management actions</td></tr>
</table>

3.2 Market Failures

Significant heterogeneity exists at one or more scales for many ecosystem services. Yet it is often found that markets have failed to develop. Heterogeneity is a necessary but insufficient condition for a market to emerge. Heterogeneity represents the potential for mutually beneficial market exchanges that increase the production of ecosystem services and community welfare. However, a number of other market failures are commonly present that may prevent market signals and incentives from emerging for ecosystem services. These obstacles will need to be identified and suitable mechanisms designed within facilitate their removal before an effective MBI can be implemented. Indeed these obstacles will need to be overcome whatever policy solution is envisaged.

Market failures typically emerge as externalities, public goods, or information failures leading to a lack of market signals and therefore exchanges. More than one market failure is often present but not all market failures will be present in every case. It is useful to revisit the nature of these market failures in more detail to determine the underlying causes, and therefore to aid in identifying potential design solutions.

Externalities arise from incomplete property rights. These rights govern resource access, use and transformation (Ostrom and Schlager 1996). That is, rights govern what individuals can and cannot do with resources implicitly or explicitly in their possession and are backed up by the protection of the state. Murtough, Aretina and Matysek (2002) note seven property right attributes of importance in creating markets for ecosystem services that are shown in Figure 4.

Figure 4: Desirable property right attributes for ecosystem service markets

Property right 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	Use of the property right has a clear relationship with ecosystem services.
7. Low sovereign risk	Future government decisions are unlikely to significantly reduce the property right's value.

Source: Murtough, Aretina and Matysek (2002)

Public goods are similar to externalities in that they are caused by a lack of property rights. True public goods are caused by a lack of practical means of excluding potential consumers rather than simply a lack of property rights and a strong incentive for consumers to free-ride. Further complications arise from the non-rival nature consumption of public goods, meaning that my consumption leaves no less for others to consume. Because of these characteristics it is often argued that governments should produce public goods. However, even where government production is considered there may be potential gains from designing mechanisms that encompass the signalling and incentive structures of markets. For example, reverse auctions effectively create what may be considered a one sided market where there are many potential suppliers competing on price and quantity, but only one buyer.

Information failures in markets for ecosystem services take many forms including:
- Asymmetric information where one party (buyers or sellers) holds information that would normally be signalled in the market place, such as a price for changing management and the value of the ecosystem services that are produced;

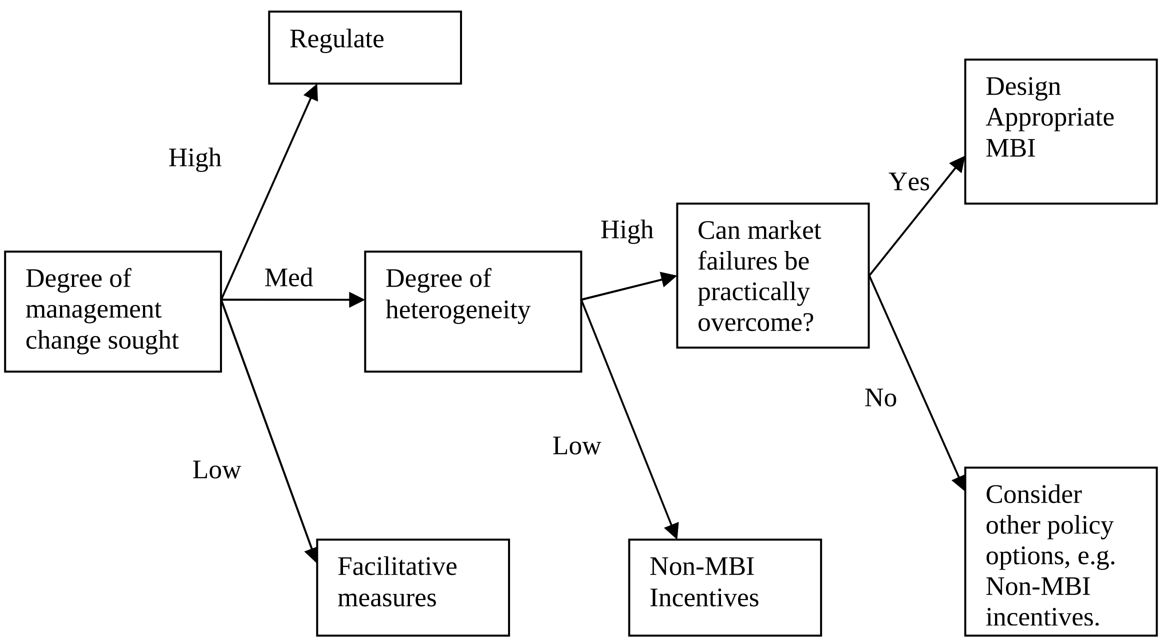
- The tools and techniques required to establish and maintain landuses that generate ecosystem services may be unknown or unfamiliar to potential producers;
- Scientific uncertainty about ecosystem services production processes, and therefore about the ecosystem service contributions of management changes;
- Buyers or sellers cannot find each other due to lack of agreed market place;
- Small numbers of buyers or sellers facilitating manipulation of information in markets to their advantage (generally termed market power); and
- Difficulty in measuring and monitoring success because of costs of information collection, scientific uncertainty, and time delays between changes to management and provision of the desired ecosystem service.

Information failures are often referred to as transaction costs because in most cases the information exists, or can be obtained, but only at a cost. Transaction costs also include the cost of negotiating a suitable contract between buyers and sellers, which is directly related to many of the information failures noted above. Other impediments such as resource or other constraints to potential producers may also be present in some situations and should be identified.

3.3 Deciding on the appropriate MBI

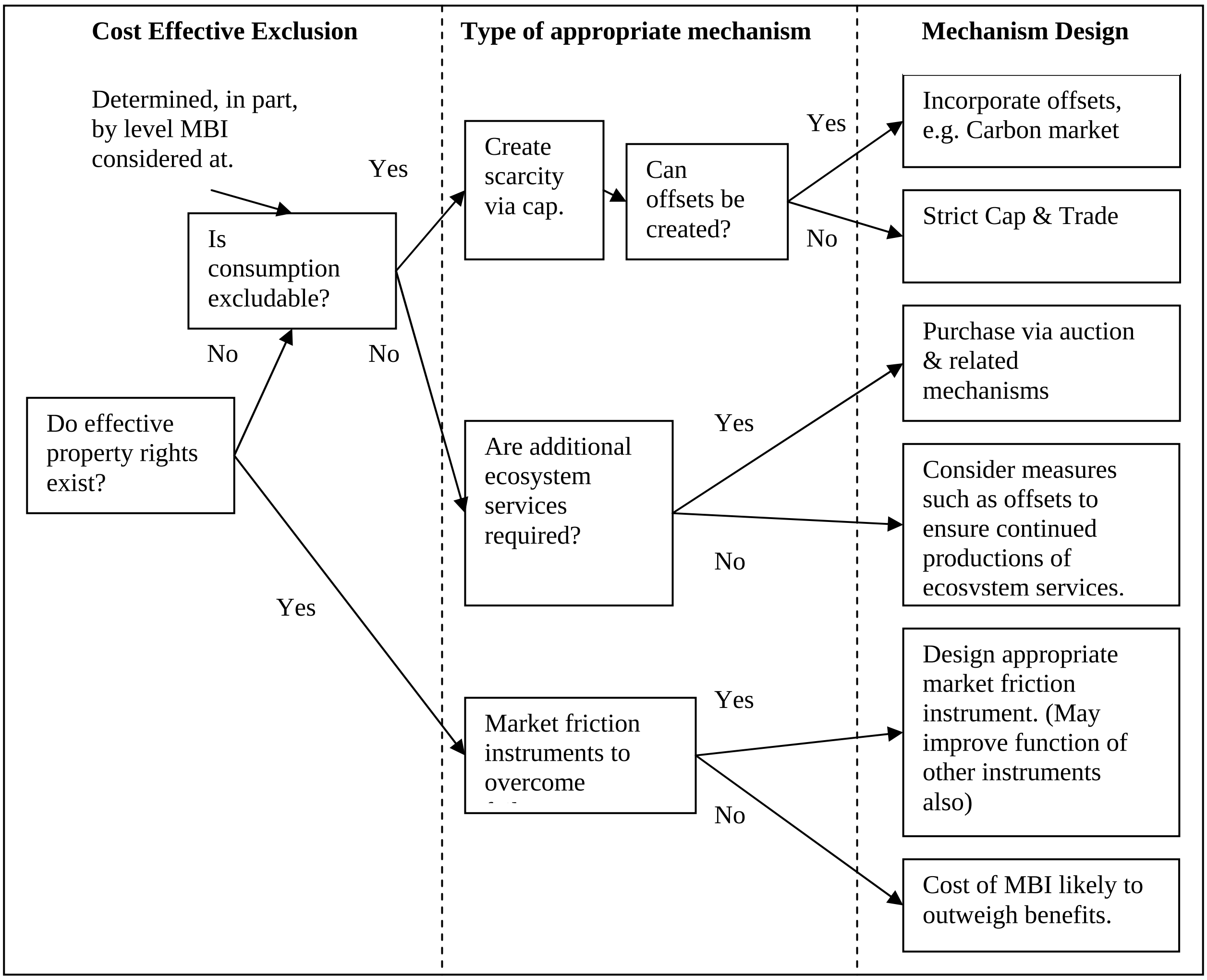
It is at this point, having identified the scale and scope of the ecosystem services issue and the market failures that will need to be overcome, the type of instrument envisaged can be settled on. Our progress to this point can be summarised as shown in Figure 5.

Figure 5: Schematic of appropriate MBI Market selection decision points.



We next need to decide whether and how the market failures can be overcome. It must be explicitly recognized that not all market failures may be able to be practically overcome. Furthermore, mechanism design will always involve a trade-off between the costs of increasingly sophisticated instruments and the relative benefits from additional production of ecosystem services. To a large extent, the decisions between the main forms of MBI shown in Figure 1 are reliant on whether potential consumers of ecosystem services can be cost effectively excluded in order to prevent free-riding behaviour. The decision about the exact form of MBI is much more complex than can be adequately addressed in this paper. A simplified decision tree leading to some common forms of MBI is shown in Figure 6.

Figure 6: Decision tree identifying common MBI forms.



3.4 Mechanism Design

Overcoming market failures requires careful attention to mechanism design in order to unlock the gains from trade through the operation of an MBI for ecosystem service delivery. Successful MBIs normally require a package of instruments in order to effectively overcome the multiple market failures present. Different MBIs will also require different design solutions and not all mechanism design issues are of importance for all MBIs. Furthermore, mechanism design is often interrelated with the potential solutions to one form of market failure restricting options or creating opportunities for others. It is not possible to do justice to the full range of mechanism design issues that may need to be considered. As a general rule the overarching issue of whether effective property rights that facilitate excludability can be designed will shape the type of MBI being implemented and the resultant design requirements.

An incomplete overview of the design parameters that will need to be considered is provided in Figure 7. For example, there are at least three aspects of scientific uncertainty that need to be considered including basic information about the generation of ecosystem services in landscapes, the impact of management changes on ecosystem services production, and the implications of community beliefs and acceptance of scientific knowledge. In the following case studies we identify the mechanism design issues critical to successful MBI implementation in more detail.

Figure 7: MBI design parameters.

Market Failure	**Issues**	**Description**
Property Rights and Excludability	1. Allocation	Who should hold the property rights to the ecosystem service? Often specified via contract or new regulations.
	2. Metric design.	How to measure? Good metric design.
	3. Relative Change	Is existing behaviour important or only aggregate outcome? (Duty of Care/minimum standard – payment for improvements).
	4. Non-excludable	Is there a Government purchaser?
One market or many?	1. Multiple outcome markets.	Overlapping heterogeneity and market types.
	2. Multiple outcomes	Who owns? Facilitate access to other markets.
Asymmetric Information	1. Costs	Market form: • Auction versus broker versus other options • Incentives in market form – tender mechanism • Risk reduction e.g. reserve price. • Acceptance to stakeholders – communication. • Multiple offers, group offers, trade-offs to market power.
	2. Benefits	How much information to provide and vehicle for provision.
Tools and Techniques	1. Unknown or unfamiliar to producers	Provide information to producers.
Scientific uncertainty	1. Ecosystem service production relationship	Is more research needed? Feedbacks to metric.
	2. Impact of management change	Should allowable actions be restricted to reduce risk? (e.g. use of recognised best management practices)
	3. Public concerns about efficacy	Concerns about management action efficacy = information communication.

Market Failure	Issues	Description
No common market place	1. Create market place	Facilitate creation of market place (see asymmetric information and market power for more information).
Market power	1. Small numbers	Identify required numbers and ask whether practical.
	2. Large players	Are there any? What is their likely impact?
Difficulty measuring and monitoring success	1. Principle agent issues	Difficulty with ex-ante actions – ex-poste outcomes.
	2. Cost of monitoring	Is this prohibitive – and are there other options?
	3. Bid quality	Quality of the bid may provide a good *ex-ante* indicator of likely success of implementation.
Other constraints to market entry	1. Capital	Payment design – up front versus ongoing.
	2. Costs of entry	Bid payment for example.
Other issues that should be considered	1. Interaction with other incentive programs.	May be perverse incentive for strategic playing off of one program against another and/or Double Dipping.
	2. Changes to stakeholder expectations	Crowding out altruistic behaviour. Path dependency may mean that management can't go back to previous incentives and outcomes.
	3. Risk if no change	If management change not achieved will any irreversible changes to ecosystem services be reached?
	4. Spillovers	Unconsidered impacts on other ecosystem services.
	5. Interaction with other non-incentive programs	Existing rules and regulations will need to be considered in the design of any new instrument.
	6. Permanent versus temporary change	Likelihood of and management changes being reversed versus cost to permanently protect.

4 Case Studies

In this section we present a detailed case study of one Australian ecosystem service MBI and less detailed summary case studies of two further MBIs. The market typology presented earlier is used to organise the case studies, thus examples of a price, quantity and market friction based MBI is presented and discussed. In each case, *a priori* consideration of gains from trade and the underpinning market failures was used to select an appropriate policy option and inform mechanism design. This supports the overarching theme of this paper that careful consideration of theory during the design phases leads to more effective and robust MBIs.

Our role has been to facilitate development and implementation of MBIs addressing high priority NRM issues rather than analysing historical cases in detail.[5] The first case is a study of a price based MBI designed to reduce in-stream salinity in the Wimmera River Catchment in Victoria. This price based MBI is scheduled for implementation later this year and is discussed in detail. This scheme is amongst the first in Australia to attempt to address diffuse source dry-land salinity using a MBI. The second case demonstrates the use of a quantity based MBI designed to aid in managing the impacts of rural residential subdivision and

[5] The importance of learning from past MBI experience cannot be underestimated and many of these lessons are explicitly incorporated into our MBI research and recommendations.

development on ecosystem services in the Murrindindi Shire in Victoria. The final case demonstrates the investigation of a market friction instrument to improve the efficiency of the native seed industry in Australia.

4.1 Wimmera Auction for Salinity Outcomes – A price based MBI

The Wimmera region is located in southwest Victoria in Australia. The Wimmera Catchment Management Authority (CMA) is the primary regional body with responsibility for managing and ensuring production of ecosystem services to support the community and natural resource assets of the region. CMA's as regional institutions are relatively new but are built from a long history of regionally based NRM programs. Agriculture is the main industry in the region with some light industry in the major towns. The headwaters of the catchment are in rolling hills (>20% slope) and some mountainous areas with the closed catchment ending in flat grain production areas.

4.1.1 Market potential - heterogeneity

A single issue of particular concern for the Wimmera CMA is recharge of saline groundwater aquifers leading to saline discharges causing soil salinisation and increased in-stream salinity. One target area for reduced recharge is the "steep hill country" (SHC) comprised of cleared hills of greater than 20% slope. Past clearing and continued stock grazing use has lead to significant increases in groundwater recharge and the resultant salt movement in the landscape. Historically, CMAs have focussed on regulatory and incentive based mechanisms (such as flat rate input based subsidies like fencing support programs). With an increasing focus on service provision they have increasingly moved towards use of MBIs.

The only ecosystem service target in this scheme is managing salinity outcomes (the service of maintaining hydrological balances). The goal is to reduce recharge to saline aquifers with a short response period (10 to 30 years). Groundwater recharge mapping is available to identify the recharge potential across the target area, which can then be addressed via establishment of deep-rooted, perennial vegetation. There is substantial heterogeneity of outcomes present. Specifically, a hectare of deep-rooted vegetation established in a high recharge zone would control a greater amount of recharge when compared to a hectare of vegetation established in a low recharge zone. Furthermore, not all deep-rooted perennials are equally effective in reducing recharge introducing additional heterogeneity. For example, retention of native grasses and perennial pastures deliver a lesser recharge reduction than reestablishment of native trees and shrubs.

From an NRM point of view, we are interested in the best possible recharge outcomes for a given budget (in this case without the complications and implications for mechanism design associated with pursuing side objectives). Thus it is in the interests of managers and landholders to identify, differentiate and secure changes in those areas that will lead to the most efficient and effective salinity control outcome for a given investment. Therefore, potential sellers are those that own land within the target SHC region of the catchment. Thus it is clear there is a high degree of heterogeneity in both the biophysical issue and the efficacy of management actions, thus potential for gains from trade to be unlocked. In this case, the role of the Wimmera CMA is the initiator of the market as well as the scheme administrator – but is also acting as the buyer of salinity control services using tax payer funds on behalf of the broader community, as beneficiaries from the service provision.

4.1.2 Market Failures

There are several important market failures present in improving recharge management in the Wimmera SHC. These include a lack of property rights and excludability, asymmetric information, scientific uncertainty, and difficulty in measuring and monitoring success. Each of these is detailed below to provide basic information to be input to deciding on the appropriate MBI form and the necessary mechanism design solutions. While other market failures are likely to be present they are considered less serious but are addressed during the mechanism design phase.

Property rights and excludability

The lack of a clear definition and allocation of rights is often cited as one of the main reasons why a market does not exist for a desired ecosystem service – in this case salinity management.[6] Rights define the relationship between a landowner and the ways in which they can use their resources. They are not permanently fixed and may vary through time, as has been the case with native vegetation in Australia.

Grazing rights of Wimmera landowners are reasonably well defined. The same cannot be said of the rights to salt and water movement in landscapes. Turning specifically to the issue of salt movement generated by the management of SHC, it is well established that cleared hills with limited deep rooted perennial vegetation have greater potential to contribute to deep drainage and thus salt movements in landscapes, than do hills with perennial vegetation present. However, the rights covering salt movement are not well defined. Downstream landowners and the broader community may have an expectation that SHC landowners will manage their land to minimise recharge and salt movement. Indeed there may be some direct on-sight benefits to landowners where dryland salinity impacts in discharge sites are reduced on their farms. Nevertheless, there are no direct binding or legal constraints on upstream landowners actions with respect to recharge management. That is, there is no specified duty of care. There are indirect constraints generated by soil erosion and overgrazing rules, but these are not intended to allocate or define rights to salt movement, although soil erosion is in part directed at water quality issues.

A key attribute of market failure is the inability of potential providers of groundwater management to prevent consumption by non-buyers. This is termed non-excludability and results from the impossibility of preventing downstream consumers from benefiting from their actions in reducing groundwater recharge. To some extent the benefits of recharge management are also non-rival or non-competitive in the sense that all downstream users benefit from the reduction. This is the most important market failure in groundwater management and the main driver of demand for policy interventions. The implication is that potential consumers can obtain ‘free ride’ on the purchase decisions of others and any resultant market will be inefficient or non-existent. In some cases new technologies can prevent non-purchasing individuals from consumption. For example, pay television uses new technology to restrict consumption to service purchasers. However, such restrictions are unlikely to be effective in the case of physical movement of salt within catchments.

Asymmetric information

Efficient markets are predicated on full information being available to buyers and sellers. The full information criterion requires that producers and consumers both know all relevant information about the product including factors such as quantity, quality, time and location

[6] Rights refer to property rights, entitlements, and other similar claims that can be made by individuals. Rights are commonly referred to as property rights but these represent a sub-class of a broad range of claims and entitlements that can be held by individuals.

of supply, price and so on. Where only one participant, either a buyer or seller, knows relevant information it is termed asymmetric information.

Landholder costs of changing management are the first identified asymmetric information issue. Landholders are only likely to change their management of SHC where they receive sufficient payment to compensate them for their net costs.[7] For example, landholders are only likely to take up an incentive to fence and rehabilitate parts of their SHC when they receive benefits (including payments, profits or personal benefits) greater than the costs they incur (including time, money and lost production). That is, landholders may loose some income due to lost production from SHC, but could also gain benefits such as improved amenity, and reduced waterlogging in downstream discharge sites on their land. The difference between the on-site costs and benefits (monetary and non-monetary) is the minimum payment they would need to change management. In a normal market, landholders would reveal the information about the necessary payment as offers to sell or accepted prices for good and services – this is not the case for ecosystem services from SHC.

A second source of asymmetric information is the downstream benefits of reducing recharge by changing SHC management. In contrast to the previous case governments do have information about the downstream benefits. This information includes models of local and regional groundwater movement paths and salt loads, from which government can estimate the consequent salt movement in landscapes. At a coarser scale this information can be used to target broad areas and land management activities that can influence the generation and movement of salt in landscapes. At the finer scale it can be used to estimate the potential contributions from changes to SHC by individual landholders.

Landholders are aware that Wimmera SHC has been targeted as a source of recharge and cause of salt movement in landscapes. However, landholders are not aware of the specific contribution that different changes to the management of their land, or different locations of management change could make to recharge management and reducing salt movement. Landholders need information about relative salt loads from different locations to make offers that best meet the government's needs.

Scientific uncertainty

Scientific uncertainty refers to the difficulty in identifying the outcome that would result from successfully changing SHC management. It results from incomplete knowledge about recharge quantities, groundwater dynamics, and salt sources and concentrations. Hence, the models that are used to estimate the likely outcome from changing SHC management are imperfect. A related source of uncertainty relates to the relative contribution of different actions on recharge. For example, there is uncertainty about the relative contributions of changing pasture management and revegetation. Local experts suggests that the investment in groundwater modelling generally, and specifically with respect to the Wimmera region, has resulted in models that predict salt and water movement outcomes with a relatively high level of precision and confidence.

Difficulties in measuring and monitoring success

The desired SHC land management changes require expensive upfront investment in order to produce ecosystem services in the longer term. However, the success of these actions can only be measured at a much later date, thus compliance is difficult to measure. Complicating the issue, the relatively large upfront capital investment required is likely to be

[7] Net costs include monetary and non-monetary benefits and costs. These costs include capital, management, opportunity etc.

beyond the capacity of most landholders – thus a payment schedule based on significant upfront support and ongoing performance based payments based on management inputs is likely to be needed. The provision of upfront support with an expectation of future benefits from SHC management leaves the proponent (government or CMA) bearing the risk of failure. The proponent faces a principle-agent problem where it is both necessary to pay the agent upfront in order to achieve change, and difficult and potentially costly to monitor compliance. Finally, increasing monitoring and enforcement activities may prove to be counterproductive if agents react adversely.

4.1.3 Deciding on an appropriate MBI

A summary of the decision process to identify whether an MBI is appropriate and the broad type of MBI that should be considered is shown in Figures 5 and 6. The key elements relate to the nature of the issue being addressed including the scale of change required, degree of heterogeneity within the policy target, and potential to cost-effectively overcome the market failures and other obstacles to effective MBI design and implementation. The initial analysis in 4.1.1 indicates that substantial heterogeneity is anticipated. The market failure analysis presented in section 4.1.2 identified a number of major impediments that would need to be overcome.

Following the procedure outlined in Figure 6, recharge management provides an ecosystem service to all downstream consumers who, in most cases, do not overlap the providers and cannot be prevented from enjoying the benefits. That is, the ecosystem service being considered is non-excludable. Wimmera CMA targets also indicate that additional recharge reduction ecosystem services are required. Hence, we conclude that an auction or related mechanism to purchase these ecosystem services from potential providers/sellers (that is: landowners in the SHC) is appropriate, providing that other market failures can be cost effectively overcome.

4.1.4 Mechanism design

The market failures that need to be overcome have been identified along with the most likely MBI. The primary obstacles residing around designing and appropriate service delivery measurement metric and overcoming the asymmetric information between actors in the proposed market via careful mechanism design. The focus at this point turns to designing the features that need to be incorporated within the MBI in order to increase the chances of a successful outcome. It is useful to summarise the key conclusions from this section in advance of the full discussion in order to aid in selecting design features that are likely to work well when combined into a single instrument. In brief, we conclude that a competitive tender process (often referred to as an auction) that differentiates participants to award well-specified contracts that pays landholders for additional reductions in downstream salt contributions to streams is likely to be the most effective mechanism for achieving changes to SHC land management.

The tender recruitment, selection and awards process should gather the necessary information needed to differentiate participants based on estimating salt movement benefits (salinity control services), cover a limited range of contractible actions to reduce uncertainty of outcome, and be structured to take account of principle-agent trade-offs in risk allocation, monitoring and enforcement[8]. The risks of creating a perverse rural subsidy are ameliorated

[8] Transaction costs, and minimizing them, have been an explicit consideration in this scheme – however this scheme is a pilot and thus these costs are likely to be relatively higher during establishment and operation. These costs will be established during the evaluation following scheme roll out.

by setting reserve prices in the auction process and remaining focussed explicitly on the provision of salinity control services via management changes.

Property rights and excludability

In the absence of clear, well-defined property rights for an effectively non-excludable outcome three questions arise:

1. How will property rights be defined and measured?
2. Should a duty of care level of provision be imposed?
3. Who will purchase the non-excludable outcome/service (in this case Government via Wimmera CMA)?

Well-defined and measurable rights are an aid in facilitating markets because they structure negotiations about who is to pay whom and what is to be paid for (e.g. payments conditional on additional service provision). A measurement metric forms the basis for well-defined rights by specifying their parameters and how the right is to be measured[9]. The metric represents a complex bundle of trade-offs and is not simply a question of estimating a steady state biophysical change (which in itself is extremely complex). We have identified eight principles that should be considered in designing a suitable metric, which are set out in Table 1. Not all of these principles will necessarily be important for all MBIs, nor will they necessarily be separated in the actual construction of a metric. Strictly speaking, only the first two principles relate to defining and measuring property rights. The remaining principles relate to adjustments in the value of the commodity to the community based on various factors.

Table 1: Principles of metric design

Design principle	***Description***
Quantity/Quality	• A physical quantity or index of biophysical outcomes. • There are usually a number of measures that deliver different messages to landholders and represent subtly different outcomes. For example, estimating salt discharge differs from estimating change to recharge volumes. • Usually outputs are estimated using a proxy based on changes to inputs. For example, using models relating input changes (area and location of vegetation) to changes to salt outcomes.
Relative Change (or additionality)	Important if the goal of policy is to improve outcomes from a baseline, rather than to pay for some absolute maximum quantity or secure ongoing provision. The baseline is usually defined as the higher of what would otherwise happen (often termed business as usual), or a specified duty of care.
Location	The location where change occurs can generate different values to the community. Location is incorporated in the biophysical measure of quantity. This leads to three further related considerations: 1. Does the path to the point of estimation matter; 2. Are there any biophysical thresholds (or hotspots) that are likely to be created or impacted in different pathways? And 3. Do any packages of management change generate synergistic outcomes?

[9] In this case – the measurement metric is the means of differentiating participants based on the level of service provision offered. Opportunity costs are incorporated by bidders, resource degradation is not a concern, and contracts can vary depending on the management changes offered.

Timing	All things equal, earlier outcomes are preferred over more distant outcomes.
Risk / certainty of management change effectiveness	Some management changes may be more likely to be successful than others. The key factor in success may be the initial establishment or the on-going management. Likelihood of success can either be considered within the metric design or the payment mechanism.
Risk / certainty of outcome success	Even with successful establishment of the management change there may be uncertainty about the eventual impacts on outcomes. For example, this may be the case with management changes for which less is known about their impact on recharge.
Irreversibility	Irreversibility is related to risk. Where thresholds are anticipated, such extinction of species, there is a case for favouring less risky actions that achieve change sooner.
Spillover impacts	Spillover impacts are consequences of the specific management change elsewhere in the system. For example, reducing recharge in Wimmera SHC will also reduce base-flows in streams and rivers in the catchment. In some cases this can lead to a perverse outcome whereby the salt concentration in the remaining flow can be higher.

The recommended application of the principles of metric design to recharge in the SHC of Wimmera is set out in Table 2. In order to use the metric these eight principles must be combined into a single measure of the relative effectiveness of the proposed management change. This is often expressed as a weighted index as has been the case in other auction processes[10]. Salinity outcomes from management change in the Wimmera SHC will be estimated in terms of the additional marginal change to steady state tonnes of salt at a designated downstream point, perhaps discounted for risk of particular actions. In order to rank bids this estimate is then divided by price in order to produce a tonnes per dollar price for each tender.[11] This metric is set up to measure salinity only, no side objectives are pursued by the scheme and thus the metric does not attempt to measure any benefits.

Table 2: Wimmera SHC metric design recommendations

Design principle	***Recommendations***
Quantity/Quality	• Estimate salinity outcomes in tonnes of salt using input based proxy measures based on changes to vegetation cover and other salinity reducing management actions across the designated site.
Relative Change (or additionality)	• Change should be measured relative to a uniform benchmark for value of business as usual. This reduces the difficulty of collecting baseline information from each site and creates an implied minimum duty of care. • Bids in areas with scattered trees may complicate this baseline.
Location	• The contribution of individual changes will be measured at the best downstream location for determining their relative values. • The boundaries of those eligible to tender may be an alternative means of taking location into account.

[10] For example, the development and use of the habitat hectares index within the BushTender scheme.
[11] Prices may need to be discounted to a present value if they represent an ongoing commitment in order to accurately compare these against alternative bids.

Timing	• A steady state estimate is favoured due to the relatively short time horizons and uncertainty in time to achieve change to outcomes.
Risk / certainty of management effectiveness	• Weight by assessed probability of successful implementation.
Risk / certainty of outcome success	• Weight by assessed probability estimated outcome being achieved.
Irreversibility	• No irreversibility issues identified.
Spillover impacts	• No serious mechanism design issues identified.

A clear baseline for the duty of care expected from landholders in the SHC defines which ecosystem services will be paid for and which will not (that is: additional marginal change above a minimum standard is what payments will be based on). While there is no existing duty of care relating to recharge and salt movement in the SHC, there is a strong perceived duty of care linking to recharge that landholders are expected to achieve by their peers and by natural resource management authorities. An implied duty of care via a uniform baseline approximately equal to average landholder performance in these landscapes is used as shown in Table 2. Use of a uniform baseline will tend to disadvantage underperforming landholders rather than reward them. In this case, improvements to marginal change ("additionality") within the scheme are unlikely due to the long time horizons for truly conditional outcome monitoring. The only possibility is via improvements to the underpinning biophysical model used in the measurement metric.

The non-excludability issue is avoided by Wimmera CMA acting as a purchaser of salt reductions on behalf of the wider community benefiting from the reductions (that is, beneficiaries are not overlapping). The introduction of WCMA as a monopoly purchaser utilising taxpayers money does introduce some additional requirements for transparent demonstration of ethical and equitable treatment of potential producers and purchase requirements of probity and value for money. These additional requirements are relatively minor and can be overcome by ensuring key elements of the MBI design, such as decision making processes and contract negotiation, are transparent to the participants and the wider community.

Asymmetric information – landholder costs

A major impediment to creating an MBI to reduce salt movement in SHC landscapes is asymmetric information about the cost of changing management to generate SHC outcomes. Competitive tender mechanisms are specifically designed to create incentives for landholders to reveal the costs of changing management of SHC thus eliminating landholder cost asymmetric information. Competitive tenders are a reverse auction technique that can be simplified into three steps:

1. the government offers to purchase ecosystem services – in this case reductions in salt generated to Wimmera streams;
2. Landholders submit voluntary offers to provide the desired ecosystem services (thus sellers self select to participate);
3. The CMA ranks the offers according to cost per unit of salt reduction and accepts offers up to a budget limit or a preset reserve price – thus payment to participants is based on competitive outcomes up to a pre-specified total budget.

While the steps involved are relatively simple, there are a number of mechanism design issues of importance including what form the competitive tender should take, acceptability of price risk, acceptability to potential participants, and the form of allowable offers.

There are a number of alternative auction designs that could potentially be used to solicit and award contracts. Particular design aspects include sealed or open bid and the rules for payment. In the Wimmera case, a sealed bid, set period tender submission process with discriminatory pricing is suggested. Sealed bids are preferred due to the strong strategic advantage to any individual landholder knowing the particulars of other landholder's bids (especially pricing information) prior to submitting their own.

The rationale for a standard discriminatory pricing mechanism is more complex. Selection of an appropriate pricing mechanism is a trade-off between the relative cost differences between individual bids and the incentive to those tendering to reveal their true costs of changing management.[12] Economic theory suggests that uniform price auctions give landholders the best incentive to bid exactly at their cost of changing land management. The underlying theory is that in a uniform auction, winning tenders are guaranteed at least some margin above their costs by being awarded the price of the first loosing bid. Therefore they should reveal their true costs in their bid. This is in contrast to a standard discriminatory price auction where tenders are awarded the price they ask.[13] In a discriminatory auction, bidders have an incentive to try to guess the market price because the price that they receive will be higher if they guess successfully. Pre-tests for the BushTender competitive tender for biodiversity concluded that a discriminatory price mechanism out-performed other designs in practice. This was at least in part because of predicted increasing costs of changing management, and therefore an upward sloping offer curve, and because landholders were not able to guess the final market price due to a lack of experience with these types of mechanisms. If a flat offer curve is expected, or repeat auctions have taken place, the conclusion in favour of a discriminatory price auction is not so clear and further investigation of the auction mechanism may be required.

The setting of a reserve price beyond which tenders will not be awarded can reduce the price risk to Wimmera CMA and avoid unrealistic expectations about future payments. The reserve price effectively caps the maximum payment and removes the potential that a few high priced tenders will be seen to profiteer from the MBI. The reserve price will need to be set high enough that legitimate, cost effective, tenders can be awarded above existing payment rates. If the reserve price is set too low and is binding it may discourage landholders from participating in future tenders. The reserve price should be set in advance and remain confidential at all stages of the auction including after bids are awarded.

The level of confidence of stakeholders in the competitive tender process will in part drive participation. Anecdotal evidence suggests that where landholders have had experience with cost sharing and incentive schemes there is a much greater likelihood a competitive MBI approach will be acceptable. Wimmera SHC has been exposed to a number of such schemes, but this may be a consideration when planning further MBI's in the future.

Tendering rules will need to detail whether individuals can collaborate on joint tenders or submit multiple individual offers. In principle group tenders should simply be considered as

[12] A more extensive and technical discussion of auction design in the context of BushTender can be found in Stoneham et.al. (2003) 'Auctions for conservation contracts: an empirical examination of Victoria's BushTender Trial', *Australian Journal of Agricultural and Resource Economics,* 47(4) pp. 477-500.

[13] A number of hybrid forms between the uniform and discriminatory auctions also exist such as the 2nd price auction. These were not preferred because the incentives for true cost revelation are mixed.

thought they were individual bids and multiple tenders as separate individual bids. However, there are some circumstances where this may vary, or additional difficulties may arise.

If synergistic impacts between tenders are anticipated (which are considered unlikely in this case) group tenders that capture these could be specifically encouraged via a special tender payment or facilitative mechanism such as designated support officer time. Where no synergistic impacts are anticipated the main reason for joint tenders is likely to be driven by economies of scale by combining changes across a group of landholders. In this case considering group bids as though they were from a single individual is a suitable response. If such economies of scale are considered large then mechanisms facilitating their capture in the tender process may need to be considered.

Where individual landholders submit multiple bids this is likely to be a strategic response to critical supply constraints (overlapping or ranked tenders) [14], or in response to insufficient information about the impact of management changes in alternative sites on salt movement (separate tenders, only one of which can be accepted by the CMA). Since landholders are likely to have clear preferences about the location of changes, there are likely to be few benefits to accepting mutually exclusive tenders covering single sites on the one property. The case of overlapping or ranked tenders is more complex because there are good reasons to expect that labour or other constraints may be reached for individual landholders. Ranked tenders are less distortionary and are easier to incorporate into the selection process and therefore preferred to over-lapping tenders.

Asymmetric Information – salt benefits of management change

Landowners do not know the specific quantity of salt movement in Wimmera streams that a change to their management would generate. However, revealing full information about change to salt encourages pricing based on salt reduction rather than costs of management change as well as creating project support problems in calculating a number of alternatives for any particular landholder before they settled on a final bid. Hence, in this case a practical compromise was used whereby graded salt maps for the SHC are released showing high, medium and low predicted salt yield areas. This represents a pragmatic trade-off between the necessary information about salt yields needed in order to obtain bids with the highest contributions to reducing salt loads maintaining clear incentive signals.

Scientific uncertainty

Three aspects of scientific uncertainty may cause market failure:

1. Insufficient knowledge about biophysical relationships and consequent salt impacts;
2. Insufficient knowledge about management action outcome efficacy; and,
3. Public concerns about management action efficacy.

Sufficient knowledge about biophysical relationships is an essential input to an effective metric, which is needed to underpin any MBI. Wimmera CMA is confident that the existing level of knowledge is sufficient for an effective metric to be developed. A related concern is the ability to compare alternative management actions, particularly newer approaches. There is a high level of confidence that changing land management based on recommended best management practices (BMPs) for the SHC would eventually impact on salt movements. It

[14] Ranked tenders are defined as a series of tenders that are ranked in order of priority, and for which acceptance of each subsequent tender is dependent on acceptance of the previous tender. For example, a landholder submits three tenders, for 10ha, 30ha and 15ha ranked in that order. The 30ha tender can only be accepted if the 10ha bid has been accepted and the 15ha bid if both other offers have been accepted. The equivalent overlapping tenders would be a 10ha tender, 40ha tender and 55ha tender.

is less clear whether bids containing BMPs for salinity outcomes can be adequately distinguished and ranked against bids containing a newly developed, but high risk and untested alternatives. The trade-off here is securing the best possible outcomes for the budget allocated, versus constraining innovation. Restricting bids to recognised BMPs ensures confidence in outcomes being achieved but may constrain innovation in management and implementation. This is an important consideration because ongoing innovation drives increasing benefits from MBIs compared to alternative instruments.

Wimmera landholders have indicated concerns about the efficacy of management actions to deliver NRM outcomes (Curtis & Byron 2002). Generally, efficacy concerns tend to reduce willingness to participate in schemes because they reflect lower private values for outcomes. More importantly these concerns can impact on the confidence that taxpayers' money is being well spent and thus ability to secure future investment in such schemes. It is unlikely these concerns alone would cause failure of a competitive tender where a concerted communications effort is undertaken.

Difficulty measuring and monitoring success

Difficulty in measuring the success of outcomes ex-ante, and the likely requirement for a significant proportion of payments to be made up-front (either cash or supplying materials/services), leads to Wimmera CMA bearing a significant proportion of the risk of failure to achieve successful management change. In addition, heavy handed monitoring and sanctions will be unfavourably received by the landholder community and may be counterproductive. There are a number of strategies that could be pursued to minimise the risk to the CMA, but all require a trade-off between flexibility on the part of participants and monitoring effectiveness on the part of the CMA. Potential strategies include:

1. Including an ongoing payment component that is sufficient to encourage successful implementation of management change despite the risk of potential participants deciding not to tender;
2. Controlling the quality of inputs via a specific contract with service providers or accreditation of third party suppliers;
3. Increase *ex-post* monitoring efforts despite the potential disadvantages; and,
4. Identify *ex-ante* indicators of commitment and likelihood of successful implementation.

The primary area of ensuring compliance is monitoring critical inputs via directly sourcing production or certifying third party suppliers. For example, Wimmera CMA may sub-contract some inputs such as tree planting directly with third party suppliers. This may come at the cost of reduced benefits from a competitive tender because any difference between landholder costs for that action can no longer be leveraged. The higher the level of landholder understanding of the management technique, their on-farm capacity to undertake the activity, the ease of monitoring the quality of outcome, and the greater the range of cost structures expected, the greater the benefits from including these within landholder tenders. However, spreading risk in this fashion can have detrimental impacts such as a lack of ownership of outcomes. For example, landholders may fail to manage trees planted by a contractor because there is a feeling of reduced ownership and responsibility for success.

An alternative way to manage risk is to increase *ex-poste* monitoring and sanctions. Monitoring is often viewed as invasive, and indeed offensive (as are sanctions), to the many trustworthy and community minded participants in improving natural resource management. Less formal forms focusing of monitoring are preferred and focus on demonstrating success, thus facilitating "public accountability" for projects. For example, a non-intrusive way of demonstrating success is establishing consistent photo points across projects with these images being published on a web site. This has the advantage of being less invasive, cheaper to conduct, and can market future landuse change.

Anecdotal evidence from competitive tenders undertaken elsewhere suggests that higher quality tenders are more likely to be effectively implemented with greater probability of successful outcomes. However, it is important that any indicator of bid quality is incorporated through a transparent and repeatable process in order for natural justice to be followed and so that potential participants are aware of any requirements. The key aspect lies in designing tender forms to ensure that landholders are fully aware of the actions that they will need to take to ensure a successful change to management. In the SHC case this will take the form of a reasonably detailed management plan submitted as part of the tender. True sanctions such as payment removal and legal actions are credible, but generally considered "weak" due to the small likelihood they would be invoked. Schemes in Australia all tend toward public accountability rather than sanctions.

Mechanism design for other relatively minor market failures

<u>One market or many</u>

It is often argued that multiple ecosystem services should be addressed by a single MBI, or certain MBI's should directly pursue side objectives. Multiple issues should only be incorporated into a single mechanism when significant correlation between outcomes is anticipated given the ecosystem services potential of the landscape and the potential management actions anticipated. In the case of the Wimmera SHC, management changes may contribute small but measurable side contributions to biodiversity and carbon sequestration. Because these services are expected to be small relative to the salinity impacts and because of the difficulty and cost in measuring and comparing additional side objectives, the initial scheme will focus on a salinity outcomes alone.

Generation of further ecosystem services and other side objectives, albeit minor, creates the issue of who should own the rights to these services or measure their production: the CMA or the landholder. Landholder ownership is supported by existing research in this area.[15] A potential role may remain for the CMA in assisting landholders to access existing or new markets, for example via a brokerage or pooling role. The pooling option may be particularly attractive where there are significant economies of scale in bundling together the ecosystem services produced by different landholders both within and beyond the scheme.

<u>Tools and techniques – an information failure</u>

Information failure was initially identified as a potentially serious market failure but consultation with target landholders indicated that existing knowledge is likely to be sufficient for effective engagement. Two communication strategies will be applied to minimise the possible impacts of tools and techniques information failure. First, generic information about the nature of SHC recharge and consequent salt movement will be provided to interested landholders. Second, tender support staff will advise landholders on detailed attributes of management change, including aspects such as site preparation, timing of planting, and sources of necessary inputs such as machinery or seedlings. Detailed support in this fashion is likely to lead to higher quality bids and improved chances of successful management change.

---

[15] See for example, Strappazzon et.al. (2003) 'Efficiency of alternative property right allocations when farmers produce multiple environmental goods under the condition of economies of scope', *Australian Journal of Agricultural and Resource Economics*, 47(1), pp. 1-28.

Market power

Either too few participants or the impact of large individual participants generally drive market power issues. There are unlikely to be dominant large participants in the SHC case. However, there may be too few participants. Competitive tenders are reliant on inducing competitive behaviour amongst potential participants. While there is no technical minimum number of participants in a competitive tender arrangement, the efficiency advantages of these tools over others, such as negotiated individual agreements, are reduced as the proportion of tenders accepted increases. This is particularly the case when the cost of designing and managing a competitive tender process is considered. Hence, an assessment of the minimum number of tenders required against the number of eligible landholders and likely participation rates should be undertaken to inform both the extent of the communication process required and the likelihood of success.

Constraints to market entry

Two likely constraints to market entry are upfront capital requirements to invest in ecosystem services production and the costs of participating in a new and unknown instrument with indeterminate likelihood of success given a lack of previous experience. Upfront capital constraints have been discussed within the asymmetric information and measuring and monitoring success sections and are not repeated here.

Preparation of tenders is a time consuming and potentially costly process for all concerned. In some cases it may be worthwhile considering compensating those submitting tenders for the efforts required in preparation and submission, particularly where these costs are anticipated to reduce the number of potential tenders below target rates. In general such payments should be flat rate, only be sufficient to cover costs of tender preparation and submission and be made to both successful and unsuccessful tenders that meet the submission guidelines. Tender payments should obviously only be used to solicit genuine tenders rather than to meet a target number of offers.

Other mechanism design issues

There are a large number of other potentially important mechanism design issues of which we focus on four: interactions with existing policy; changes to stakeholder expectations; permanent versus temporary change to service delivery ("permanence"); and transferring environmental harms (leakage).

MBIs are not implemented in isolation and are commonly considered in conjunction with, or following on from existing incentive mechanisms. The new MBI mechanism may support or conflict with existing instruments. In particular, potential exists for landholders to systematically game different incentive packages in order to maximise their individual returns. From an implementation point of view there are some practical steps that can be undertaken to manage these interactions by avoiding overlaps between existing and continuing schemes be minimised. Where overlaps cannot be avoided consideration should be given to requiring landholders to only bid to one scheme for any specific action, or removing/suspending parallel schemes.

Another consideration in mechanism design is the long-term change to expectations that results from a change to MBIs, particularly if marketed as direct payments for ecosystem service provision. Experiments from around the world have shown that it can be very difficult to remove service type payments once they are established. Similarly, experimental evidence suggests that payment schemes change the expectations of potential participants. Therefore, non-participants, or loosing tenderers may reduce their management effort with respect to the desired service. Likewise, if the payments are discontinued participants are unlikely to return to pre-scheme voluntary levels of provision (termed institutional crowding). The experimental evidence suggests these differences are non-trivial and should be an important consideration in MBI consideration and design. Hence, care should be taken to limit expectations of the scale and term of future MBIs in the region.

There are a number of pathways that recharge can be influenced, some of which are more permanent than others. For example, native vegetation regeneration more than ten years old effectively becomes permanent due to native vegetation laws. Alternatively, covenants can be used to secure permeance of service delivery by linking vegetation cover changes to the title of land. There are two aspects to the relative permanence of change: first, the cost to make change more permanent, which includes at the least either an extended length of contract or direct legal fees; and second the benefits to recharge from legally restricting future options. Furthermore, the relative permanence of change can be considered as a weighting within the metric design process or as a bonus payment outside of this process. If the likelihood of landholders reversing management changes is low there is not likely to be a significant benefit from pursuing additional legal protection when compared to the costs of achieving that benefit. In this case, beyond scheme duration of service delivery is not secured as contracts are generally for a specified period only.

Finally, in this case transferring environmental harms (leakage) is not considered an issue (spillovers are discussed under metric design). Existing regulations and the current baseline are essentially at a minimum across the entire region (that is: in the case of vegetation, clearing has been so extensive there are no further opportunities to clear in this landscape). What remains is heavily guarded by existing clearing regulations.

4.2 Case Studies Two and Three

Case studies two and three are presented in less detail to provide and overview of the differences between price based, quantity based and market friction instruments, although it should be noted that within group differences may be just as large.

4.2.1 Quantity Based MBI – Development Offsets in a Rapidly Growing Regional Centre

The Murrindindi Shire in Victoria, Australia is an attractive rural area that is undergoing increasing subdivision of farms into smaller land units used for hobby farming and rural residencies. This change in landuse has the potential to adversely impact on important ecosystem services for future residents, including those purchasing hobby farms and rural residencies, and for downstream communities in the Goulburn River Catchment. The major ecosystem services of interest are water quality (including sediments, nutrients and salinity issues), quantity, biodiversity and amenity values.

The challenge in this case is to design an instrument that would protect existing ecosystem services during and beyond the change to landuse rather than to increase production of an important ecosystem service.16 Following the paths set out in Figures 5 and 6 we have identified significant potential to leverage heterogeneity within the catchment and are now exploring how the market failures in the current system could be overcome. In summary, we have found that the property rights are incomplete and that the ecosystem services are largely non-excludable. The focus has therefore been on the application of development

[16] Some of the ecosystem services of importance are under produced. However, enhancing their production is a different issue to protecting existing ecosystem services during landuse change. Nevertheless, it is important to consider the consequences of any proposed MBI for future policy development to enhance ecosystem service protection.

offsets in this context. The major market failures anticipated together with the mechanism design solutions is shown in Table 3.

Table 3: Market failures and mechanism design for development offsets in Murrindindi Shire

Market Failure	**Issues**	**Description**
Property rights and excludability	1. Allocation	Rights recognised in development application process.
	2. Metric design	Vegetation services, biodiversity and water quantity via existing Victorian frameworks. Nutrients, sediment and aesthetics still being considered.
	3. Relative Change	Goal is protection of baseline ecosystem services.
	4. Non-excludable	Protect production due to non-excludable consumption.
One market or many?	1. Multiple outcome markets.	Each ecosystem service must be offset but allow single action to cover multiple services where appropriate.
Asymmetric Information	1. Costs	Revelation via decisions about whether to mitigate onsite or offset offsite.
	2. Benefits	Covered via metric included in development application requirements.
Tools and Techniques	1. Unknown or unfamiliar	Provide information to developers.
Scientific uncertainty	1. Production relationship	Most pathways are well known but metrics not yet developed for all ecosystem services.
	2. Public concerns about efficacy	Communicate aims and processes of development offsets program to community and stakeholders.
No common market place	1. Create market place	Consider creating offset banks or cooperating with third parties to ensure offsets available to developers.
Market power	1. Small numbers	Identify required numbers and ask whether practical.
Difficulty measuring and monitoring success	1. Principle agent issues	Difficulty with ex-ante actions – ex-poste outcomes and long time horizons. Ensure offset actions have good probability of success.
	2. Cost of monitoring	Offset banks and third party providers may simplify monitoring process.
Other issues that should be considered	1. Changes to stakeholder expectations	Main issue is perception of allowable damage. Communication of actions and clear rules for offsets will minimise this.
	2. Interaction with other programs	Given the complexity of development planning requirements this is a major issue, especially as development offsets have the potential to significantly increase transaction costs if not well designed.

Many issues are similar for the quantity-based development offsets instrument as a price based instrument. In particular in this case a non-excludable good for which property rights are not well defined. However, the issues in market design differ substantially because of the need to create an offset market with both buyers and sellers of offsets. Furthermore, a key element in offset design is the integration of the new instrument within a large number of existing development requirements. Integration requires particular attention to the transaction cost consequences of any interaction between the new MBI and existing command and control planning regulations.

4.2.2 Market Friction Example – Enhancing native seed supply in Australia

In Australia, re-establishing native vegetation is critical to addressing many environmental issues and re-establishing important ecosystem services. However native seed is in short supply, in particular there is a scarcity of seed of high value to biodiversity conservation and provision of certain ecosystem services17. That is, there is market failure in the underpinning native seed market. Broadly, the native seed industry is fragmented and inadequately structured leading to a failure to meet this demand. Institutional, industry and biophysical constraints are implicated to varying degrees in this market failure. To address these issues, a market friction based solution built primarily on addressing information failures through industry development, certification and web based information, and seed purchase support is being designed to address these market failures. Once again, a focus on the market failures provides robust input into the solution design, which is summarised in Table 4.

Table 4: Market failures and mechanism design solutions for native seed industry.

Market Failures	Issues	Description
Property Rights and Excludability	1. Metric.	Seed quality metrics are poorly defined – but quality is important to ecosystem service and biodiversity outcomes.
	2. Excludability	Underpinning good is excludable.
Asymmetric Information	1. Buyers	Buyers do not have a visible measure of seed quality.
	2. Sellers	Sellers have limited tools to forecast market demand due to the vagaries of demand side economics (government agendas and market trends). Industry tracking, ordering and forecasting capability required.
Information Failure	1. Tools and techniques	Provenance specific collection tools and techniques are often unknown to collectors. Industry development and training required to meet increasing demand for provenance specific seed.
Scientific uncertainty	1. Ecosystem service production relationship	The link between use of provenance specific seed and important ecosystem services is not well established and accepted.
No common market place	1. Create market place	Facilitate creation of market place designed to facilitate information flows and reduce transaction costs – in this case through web based service provision.

[17] Ecosystem services such as salinity control have been shown to be enhanced where provenance considerations are taken into account in seed supply.

Market power	1. Fragmented supply side – small players	Fragmented suppliers serve small areas – can hold local monopolies and small niches.
	2. Large players	Current impact tends to result in price setting and dictating quality expectations in the market.
	3. Buyers	Small number of large buyers may develop market power – although considered unlikely.
Difficulty measuring and monitoring success	1. Principle agent issues	Difficulty determining seed quality till growth performance becomes observable – can be years. Quality based accreditation will enhance buyer confidence.
Other issues and constraints to market formation	1. Entry	Many entries and exists from supply side reduces average industry skill levels – accreditation may increase desirable barriers to entry/exit.
	2. Spillovers	Seed collection activities when poorly managed can have a negative impact on natural populations.
	3. Agendas and trust	The seed industry is established and thus, has pre-existing agendas, relationships and concerns. Communication and commitment to transcend these issues will be required.

Market friction based MBI applications differ from quantity and price based MBI's in one key attribute – a market is already in existence and property rights are already established (although perhaps poorly defined). Market friction MBI's are usually developed in an environment where a market is already functioning and thus relationships and processes are established (possibly entrenched), and there are already supporting rules and regulations. Market friction tools tend to focus primarily on removing market failures in order to reduce transaction costs and facilitate mutually beneficial exchanges that realise gains from trade. In the case of the Australian native seed industry, the key market failures are asymmetric information, information failures and the absence of an accepted property right metric relating to quality. These can be reduced and/or removed by developing quality based accreditation measures for seed supplies, industry development through training, and targeted open source information provision targeting tools and techniques and web based transaction support. In this case, there are additional agendas and pressures derived from government natural resource goals, participation of non-government conservation organisations and private sector industry interests.

5 Discussion

In recent times a number of new and innovative MBIs have been developed and trialled within Australia.[18] In this paper we have detailed just three of a number of innovative MBIs that are in the process of implementation in Australia; a competitive

[18] See for example the eleven pilots within the National Market Based Instrument Pilots Program at: www.napswq.gov.au

for recharge management in Wimmera CMA; development offsets for managing the ecosystem services impacts of rural residential and hobby farm development in Murrindindi Shire; and a market friction instrument to improve native seed markets in Australia.

The Australian experience suggests care in MBI selection, design and implementation is vital to success. Each of the instruments we have described has been developed from a detailed analysis of the characteristics of the ecosystem service issue and the market failures that would need to be overcome in designing an effective and efficient MBI solution. The careful analysis of the underlying requirements for MBIs is critical. In other cases not reported in this paper our analysis has indicated that the underlying heterogeneity requirement is insufficient to drive a MBI solution and other policy options should be explored.

Detailed consideration of mechanism design issues is also critical to the design of effective MBIs. For example, in the case of competitive tenders there are three elements that are absolutely critical to successful MBI outcomes. First, the metric must be able to accurately link management change to changes to outcomes. Second, the competitive tender processes must be robust and effectively engage with the community in seeking bids to change management. Third, mechanisms must be in place to ensure that management changes are successfully implemented to ensure that the desired outcomes are in fact achieved and thus taxpayers' money is well spent. Within each element there are a number of important design elements such as identifying whether landholders have a clear understanding of the management changes desired.

6 References

Curtis & Byron 2002. *Understanding the Social Drivers of Catchment Management in the Wimmera Region.* Wimmera catchment Management Authority, Victoria, Australia.

Murtough, G., Aretino, B., and Matysek, A., 2002. *Creating Markets for Ecosystem Services*. Productivity Commission Staff Research Paper, Ausinfo, Canberra.

NMBIPP 2004. 2004 *Managing our Natural Resources: Can Markets Help?*. National Action Plan for Salinity and Water Quality – National Market Based Instruments Pilots Program. Australian Federal Government. Canberra.

Ostrom, E. and Schlager, E., 1996. *The Formation of Property Rights*. Island Press, Washington D.C.

Stoneham G., Chaudhri, V., Ha, A. and Strappazzon, L. 2003. 'Auctions for conservation contracts: an empirical examination of Victoria's BushTender Trial', *Australian Journal of Agricultural and Resource Economics,* 47(4) pp. 477-500.

Strappazzon L., Ha, A., Eigenraam, M., Duke C. and Stoneham, G. 2003 'Efficiency of alternative property right allocations when farmers produce multiple environmental goods under the condition of economies of scope', *Australian Journal of Agricultural and Resource Economics,* 47(1), pp. 1-28.

Whitten, Shelton & Langston 2004. *Market based Instruments – A rapid assessment technique for identifying the potential for MBI application*. Rural Industries Research and Development Corporation. Canberra (in press).

Wills, I., 1997. *Economics and the Environment, A signalling and incentives approach*. Allen and Unwin, St Leonards, Sydney.