The Environment for sale?

The examination of the critical features of a third-party in facilitating a transaction in the market for environmental offsets.

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25 May 2008

Submitted in partial fulfilment of the requirements for the International Master's Programme in Environmental Studies and Sustainability Science (LUMES), Lund University, Sweden

Abstract

Offset markets for non-traditional market goods differ around the world, from design of market mechanism to what they aim to protect. The goal however for any market mechanism is for a transaction to take place between buyers and sellers. The offset market for environmental goods (such as native vegetation and biodiversity) is an artificial market and faces unique challenges by grace of being socially constructed and because of the commodity being traded. Because of these challenges, a third party is necessary to facilitate a transaction between buyers and sellers.

A survey of the most common offset schemes in Australia and the United States of America is conducted and the third party identified. Two broad approaches were identified: a bank based approach and a combinatorial double auction approach. The critical features and functions of the third party facilitator with relation to their role in a successful transaction have been established and are presented in a 'Transaction space' diagram. This diagram focuses not only on *what* offset schemes must overcome but *when* the potential transaction-stopping problems will occur. The analysis then focuses on the differences between the two approaches and their respective methods of overcoming the difficulties inherent with offset markets with-respect-to a third party facilitator. The differences are considered and possible reasons for their occurrence discussed. The combinatorial double auction approach is found to consider more thoroughly the critical functions and thus has a higher chance of a successful transaction taking place. Recommendations for further research are made.

Keywords: offset markets, third party facilitator, barriers to transaction, Australia, United States of America, biobanking, combinatorial double auction

Word count: 14 287

The author would like to thank several people without whom this finished product would not have been possible. To the Victorian Government Department of Sustainability, in particular Veronika Nemes, Gary Stoneham and Ingrid Burford for providing valuable guidance and support. Thank you for welcoming me into your team. To Louise Gilfedder from the Tasmanian Government Department of Primary Industry and Water for putting me on the right track many months ago. To my interviewees thank you for taking the time to talk to me. To my supervisor Anne Jerneck for her sage advice and cups of tea. Finally to Christine Howard, Jeannie-Marie LeRoi, Robin Goldstein and Roseann Dunne for their invaluable feedback and proofreading skills.

Thank you

List of abbreviations used

CB	Conservation Banking
DECC	Department of Environment and Climate Change
DSE	Department of Sustainability and Environment
EBB	Electronic Bush Broker
EPA	Environmental Protection Agency (United States and Australia)
EPAA	Environmental Planning and Assessment Act 1979
FWS	Fish and Wildlife Services
MC	Marginal Cost
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NVA	Native Vegetation Act 2003
OECD	Organisation for Economic Co-operation and Development
P	Price
TDR	Transferable Development Rights Schemes
UNFCC	United Nations Framework Convention on Climate Change
USA	United States of America
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
WCED	World Commission on Environment and Development
WMS	Wetland Mitigation Scheme

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1 Introduction

Market-Based Incentive Schemes (MBIS) have recently gained in notoriety and popularity to become a prevalent policy tool for decision-makers to encourage behavioural change towards more environmentally sustainable behaviour; specifically sustainable development. A well-known example of a MBIS is the carbon market, which is one of the mechanisms under the Kyoto Protocol employed to reduce greenhouse gas emissions (United Nations Framework Convention on Climate Change (UNFCCC), 2008). The carbon market works by assigning a value to greenhouse gas emissions, known as 'credits'. Countries able to reduce their greenhouse gases easily/cheaply to below the limit they have been assigned (under the Protocol), will then have a surplus of credits. These credits can thus be traded like any other commodity (UNFCCC). Environmental offset credits are an important tool seeking to combine the economy and the environment, but they exist in a difficult and emerging market which can hinder their effectiveness.

MBIS exist in an artificial market; a market which without intervention from Government would not exist. Some examples of non-traditional market goods which such artificial markets aim to protect are wetlands, native vegetation and biodiversity. These markets for non-traditional market goods have inherent difficulties in comparison to natural markets because the measurement for one unit of this good (i.e. biodiversity) is subjective. These difficulties are not the same for all MBIS for non-traditional goods: in the carbon market, the unit traded is one tonne of carbon which is comparatively easy to measure. The other important difference between MBIS for non-traditional market goods from naturally occurring markets is whilst informally they mention credits, because of the nature of the good being traded, they are in fact a market for contracts (Nemes, Plott, & Stoneham, 2008). Biodiversity credits thus refer to areas of land which a party has agreed to manage to maintain a specified level of biodiversity for a certain time period.

In a naturally forming market, buyers and sellers are able to identify each other, negotiate a transaction and (assuming clearly defined and enforceable property rights) execute a trade resulting in a higher level of utility for both parties. Utility in economic terms can refer to well-being or profits (Gustafsson, 1998). In created markets more barriers to transactions can evolve (i.e. time restrictions, factors relating to a thin market and matching problems); this may result in a transaction not being executed. Market failure (i.e. no transaction occurring between buyers and sellers) is not unique to artificial markets; however because of the nature of the market and the goods being sold, market failure in created markets for non-traditional goods is more common. For this reason, a third party is often needed to ensure transactions take place between buyers and sellers (Nemes et al., 2008).

The third-party facilitator (TPF) is normally the government; however there are some examples where a non-governmental organisation has played a part; for example in the USA where a non-profit organisation is responsible for monitoring the management plan of a developer's credit bank. The functions that the TPF fulfils varies between markets, but the most common roles include providing information about the MBIS to buyers and sellers, matching buyers and sellers, matching credit types, and monitoring and enforcing offset outcomes.

This thesis will look at the different functions TPFs fulfil, and how these functions impact on the probability a transaction will take place. MBIS in Australia and the USA are examined. The history, commodity at stake, and supporting and trigger legislation will also be included in the analysis as these variables might influence what type of a MBIS is constructed and implemented and (based on the supporting structure) could determine if the MBIS is successful (i.e. if a transaction occurs). Several inductive questions were considered throughout this investigation.

1.1 Research questions

1. What are the most used approaches to MBIS in Australia and the USA and what are the credits traded?
2. How do the MBIS differ within and between Australia and the USA?
3. What are the critical functions a third party facilitator performs to facilitate a transaction between buyers and sellers in an offset credit market?
4. How are markets for environmental offsets related to sustainable behaviour?

1.2 Context of Sustainability

Typically sustainability and economic efficiency are conflicting terms. Economic efficiency involves maximising the net present value of society's well-being (van Kooten & Bulte, 2000). The reason for the conflict lies in the definition of sustainability: meeting the needs ... of the present without compromising the ability to meet those of the future (chapter 2, World Commission on Environment and Development (WCED), 1987) known as the Brundtland report. Because sustainability encompasses future value (and not just the present value) there is a potential conflict with economic efficiency.

The current paradigm in which our society works is a market-based paradigm. Markets theoretically allow the most efficient allocation of goods (high economic efficiency). The present situation in which humankind finds itself however demonstrates that externalities which negatively impact the environment for the majority are not considered when goods are efficiently allocated via the market system. MBIS are a positive step forward for sustainability because they include environmental externalities in the market sphere, whereas previously it has been difficult to incorporate environmental externalities into market transactions. There are a number of reasons why environmental externalities are often not incorporated into market transactions including valuation difficulties and the nature of managing public goods where access is impossible to restrict. MBIS attempt to address some of the valuation problems.

With the environmental threat from anthropogenic global climate change and the current financial crisis threatening livelihoods, MBIS offer a win-win situation as they provide an economic incentive to protect an environmental asset. However these artificial markets are fragile and if the barriers to transaction are too high then market failure will occur and no transaction will take place. The functions the TPF performs are critical to ensure that a transaction takes place and the market functions.

There are two approaches towards the concept of sustainability coined in the Brundtland report. Strong and weak sustainability are both approaches to the ideal of sustainability, but with different foci. Strong

sustainability is the idea that the natural capital stocks must not be depleted over time, whereas weak sustainability focuses on income not being depleted over time (El Serafy, 1997). All of the mitigation schemes have the legislation that any offsetting must result in either equal or improved environmental values to the area. The strong sustainability paradigm provides the impetus which gives rise to legislation for implementation of MBIS. In the United States, the impetus for the Wetland Mitigation Scheme is no net loss to wetland. In Victoria, Australia, the combinatorial double auction scheme is based on the idea that there will be no net loss of native vegetation.

1.3 Background

One motivation for governments to protect biodiversity is found in several different international conventions. The Ramsar Convention 1971, the Bern Convention and the United Nations Convention on Biodiversity and just three example where protection of biodiversity is mandatory (State of New South Wales, 2006). Markets were recognised as being capable of solving environmental problems by Coase in his seminal paper on social cost which discovered that all costs are reciprocal, and thus transactions can theoretically solve environmental problems (Coase, 1960). The United Nations Convention on Biodiversity explicitly states in Article 11 of COP 7 that there should be a greater focus and more research on markets and payment schemes for ecosystem services at local, national and international levels (Secretariat of the Convention on Biological Diversity, 2008). Some countries have embraced the idea of using markets to solve environmental problems more fully than others.

Countries all over the world were searched for MBIS and the existence of environmental offset markets and a purposive sample of Australia and the United States was chosen. Other examples of MBIS were found, however the majority identified were carbon-focused. For example, Canada has an offset policy for mitigation of greenhouse gasses (see Government of Canada (2008) for more information). The European Union's Natura 2000 policy states that 'Care must also be taken to prevent, minimise and offset any potential damages to biodiversity arising from climate change adaptation and mitigation measures' (European Communities, 2008, p. 1) and there are guidelines on how to assess projects which impact on Natura 2000 sites (see (European Communities, 2002)). It is however the responsibility of member states to determine the procedural requirements and no information about offset markets (as opposed to offsets) was found. Because of space and time limitations, and the lack of information about offset markets the EU was not included in the investigation.

Brazil has an established a forestry offset scheme but mitigation is carried out solely through payments to Brazil's National Protected Areas Scheme (McKenny, 2005) and no market for environmental offsets exists which is why Brazil has been excluded from the analysis.

The United States of America was chosen as an example because they have been using MBIS for nearly 20 years now to protect their wetlands (Environmental Law Institute, 2002). Australia was also selected because three Australian states (Queensland, New South Wales and Victoria) will have an environmental offset market in place by the end of this year[1]. It is interesting to compare the USA and Australia

[1] Western Australia has legislation which prohibits the clearing of native vegetation. Landholders who wish to clear must apply for a permit to do so, and in some cases offset their intended clearing (Government of Western

because Australia has not always chosen the same methods as the United States. This study aims to identify firstly what the critical functions of a TPF are, compare the schemes identified in the USA and Australia and discuss why the emerging market in Australia has deviated from the 'known' approach used in the United States.

This thesis aims to contribute to the discussion about the emerging environmental offset market and not only provide information for governments wishing to enter the market/set up a MBIS themselves, but also supply current participants with some explanations as to why their markets may not be functioning as well as they might. There is much information available in the literature about barriers to transactions[2] however there is not much literature available which is specifically focussed on the market for environmental offsets.

2 Methods and design

2.1 Methodological approach

The research conducted for this thesis was of a qualitative nature. Bryman (2004) suggests that qualitative research involves investigating the relationship between theory and research, wherein theory evolves from research conducted (an inductive approach). This thesis is based on research of environmental offset markets and aims to provide a set of criteria (or theory) of what must be considered if a successful transaction is to take place. The contribution the thesis will make is however not solely inductive nor is it solely based on grounded theory. The starting point for analysis is based on existing theory on market failure for traditional markets. The intended contribution will build on what is already known about market transactions, through the 'measuring' of the different MBIS against the identified critical functions of the third-party in facilitating a transaction.

The process of thesis construction also followed the main research methods mentioned in Bryman (2004) as relating particularly to qualitative research which was starting with a general research question, collection and interpretation of data, conceptualising the problematique, asking a new research question, collecting more data and then writing up findings. Research was supplemented with qualititative interviews. Epistemologically, this thesis takes an interpretivist approach, and seeks to understand concepts through the interpretation of offset markets from an economic viewpoint.

This thesis also takes some of its theoretical framework from social learning. Bandura (2003) writes that social learning is a process whereby individuals learn from successes and mistakes of others, as opposed to the process of trial-and-error. The community directly affected by offset markets will benefit from the increased knowledge this thesis provides, but no actual MBIS were constructed using information from research and then trialled.

Australia, 2007). Offsets in this sense however refer to direct actions by a landholder, and there appears to be no intention of establishing an 'offset market' for non-carbon credits as in the other three Australian States. For this reason Western Australia was not included in this analysis.

[2] For further reading on this topic see Barzel (1982), McCann, Colby, Easter, Kasterine and Kuperan (2005) Pehrsson (2009) and Yao (1988).

At all opportunities triangulation of data was employed to increase the credibility of the data (Bryman, 2004). However because much of the analysis relied on government documents this was sometimes not possible. When there were gaps of knowledge after reading government documents and peer-reviewed journals, interviews with relevant people were conducted to supplement the knowledge base.

The framing of the issues covered in this thesis could be interpreted from either an economic or an environmental perspective. It was decided however that because this thesis has a specific focus on a transaction occurring between buyers and sellers in the market for environmental offsets, the framework of this thesis was economic, with the specific case of the environmental offset markets.

2.2 Data availability

A review of articles relating to offset schemes and policy documents was conducted to identify the types of MBIS currently in use and to catalogue the development of MBIS as a policy tool from the earlier schemes to the current day usage. Phone interviews were conducted with government officials and business professionals in the USA and Australia when certain aspects of the respective schemes were not apparent or information was not available on the internet.

Some of the questions referred to when reading include:

- What is the policy environment which leads to a MBIS being made?
- What is the supporting legislation that triggers an offset scheme?
- What are the different approaches to offsetting environmentally destructive behaviour?
- How is a transaction made?
- Who is the third party?
- What role does the third party play in matching buyers and sellers?
- What role does third party play in 'like for like' offset matching?
- Will the threat of enforcing and monitoring affect a transaction being made?
- Are there any commonalities within the third parties?
- What are the factors which impede a transaction being made?

No specific interview schedule was used for the telephone interviews; rather questions related specifically to the information 'holes' which arose after the relevant policy documents and online media had been consulted.

The five schemes analysed in this study were chosen because they provided a cross-section of the different approaches to environmental offset markets. Because there are so few working examples of environmental offset markets, the yet-to-commence Australian schemes were included in the analysis.

3 Analysis

All information was organised in an Excel spreadsheet as the first analytical step. A set of criteria for market failure against which the different MBIS could be evaluated was compiled from peer-reviewed literature and intuitively from reading the government documents.

While none of the Australian schemes are currently in operation, they are either starting this year (2009), commencing field trials this year or will start next year. Lack of implementation will not impact analysis as this thesis is not focussed on the outcomes of these schemes; rather it focuses on the market design. The Australian schemes have already been designed and thus meet this focus.

In the literature and policy documents environmental offsets and credits are used interchangeably. This thesis uses both as the term for the unit traded in MBIS.

3.1 Limitations

This thesis will not consider the environmental fairness of these schemes (i.e. if these schemes are designed with the optimal environmental outcome in mind) or the environmental success of the schemes (do they achieve what they aim to?). An assessment of the environmental impact of credits is vital to fully assess the link between offset markets and sustainability; however this topic was too broad for the space and time allocated for this thesis. The focus of this thesis has been narrowed to what roles a TPF performs in the offset-market and how do these functions influence a transaction between buyers and sellers. If a transaction between buyers and sellers is achieved, then the offset market can attempt to realise the 'no net loss' goal, which was the explicit reason why the offset market was initially created.

Whilst the market for carbon credits is a good example of a functioning MBIS and associated credit market, it will not be included in this thesis. The carbon credit market differs significantly from other offset markets as the tradable unit (carbon dioxide gas) is ubiquitous and indistinguishable in different areas. This eliminates several of the difficulties other credit markets face and, will not be included in this thesis.

4 Scope of analysis

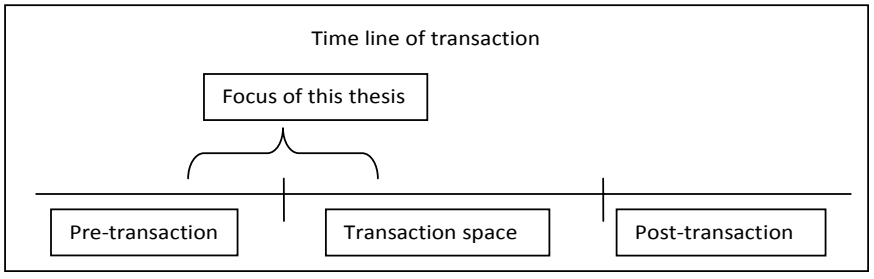

Figure 1 Transaction timeline

The criteria which influence the probability of a transaction occurring have been split up into two time periods. There is a pre-transaction time period and then a during-transaction time period. Figure 1 shows the pre-time line and Figure 2 shows in more detail both time periods. Both figures has been constructed by the author and are based on information in the literature on market failure, which has then been put in the context of a transaction occurring in the market for environmental offsets. Initially the complexities explored in the paper by Nemes, Stoneham and Plott (2008) were to be the criteria with which to compare the different MBIS. However upon investigation of the different schemes and through the

relevant literature it was discovered that there were other factors which merited attention and could influence a transaction occurring, as illustrated in Figure 2.

4.1 Explanation of criteria

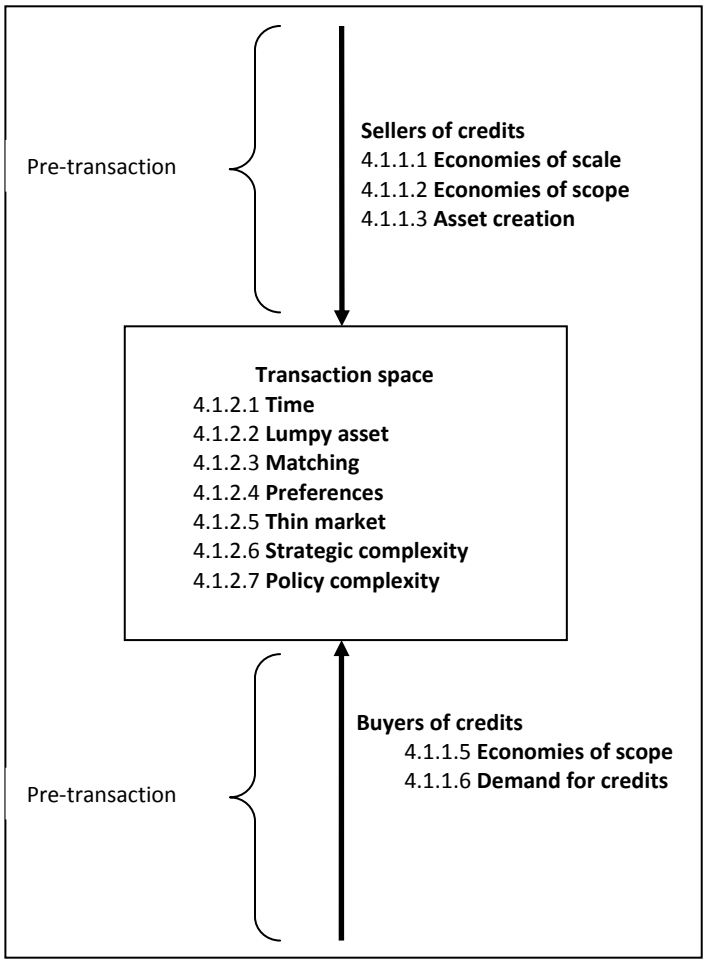

Figure 2 Transaction space diagram

4.1.1 Pre-transaction

The criteria in this section influence whether or not a seller or buyer enters the market. Gustafsson (1998, pp. 264-265) writes that one of the conditions which must be satisfied for a market to exist is the existence of many traders to ensure competition and to make traders 'price takers'. Not only is it important that the actual number of traders is large enough, but also important is the perception that there are sufficient traders. This perception (accurate or not) can influence the decision by buyers and sellers to enter/exit the market. This idea of a 'thin market' (i.e. low number of buyers and sellers) will be explored in more depth in the transaction space section.

Sellers of credit

4.1.1.1 Economies of scale

Economies of scale are defined as the long-run average costs falling as output increases. (Bougherara, Grolleau, & Mzoughi, 2009; Common & Stagle). In a traditional market, firms may choose to enter a market if there is profit to be made; specifically if P > ATC (Gans, King, Stonecash, & Mankiw, 2000) where P stands for price of the good and ATC for average total cost of production of the good. In the market for biodiversity credits, providers of credits may find there are economies of scale in producing a larger amount of credits. An example could be a firm decides to buy 100 acres of land for a credit bank and finds the ATC to be lower than if they were to buy only 10 acres. The firm experiences reduced marginal cost (MC) for each extra unit of land purchased. It is a much better environmental strategy to manage larger areas as opposed to several smaller areas, (known as patchwork mitigation (Martin, Shearing, & Warren, 2007)). The existence of economies of scale has implications on the number of credits supplied to the market for environmental offsets.

4.1.1.2 Economies of scope

Economies of scope refer to a firm's ability to provide more than one item/service more cheaply than two separate firms (Nauges, 2008). In the market for offset credits, this could refer to a credit bank producing more than one type of credit (i.e. wetland and biodiversity) more cheaply than two separate credit banks. When economies of scope exist it can be an indication of a natural monopoly (a single firm has an overwhelming cost advantage as opposed to multiple firms). However this normally applies to industries where there are substantial capital costs which create barriers to entry (Nauges) and does not apply to the offset market.

There is, however, an important feature which is unique to the market for offset credits. The fundamental goal for all offset markets is to see no net decrease in whatever commodity they are trying to protect (i.e. wetland area, number of endangered species) through the creation and trade of credits. There are specific rules which apply to the creation of credits. One of the rules which seems to be common across all the examples in this thesis is that an area of land which is already providing an offset (i.e. already protected) cannot be used again as a credit (The one exception to this rule occurs when the offset provider is improving on the existing value of biodiversity/native vegetation). An already protected piece of land (i.e. a national park) cannot be used to offset a development. This rule may have a negative impact on potential economies of scope for credit providers and, as such, may deter entry into the market.

4.1.1.3 Asset creation

Asset creation refers to the creation of credits by following specific land management practices and an accreditation process. Creating credits requires a legal understanding of scheme requirements, education about what is involved in credit creation (i.e. the science behind creating a viable endangered species habitat), the accreditation process (i.e. the steps required to create offset credits), and monitoring and enforcing[3].

Understanding scheme requirements will be more fully explored under policy complexity. The environmental successfulness of the scheme is out of the scope of this thesis.

Sunk costs are also an important consideration for firms wishing to create assets. Sunk costs in an economic sense are costs which cannot be retrieved should a firm wish to exit the market (or liquidate their investment) (Arping & Diaw Khaled, 2008). Sunk costs in the market for offset credits could refer to

[3] Monitoring and enforcing are an important part of asset creation and have the potential to seriously impact the environmental successfulness of the offset scheme. However they will not affect the likelihood of a transaction going ahead as neither buyer nor seller will make a decision based on the level of monitoring or enforcing. If the buyer is legally obligated to offset with a credit and chooses to use a third party to do so (thus absolving them of any responsibility) then whether or not the third party is monitored and laws enforced will have little or no impact on buyers' purchasing decision (assuming the buyer is not explicitly environmentally aware). Sellers of credits may be affected by monitoring and enforcing if the cost of compliance is very high and monitoring and enforcing was guaranteed. This is however a problem with the overall 'robustness' of the policy and is discussed later on. If a third party is not used (i.e. a developer chooses to offset on their own), then they will be responsive to levels of monitoring and compliance. However in this instance there is no transaction taking place between buyers and sellers and so this option is not considered. There is limited research on these topics and the environmental offset market could benefit from further study in this area.

a firm investing heavily in creation of credits for a specific endangered species, and then the species being removed from the endangered list. This would result in the company now having no market for its credits. This scenario is unlikely as presumably there would be some warning before this happened so firms could choose not to invest in this particular species. The idea of sunk costs would only apply to the market for non-specific species credits (i.e. native vegetation, biodiversity) if the state laws were to change.

4.1.1.4 Buyers of credit

4.1.1.5 Economies of scope

Because of the legislation surrounding offset credits, economies of scope cannot exist for buyers of credits. Economies of scope in this sense would refer to buyers being able to use one credit to offset multiple requirements. It is perhaps the most important policy feature as if it were possible, the underlying goal of no net loss would be very difficult to achieve.

4.1.1.6 Demand for credits

The impetus for buyers of credits to enter the market for offsets can be two different reasons. Buyers are either obliged by law to offset their environmentally destructive development or they are altruistic and offset credits are a method of providing welfare to the greater good (This issue is also related to consumer preferences and is discussed in section 4.1.2.4.). For a market to exist, buyers and sellers must be self-interested players who maximise their utility, which is contra to altruism (Gustafsson, 1998). Legislation which obliges buyers to enter the market must be sufficiently strong and enforceable to ensure a market for offset credits exists.

4.1.2 Transaction space

4.1.2.1 Time

There are several ways time affects the likelihood of a transaction occurring. Firstly there is the time cost of obtaining information and negotiating an agreement (Harris, 2006). This time cost is not unique to offset markets; however due to buyers and sellers potential lack of familiarity with policy and offset market methodology and terminology the time cost can be prohibitive, to the extent that a transaction will not occur. Secondly, buyers and sellers do not arrive to the market at the same time and when they do arrive they have different time preferences for selling and buying offsets (Nemes et al., 2008). There is one other important time feature which again is not unique to the market for environmental offsets but is inherent in environmental credits. Environmental credits depend on exogenous factors (i.e. weather, natural disasters) and as such, change over time (Nemes et al.). Accreditation procedures must recognise this time issue, for if a credit is sold after a certain time period then perhaps it will have changed and no longer be in the same state it was when accreditation occurred (i.e. not providing the same ecosystem services on which that accreditation was based)[4].

[4] For further reading on the importance of minimizing time delay in a market transaction see Hantula (2008).

4.1.2.2 Lumpy asset

Individual buyers and sellers do not determine the size of the credits which are either needed to offset their development or established on their land. The size of the development and the environmental constraints determine the quantity of credits offset and produced (Nemes et al., 2008). The providing firm's economies of scope (and environmental leanings) will also bias the firm to providing larger parcels of land as opposed to smaller parcels. A problem arises when a developer needs to offset a small number of credits and there are only large blocks of credits available (i.e. the credit is indivisible or 'lumpy'). The buyer could purchase an entire credit block and then resell the unwanted credits; however they then bear the associated risk of no sale (Nemes et al.). Sellers are reluctant to sell a partial credit bank as not only could multiple credits on one piece of land lead to increased management costs but also the seller runs the risk of not selling the credits and still being required to manage the land as per the accreditation conditions.

4.1.2.3 Matching

As with the time variable, the matching variable has several different applications. Not only must buyers and sellers be matched (and their individual preferences (if any) incorporated in the matching process) but also credits types must be matched. A developer who needs to offset koala habitat vegetation cannot offset with alpine vegetation credits.

4.1.2.4 Preferences

Preference (typically consumer) in a naturally occurring market is a powerful variable which significantly influences the occurrence of a transaction through consumers' choice[5]. In the market for offset credits the effect consumer preference has is slightly different as buyers are obliged to purchase credits and there are very strict rules about what type of credits they must/are allowed to purchase. Buyers have some choice (i.e. to choose an equivalent credit or more endangered) however they have no choice about participation in the market. This drastically reduces the impact buyer preference will have on the final transaction. In the market for offset credits, it is the sellers of credits who can use their preferences[6] to prohibit a transaction occurring. For example: an environmentally conscious credit provider may stipulate that they will only sell their credits to 'green' developers. Some schemes allow for seller preference to be recorded.

4.1.2.5 Thin market

A thin market refers to the probability of buyers and sellers being matched (Matouschek & Ramezzana, 2007). This depends on the number of buyers and sellers present: the fewer the number of buyers and sellers, the 'thinner' the market. In a thin market there are fewer sales and thus buyers and sellers have limited access to information like previous sale prices and the identity of other market participants. This limited information access can result in skewing toward a particular buyer or seller (McMillen & Weber,

[5] For more information on how preferences affect transactions see Chernev (2008) and Hsee, Yang, Gu & Chen (2009).

[6] Preferences in this instance can also refer to buyers and sellers having preferences for a package of offsets. Whilst this is important information, it is not necessary for MBIS to consider this explicitly in their design, as this preference will be revealed through the price.

2008). Thin markets also make it costly for an agent to search for trading partners (buyers and sellers) (Matouschek & Ramezzana).

A thin market can arise when there is reduced demand (Brueckner & Pai, 2009). Because developers have no choice over offsetting their development, demand is effectively guaranteed. If however developers choose not to enter the offset market (i.e. change development to different location or decide not to proceed with the development at all) because the offset requirements are too difficult to meet, this will have ramifications for credit providers who are deciding to enter.

4.1.2.6 Strategic complexity

Buyers and sellers in a market are self-interested players who maximise their utility (Gustafsson, 1998). Often this involves strategic positioning by both parties (i.e. free-riding, 'holding out' for a price decrease/increase) (Nemes et al., 2008). The Organisation for Economic Co-operation and Development (OECD) defines strategic behaviour as actions which are taken to influence the market place in which they compete (Organisation for Economic Co-operation and Development, 2003). This behaviour can lead to no transaction taking place in a naturally occurring market. Because the offset market is often thin and has a complex time component, the strategic positioning has a larger impact on the likelihood of a transaction occurring.

4.1.2.7 Policy complexity

The supporting policy for MBIS is often complex and has two parts. Buyers and sellers must understand these for a transaction to take place. Firstly the trigger legislation obliges developers to buy a quantity of credits and secondly the matching criteria determine which trades can take place between buyers and sellers (Nemes et al., 2008).

5 Schemes studied

Australia and the United State of America (USA) were chosen for this study. Five different schemes from the two countries were identified. Other regions were examined (particularly South America and Europe) but insufficient examples of non-carbon offset-markets made Australia and the USA the clear focus of investigation. Three different approaches were identified from the literature, but the transferable development rights approach was not included in the analysis. The different approaches for a MBIS identified for this thesis are explained below.

5.1.1 Bank

The most common approach is the idea of a 'bank' of credits (also known as a credit bank) where buyers and sellers alike can meet and trade (the same principle as a financial bank). Four different examples of this approach have been found in the USA and Australia. The schemes identified however do not always follow this idea of a bank, sometimes the individual sellers instead of approaching a bank to sell their credits, must establish themselves as a bank.

5.1.2 Combinatorial double auction

A combinatorial auction is an auction for multiple items for buyers and sellers (as opposed to an auction for single items). In a single auction, only buyers bid for an item (i.e. a house). In a double auction, both buyers and sellers place bids/offers (Choi, Chang, & Han, 2009). A trade is made if a buyers' bid exceeds a seller's ask (Choi, Ahn, & Han, 2008; Huang, Scheller-Wolf, & Sycara, 2002). An example of a double auction is the New York Stock Exchange. In a combinatorial double auction, buyers and sellers place bids/offers for bundles of items (in this case for bundles of credits). Combinatorial double auctions have been previously used in business-to-business trading and in a growing number of examples on the internet (Fu, Feng, & Wu, 2006). There is one example of an electronic combinatorial double auction scheme for environmental offsets in Australia.

5.1.3 Transferable Development Schemes (TDR)

TDR schemes unbundle the rights associated with owning a piece of property. Owners who choose not to develop their piece of land can sell the rights to develop to a developer who has exceeded the development restrictions on their piece of land. However the ability to buy the development rights depends on the zoning restrictions on the land, which is predetermined (into 'sending' and 'receiving' areas) (Johnston & Madison, 1997) and is at the government's discretion. There is no central/national bank which private citizens can approach and request to unbundle their rights: if they attempt this then this process is called mitigation banking. TDR programs have similarities with other types of MBIS but because they are more controlled (only designated areas can unbundle their rights, thus limiting supply and entry to the market), they have been omitted from this analysis.

6 Introduction and explanation of schemes

6.1 Wetland Mitigation Scheme (WMS), USA

6.1.1 Policy

There are two policies related to wetlands in the United States of America. Section 404 of the Clean Water Act is the legislation which mandates mitigation for wetlands. A permit is required if there is any discharge of dredged or filled materials into waters of the United States (Government of the United States of America, 2006b). There are some exceptions to this law (i.e. ranching, normal farming practices) however if these practices convert a wetland or impair the reach or introduce a new use to the wetland then they must have a permit. The United States Army Corps of Engineers (USACE) is responsible for issuing permits.

The United States Environmental Protection Agency (EPA) establishes the environmental guidelines that the USACE must adhere to when evaluating a proposed development and has veto power over USACE-issued permits. Other organisations like the United States Fish and Wildlife Service (FWS), Natural Resources Conservation Service (NRCS), and the National Marine Fisheries Service (NMFS) are able to review and comment upon permit decisions, but do not have the veto authority which the EPA enjoys (Environmental Law Institute, 2002).

However, the second policy which impacts wetlands is the Food Security Act 1985. Under the Food Security Act 1985, producers are allowed to convert wetland for production of an agricultural commodity as long as they mitigate for wetland functions which are lost (Government of United States of America, 2009b). If they omit this step, then they lose their United States Department of Agriculture (USDA) farm benefits (which include a monetary payment) (Government of the United States of America, 2005b).

The USDA's Natural Resource Conservation Service (NRCS) is responsible for administering the wetlands determinations under the Food Security Act 1985 and the USACE administers wetland determinations under the Clean Water Act (Government of the United States of America, 2005a).

6.1.2 Process

Farmers who wish to receive USDA farm benefits must obtain a certified wetland determination. They must then apply separately to both the NRCS and the USACE to ascertain that both laws (the Food Security Act 1985 and the Clean Water Act) are being met (Government of the United States of America, 2005b). Farmers are able to use an independent consultant to assess wetland status, but the NRCS makes the final wetland determination.

The wetland determination decides if the landholder has a wetland, and if so the size and type of said wetland. If the landholder does anything that impairs wetland functions, then the landholder must either restore the area to the original condition or they can choose to offset the impact (Government of the United States of America, 2005b). The USACE provides a 'mitigation sequence' which is a chain of events which must occur for a discharge into American waters to be authorised. Any adverse impact must first try to be avoided, and then minimised. Mitigation is the final option (Government of the United States of America, 2009).

There are two different approaches for wetland mitigation according to the USACE: permittee-responsible mitigation and third party mitigation. The two options specify who is responsible for construction and long term success of the site (Government of United States of America, 2009a). This study will only look at third party mitigation options as no transaction takes place for the permittee-responsible mitigation because it is the developer who compensates through direct action for wetland function losses.

Under the third party mitigation, there are two options for developers; mitigation banking and in-lieu fee mitigation. The difference between the two options determines when the mitigation occurs. If mitigation banking is chosen, developers approach a mitigation bank to purchase credits. Credits take the form of an already established wetland area that has been restored, established, enhanced or preserved. In-lieu fee mitigation occurs when a developer provides funds to a third party who then purchases (usually with monetary contributions from other developers) an area of land where a mitigation will be constructed (Government of the United States of America, 2009). The legal responsibility for the success of the mitigation bank has now been transferred from the developer to the banker.

Persons wishing to establish a bank (under the 'mitigation banking' option) must submit a Mitigation Banking Instrument to the USACE (Environmental Law Institute, 2002; United States Army Corps of Engineers, 1996). The Mitigation Banking Instrument must include

- Bank goal and objectives
- Ownership of bank lands
- Bank size and classes of wetlands
- Description of baseline conditions at the bank site
- Geographic service area
- Wetland classes or other aquatic resource impacts suitable for compensation
- Methods for determining credits and debits
- Accounting procedures
- Performance standards for determining credit availability and bank success
- Reporting protocols and monitoring plan
- Contingency and remedial actions and responsibilities
- Financial assurances
- Compensation ratios
- Provisions for long-term management and maintenance. (Environmental Law Institute, 2002, p. 20)

Landholders can also apply for an 'umbrella agreement' defined as an agreement for a single entity to establish multiple banking sites (Wilkinson & Thompson, 2006). This single entity has the same initial approval process, however instead of lodging a full application for every new bank established, only site-specific information is required.

6.2 Conservation banking (CB), USA

6.2.1 Policy

If a development will affect a species listed under the Endangered Species Act, then a developer needs to mitigate the impact on the affected species. The more general term 'conservation banking' is used to cover different species not included in wetlands mitigation scheme.

6.2.2 Process

A developer uses a mitigation bank to offset damage their proposed development will create. Approval for the development is granted by USACE on the condition of the mitigation. The developer contacts the Fish and Wildlife Services (FWS) if their development will impact on a threatened species. The USACE are responsible for providing the environmental guidelines which dictate the ratio of credits developers must provide and also determines if the developer is allowed to use offset credits to mitigate the damage they have caused (Hemmen, 2009). If the developer is not allowed to use offset credits then the development cannot occur.

For landholders wishing to establish a credit bank, there is a specific procedure. Firstly landholders approach the FWS and enter into a Conservation Banking Agreement. The landholders then must grant a conservation easement to a third party. The conservation easement in this case is the right to develop the land. The third party (usually a non-profit organisation, although it can be a government organisation) holds the easement and enforces the agreement (i.e. not to develop). The final steps in registering a conservation bank involve developing a long term management plan for the area and providing funding for managing and monitoring the conservation area (Government of the United States of America, 2006a). The number of credits available for purchase is then decided by the FWS and specified in the Conservation Banking Agreement. The land is unable to be used as credits until the management plan and financial insurance are in place, and, once the credits have been purchased the third party must submit a credit 'banking statement' to the agency (Hemmen, 2009).

6.3 EcoFund Queensland (QLD), Queensland, Australia

6.3.1 Policy

The MBIS in Queensland is governed by the Queensland Government Environmental Offsets Policy (QGEOP). The QGEOP is also the trigger legislation requiring a developer to offset (State of Queensland, 2009b). There are three different types of offsets shown in Figure 3. Each of the specific offsets has its own policy and regulating agency (denoted in parentheses in Figure 3). The individual policies are designed to complement the QGEOP. The QGEOP differentiates between direct and indirect offsets: direct offsets substitute for environmental values (e.g. restoration measures at a development site) and indirect offsets support an intended environmental outcome (e.g. fauna crossing) (Driml, Clouston, & Bortman, 2009). Ecofund Queensland has been established by the Queensland Government to provide carbon and environmental offsets to government agencies (Driml et al., 2009; State of Queensland, 2009b). Only the environmental offsets will be included in the analysis. There are plans to expand the EcoFund to non-government organisations sometime in the future.

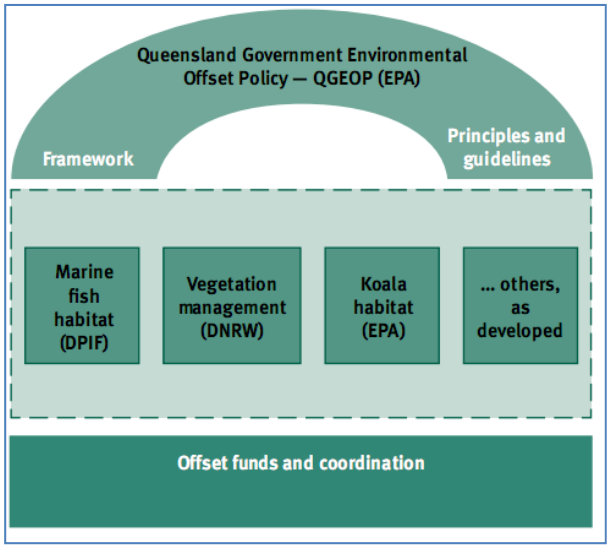

Figure 3 Structure of QGEOP (State of Queensland, 2009b)

6.3.2 Process

A developer triggers the QGEOP in one of three ways. If the legislation requires State Government assessment of impacts on environmental issues and if the State Government is the decision maker for any specific issues (in particular for the specific issue policies) then Government must refer to the QGEOP. Decisions on development approvals which encompass an array of approval processes (i.e. Environmental Protection Act 1994, the Integrated Planning Act 1997, the State Development and Public Works Organisation Act 1971, and Main Roads administrative processes (State of Queensland, 2009b)) must also refer to the QGEOP. The specific

issue policies are trigged when a developer will impact a specific area: either marine fish habitat, native vegetation or koala habitat. Each of these specific areas has its own policy and regulating department which handle offsets (see Table 1). The specific issue policies must however adhere to the seven principles (or rules) outlined in the QGEOP which direct the way offsets are used.

	Specific issue policy	Regulating agency
Vegetation management	Policy for Vegetation Management Offsets, September 2007	Department of Natural Resources and Water
Marine Fish Habitat	Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss, 2002	Department of Primary Industries and Fisheries
Koala Habitat	Offsets for Net Benefit to koalas and koala Habitat, 2006	Environmental Protection Agency

Table 1 Specific issue policies and regulating agencies (State of Queensland, 2009b)

The principles are:
Principle 1: Offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy.
Principle 2: Environmental impacts must first be avoided, then minimised before considering the use of offsets for any remaining impact.
Principle 3: Offsets must achieve an equivalent or better environmental outcome.
Principle 4: Offsets must provide environmental values as similar as possible to those being lost.
Principle 5: Offsets should be provided with a minimal time-lag between the impact and delivery of the offset.
Principle 6: Offsets must provide additional protection to environmental values at risk or additional management actions to improve environmental values.
Principle 7: Offsets must be legally secured for the duration of the offset requirement.
(State of Queensland, 2009b, pp. 11-12).

The regulating agency then needs to calculate the size of the offset by use of an environmental metric, which are agency specific and based on the latest scientific research. The metric must ensure that "...an offset will be relevant (in type, quantity and duration) to the environmental values impacted, reflect the scarcity, significance and depletion of the environmental values impacted and be sufficient to address time-lag, risk and uncertainty" (State of Queensland, 2009b, p. 13). Once the size of the offset has been calculated, the developer and agency must choose a delivery option. There are several different delivery options from which agencies can choose. They can require developers to provide and manage an offset, provide a financial contribution to an offset fund[7], engage a third-party to provide the offset on their

[7] Offset fund in this instance is defined as a Queensland Government run fund. Other offset funds can be used in mitigation, however for financial contributions only a Queensland Government approved fund is allowed (State of Queensland, 2009b).

behalf and purchase offset credits which have been established in advance. The two latter options relate to the focus of this thesis. Once the offset has been calculated and a delivery option selected, the developer and agency enter into an offset agreement, which is legally binding and is part of the development approval and enforceable (State of Queensland).

Landholders who wish to develop 'advance offsets' are able to do so by contacting the relevant agency for the type of offset they will create. For example, should a landholder wish to establish koala credits, they contact the EPA and start the accreditation process (State of Queensland, 2008).

6.4 Biodiversity Banking and Offsets Scheme (biobanking), New South Wales, Australia

6.4.1 Policy

Biobanking is a option for developers instead of using the Assessment of Significance under the Environment Planning and Assessment Act 1997 (State of New South Wales, 2008c). The biobanking scheme is established under the Threatened Species Conservation Act 1995 (State of New South Wales, 2008b) and is triggered when a development will affect threatened species as listed under this act. Under the Environmental Planning and Assessment Act 1979 (EPAA) developments under part 3A and 4, and activities under part 5 can either be required or under certain circumstances choose to offset their impacts (State of New South Wales, 2007). The EPAA applies to urban areas. For rural and peri-urban areas the Native Vegetation Act 2003 (NVA) applies (Farrier, Kelly, & Langdon, 2007). The Department of Environment and Climate Change (DECC) and local councils are responsible for administrating biobanking. Their respective roles are outlined in Figure 4.

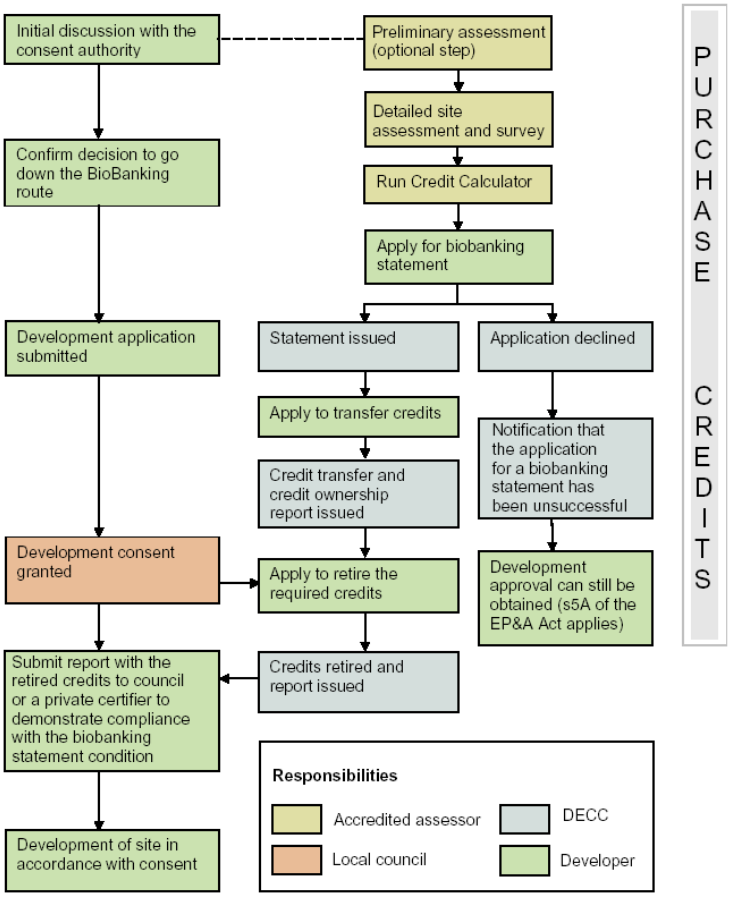

Figure 4 Overview of Biobanking process (State of New South Wales, 2008c)

6.4.2 Process

Developers volunteer to use the biobanking approach instead of an Assessment of Significance. Biobanking only applies to biodiversity values and threatened species (State of New South Wales, 2007).

Once a developer has decided to use biobanking, application must be submitted for the proposed development site to be assessed and for the number of required offset credits to be determined (State of New South Wales, 2007). No development is possible in designated 'red flag' areas, identified during the assessment process. A DECC accredited assessor is required to assess the site, identify and assess negative direct and indirect impacts, specify the on-site measures needed to mitigate the negative impacts and use the 'Credit Calculator' to determine the

number and type of credits that must be purchased (and subsequently retired) to offset the negative impacts (State of New South Wales, 2008c). The developer then submits an application for a Biobanking Statement. If approved, the Biobanking Statement can be included with the development application, provided the conditions that were stipulated in the Credit Calculator report are met. The inclusion of a Biobanking Statement in a development proposal has certain ramifications for the consenting authority. The consenting authority must not consider the likely impact of the development on biodiversity values, and cannot impose more conditions already covered under the Biobanking Statement (State of New South Wales). There is one exception to these rules: if there is an existing environmental planning instrument (i.e. local environmental plan) which requires additional development standards (specific to biodiversity values), then both the developer and consent authority must comply.

If the development application is successful and consent is granted, then the Biobanking Statement is written into the consent for development. The Biobanking Statement specifies what credits are needed and what must be done before development starts (State of New South Wales, 2008c).

Landholders who wish to register credits apply for site evaluation like the developers, and then the Credit Calculator is used to identify how many credits the land is worth. There are two types of credits: species credits and ecosystems credits (State of New South Wales, 2007). There is also a list of wanted credits which allows potential buyers of credits to communicate with sellers about future demand (State of New South Wales, 2008a).

6.5 Electronic BushBroker (EBB), Victoria, Australia

6.5.1 Policy

Under the Planning and Environment Act 1987, landholders who wish to clear native vegetation from land in an area larger than 0.4 hectares must obtain a permit to do so. There are however some exemptions and potentially additional State and Federal Government requirements (under the Flora and Fauna Guarantee Act 1988 and the Environment Protection and Biodiversity Conservation Act 19 respectively) (The State of Victoria, 2009).

6.5.2 Process

A landholder wishing to develop land on which native vegetation grows must first approach the local council to find out whether a permit is required. If a permit is required, and the area to be cleared is small, then landholder can fill out an application form which is administered by the Victorian State Government Department of Sustainability and Environment (DSE). The application requires aerial photographs of the area, a description of the vegetation to be cleared (preferably using the Government adopted Ecological Vegetation Class scheme) and an explanation of how the landholder will address the three-step approach (i.e. avoid, minimise and offset) (The State of Victoria, 2009). For larger areas and more complex proposals, a consultation with a DSE representative may be required.

If the negative impact to native vegetation is unavoidable, and has been minimised as much as possible, then landholders can offset the impact using the Electronic BushBroker scheme[8] (EBB). Buyers and sellers of credits use an electronic exchange program, which features a combinatorial-double auction. Buyers and sellers can bid for packages of offsets.

EBB is based on the idea that land quality declines over time unless active management steps are taken (see Figure 5).

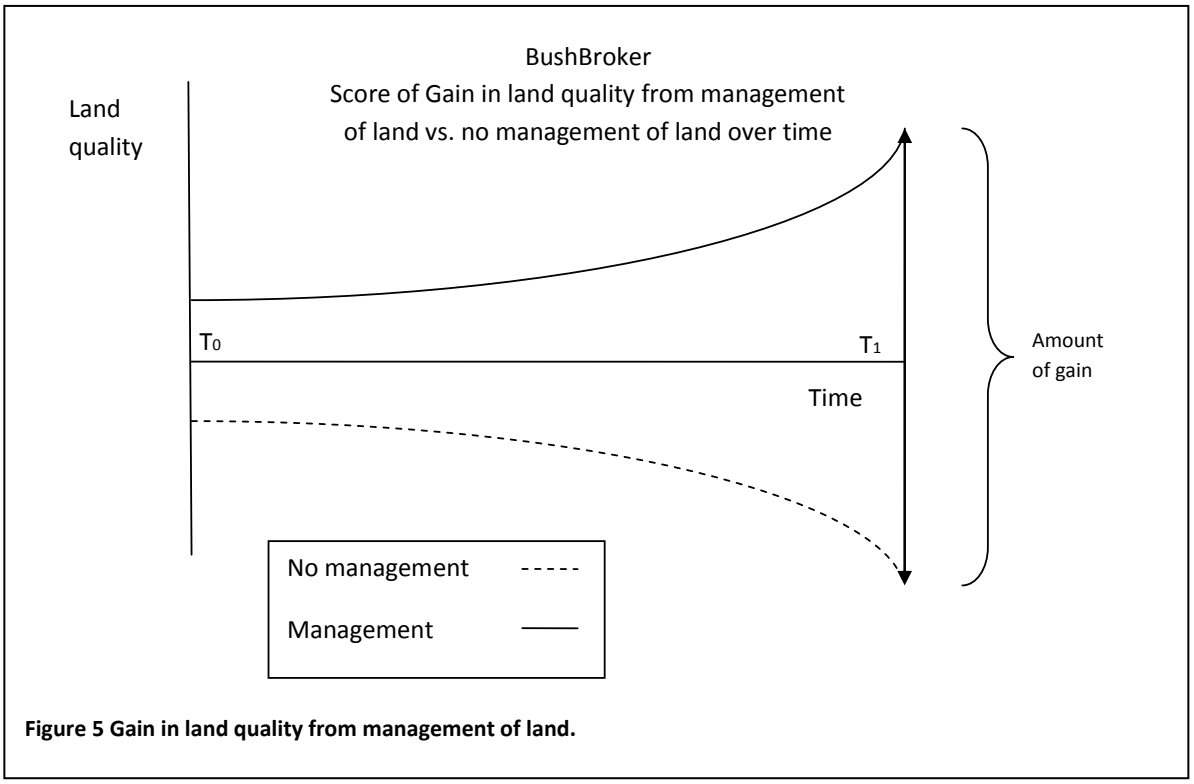

Figure 5 Gain in land quality from management of land.

Farmers who wish to establish credit banks must include a management plan for the credits to be established (The State of Victoria, 2008a). Gain is calculated for any registration of credits using DSE's gain calculator and this will then impact the number of credits able to be registered. Gain is an important factor in the calculation of the quality and extent of Victoria's native vegetation (The State of Victoria, 2008b).

[8] At the time of writing, there were two distinct approaches listed under the term BushBroker. In BushBroker, the Government matches up buyers and sellers, who then negotiate a price, and a transaction occurs (The State of Victoria, 2006). The Government ensures all rules are met. In Electronic BushBroker (EBB), a combinatorial double auction process is used to facilitate a transaction. BushBroker will be excluded from the analysis, as it was thought that it would not provide anything new to the discussion (as it is very similar to the other MBIS in Australia and the United States) and because EBB uses different tools to tackle the offset problems. There was some discussion within DSE also about an alternative name for EBB (i.e. the Native Vegetation Exchange) but at the time of writing it is unknown which name has been officially adopted.

7 Analysis and Discussion

Time	Function	Line no.	Biobanking				C. Double Auction
			1	2	3	4	5
			WMS	CB	QLD	NSW	EBB
Sellers of credits pre-transaction	Economies of scale	A					
	Economies of scope	B					
	Asset creation	C					
Buyers of credits pre-transaction	Economies of scope	D	na*	na	na	na	na
	Demand	E					
Transaction space	Time	F					
	Lumpy asset	G					
	Matching	H					
	Preferences	I					
	Thin market	J					
	Strategic complexity	K					
	Policy complexity	L					

Table 2 Comparison of different MBIS with transaction space criteria

Score Key

Good

Partial

Poor

WMS	Wetland Mitigation Scheme (USA)
CB	Conservation Banking (USA)
QLD	Queensland (AUS)
NSW	New South Wales (AUS)
EBB	Electronic Bush Broker (AUS)

Table 2 Comparison of different MBIS with transaction space criteria shows the comparison of the different schemes with respect to the criteria identified in the transaction space in section 0. The table is coloured according to the extent that the scheme addresses the particular criteria.[9] The terms in parenthesis denote to which cell in the table the section refers.

[9] This method has been used because it provides a visual map of the 'scores' that the MBIS received. It was decided that it would be clearer than using high, partially and low. A similar code was used by the Government of Canada (2006) for comparable reasons in a sustainability study released by their Infrastructure department.

7.1 Sellers of credit

7.1.1 Economies of scope/scale

Because all four biobanking schemes have a banking option, the potential barrier to entry for sellers of credits arising because of dis/economies of scope/scale is not an issue (Table 2, A1-4 and B 1-4), as a large bank providing multiple credit types will experience economies of scale and scope. A USA mitigation bank such as Westervelt provides several different types of offsets at multiple sites across the country (Westervelt Ecological Services, 2009). Whilst a bank might experience the same large up-front costs of purchasing land, the construction of the banks (i.e. any land management like fencing, removal of weeds or planting of trees), monitoring and enforcing will be spread over more projects (for example, a bank has already employed a full-time botanist on a fixed wage to assist in credit-creation. It does not need to pay more money to the botanist when they construct a new mitigation bank), and thus the botanist's wage (part of the ATC) will be spread out over more projects. In economic terms, the marginal cost of producing an extra unit (i.e. an extra credit) has fallen.

Individuals who choose to register credits (either by approaching a bank or registering their interest in the EBB scheme) (Table 2 Line A5 and B5) however will not experience economies of scale or scope. Firstly it is unlikely that small-scale landholders wishing to register their land would have multiple types of credits on their property. If they do, then each different type of credit needs a different management plan and individuals would be unlikely to have the resources at their disposal without increasing their costs. Secondly, large biobanks have greater potential to have multiple customers who will be able to absorb some of the cost associated with entering the offset market. Market construction must ensure that economies of scale/scope do not deter small-scale landholders from entering the offset market because a) the returns they will receive will equal or outweigh credit-registration cost or b) they are environmentally conscious and receiving any money for good land-management practices is an incentive compared with the past when they received nothing.

7.1.2 Asset creation

Asset creation for sellers of credit (C 1-5) is partially addressed by all the schemes here and fully addressed by EBB and the NSW scheme. Asset creation as referred to in Section 4.1.1.3 involves a level of understanding of the legal and biophysical processes. The schemes provide some information about creating credits, however some schemes are clearer than others.

To create credits under the EBB and the NSW scheme, it is a straightforward process for landholders. The legislation is not complicated (i.e. only one policy and one department to implement) and suppliers merely contact the relevant authority (the Department of Sustainability and Environment and Department of Climate Change respectively) which organises site visits and calculation of credits. Furthermore, the DSE has run information sessions with potential offset sellers/buyers who can register an Expression of Interest (EOI) and who will then receive more information about training sessions.

For the QLD scheme, each different type of credit has a different department to handle the administration process (see section 6.3) which means more steps for sellers of credits. Not only do they

need to consult the relevant department (as each credit type has different requirements to be established as a credit bank), but also they need to initially identify what type of credit they wish to create. This is straightforward if wanting to create marine habitat credits, but perhaps not so clear when differentiating between biodiversity credits or koala habitat credit. The idea of sellers establishing credits in advance appears be uncommon, as the Government explicitly states that they support establishing 'advance offsets' whereas in other policies (i.e. NSW, EBB) establishing credits in advance is an important part of the offset process and thus the policy documents do not need to include an 'advance offsets' section.

The WMS and CB differ from the Australian examples. To establish a wetland or species/biodiversity credits, landholders must establish themselves as a credit bank (as opposed to merely establishing credits). This requires a high level of understanding of policy and procedure from the landholder. Furthermore, once a landholder has established a credit bank, there is a 'credit release schedule' which specifies the percentage of credits which can be released for sale. The release schedule is conditional and allows credits to be sold based on the environmental state of the credits (United States Army Corps of Engineers, 2009) over a six year period.

Because the methods used by QLD, WMS and CB to create credits require understanding of several different policies and several more steps than NSW and EBB, they have been awarded only a 'partial' score under asset creation.

7.2 Buyers of Credit

7.2.1 Economies of scope

Whilst economies of scope (cells D 1-5) are an important barrier to transaction, they are not a consideration here because of legislation denoting that only one credit can be used to offset one impact. Economies of scope have been retained because were they to exist, they undermine the basic goal of the schemes, which is no net loss in the environmental commodity.

7.2.2 Demand

The American approaches, the QLD scheme and EBB all cater for demand in some aspect which is why they have all received a partial score (cells E 1-5). Legislation requires that developers offset their negative environmental impacts. There are exceptions or 'loopholes' to these laws for all the schemes which impact on demand for credits. For example, native vegetation is able to be cleared in the State of Victoria if it is for the purpose of mineral exploration (State of Victoria, 2008). The QLD scheme allows projects which 'will result in a demonstrated high level of community benefit at a local, regional or state level' to provide offsets after the project has started (with no mention of follow up) (State of Queensland, 2007). The WMS offers exemptions for common agriculture activities which have 'minimal' impact (Government of the United States of America, 2005b).

The NSW scheme received a low score because participation in the biobanking is voluntary (State of New South Wales, 2007). Developers choose to use biobanking instead of an 'assessment of

significance'. Biobanking is touted as having several advantages over the alternative method (mainly time, species protection and information about expected costs). However because developers have a choice about participation and may not be required to offset, demand is not as secure compared to a scheme were participation is obligatory.

Another factor to consider in the stimulation of demand is the 'robustness' of the laws. If the legislation requiring offsets is too severe (i.e. requiring the developers to offset with many credits meaning higher costs), then no development will take place at all. If the laws are too weak, then too much development will occur without needing to offset and the goal of no net decrease in an environmental commodity will not be achieved.

7.3 Transaction space

7.3.1 Time

Time is one of the most important factors in allowing a transaction to occur and it alone has the power to halt a transaction. The varying schemes have received different scores with EBB receiving the highest, the two Australian Biobanking schemes a partial result and both American schemes a low result (cells F 1-5. As mentioned in section 4.1.2.1, there are several components to the time factor, including the time-cost to become informed, negotiating an agreement, buyers and sellers arriving to the market at different times and credits not being sold within a time period (and needing to be reassessed).

EBB received a high score because it seeks to address all of these components. DSE has run multiple training programmes to familiarise and inform potential users about the programme and further information is clear and easily available on the DSE website. Negotiating an agreement in EBB is straightforward due to the design of the electronic program. Buyers and sellers indicate their willingness-to-accept/pay when they log in to the programme, and that information is available to all potential buyers/sellers who are able to trade (i.e. have satisfied the 'like for like' criteria) (Nemes et al., 2008). Buyers and sellers are able to change their bids (and have multiple bids in the system) but all postings are binding. Negotiation problems are further negated with the inbuilt rule that whoever executes the trade between buyers and sellers receives any surplus. For example: buyer 1 has indicated the maximum willingness-to-pay for credit type X is $300. Seller 1 has indicated the minimum willingness-to-accept for credit type X is $200. If the buyer executes the trade (i.e. locates the seller and clicks the execute button) then they receive the $100 surplus, and likewise if the seller executes the trade. A third entity (be it buyer or seller) can also be a 'market maker'; if they find, match and execute a trade then they receive the surplus (Nemes et al., 2008). These steps all seek to minimise negotiation costs and encourage a transaction to occur. Built into the EBB programme is also a time limit for the credit, which, if it expires, means the seller must be reaccredited before that credit can be sold (Nemes et al.). The problem of buyers and sellers arriving to the market at different times is almost a thin market problem (which will be addressed further on in section 7.3.5), as the probability of buyers and sellers being matched will be affected by asynchronous arrivals. This problem is almost impossible to deal with as whether or not a participant enters a market depends on exogenous, highly heterogeneous factors. If

demand and supply are stimulated through policy and monetary incentives, then this 'thin market' problem should be lessened.

The Australian Biobanking schemes for QLD and NSW both address some of the time problems but not to the same extent that EBB does. Community consultation has occurred in both states which show a desire to inform the public. In NSW, information for both buyers and sellers is clearly available on the website[10]. With QLD however, there are more information communication problems because there are more policies. The problem of policy complexities will be addressed later in section 7.3.7. Negotiation between buyers and sellers is linked to buyers being able to locate sellers and neither scheme appears to have addressed this problem fully although both have made some attempt. This 'matching problem' will be discussed further in this section. The NSW scheme has a time component written into its accreditation process (the Biobanking statement is valid for two years from the date of issues (State of New South Wales, 2008c)). There is no mention in either scheme of the length of time a credit is valid once it has been approved for accreditation.

The American schemes both fail to address the time complexities. There is no formal (or informal) matching process available for buyers and sellers and because of multiple state and federal policies, the time cost to become informed and negotiate an agreement is thus high. There is no information available about for how long a credit is valid.

7.3.2 Lumpy asset

The majority of the MBIS studied fail to address the lumpy asset problem (namely credits may not be divisible and credit size is not homogenous). Cells G 1-4 indicate that the biobanking schemes do not even attempt to resolve the problem. In all of the literature studied there is no acknowledgement that this problem even exists, let alone an attempt to address it. However it must be considered that for biobanking schemes based around a bank, some of the problems with lumpy assets could be alleviated if the bank owns the credits, as opposed to merely providing a medium whereby buyers and sellers can meet. A bank which purchased an area of land worth X credits could sell X-Y number of credits to a developer requiring X-Y number of credits. The bank will be able to sell its remaining credit (Y) because of more exposure to different buyers, and is able to divide up its credits, because of reduced marginal cost of management compared to a small landholder. For individuals who wish to supply credits, credit division is sub-optimal because of increased cost of management and the risk they will not sell a small quantity of credits. None of the biobanking schemes which all allow individuals to supply credits address the problem of a lumpy asset.

EBB (cell G5) has not only identified that the problem exists but attempts to overcome it by allowing buyers and sellers to 'band together' and buy/sell an offset (Nemes et al., 2008). Buyers and sellers can also express preference for and buy/sell packages of offsets which can not only address the lumpy asset issue but also attend to buyer preference.

[10] At the time of writing however, there was no 'real-time' information available (i.e. credits wanted by buyers) as the scheme has not officially commenced.

7.3.3 Matching

Cells H 1-5 show the scores detailing how each scheme deals with the two-pronged matching element (matching buyers and sellers and credit matching). The American Biobanking schemes received low scores because they only assist in credit matching and offer no matching process for buyers and sellers. When asked about this, the Business and Market Development Coordinator for Westervelt Ecological Services in Sacramento, California, Travis Hemmen, said that the regulatory agencies do not suggest particular mitigation services to developers as they do not wish to 'favour' any one credit provider (Hemmen, 2009). Whilst there is no market place where buyers and sellers can meet, the third party which holds the land easements could provide a similar service on a smaller scale. A developer can contact a third party (for example the Centre for Natural Land Management (a not for profit organisation)), view the easements they hold and identify banks/sellers of credit. This process is not always satisfactory as developers will only get access to a specific subset of sellers. Some third parties may not provide public information about the owners of the land easements and this approach would then be defunct. In regards to credit like-for-like matching, the authority dealing with the administration of credits (USACE or FWS) specifies what type of credit is needed where, so developers can identify what credits they must purchase.

The QLD scheme has been given a similarly poor score because there appears to be no way of matching buyers and sellers. Currently offsets are calculated for developments on a case-by-case basis (State of Queensland, 2009b). Some of the specific issue policies (i.e. koala offsets) aim to have a 'bank' and the EPA plans to establish ecoFund which can be used for any of the specific issue policies (State of Queensland). Advance offsetting appears to be an option as opposed to the status quo.

NSW and EBB have the most comprehensive approaches to the matching element. NSW received a 'partial' score because it provides only a credit register on the government website. This presents a starting point for buyers and sellers to identify one another and access information on ownership and credit status. There is also a register for Biobanking Statements which shows location of development, credits required to offset, credits retired, and a copy of the Biobanking Statement (State of New South Wales, 2008a). The type of credit required to offset is identified during the application for a Biobanking Statement, which makes it clear for developers which sort of credit they need to offset their development.

The EBB scheme uses the most rigorous matching method (and hence achieves the highest score) because not only does it provide a real-time, easily accessible, electronic system to bring buyers and sellers together, but it also has credit matching specifications written into the programme design. This means that buyers and sellers can only see information about credits they with which they are allowed to trade (i.e. the 'rules' governing trades are built into the system).

Credit matching is important because of the 'equal to or improvement' rule. This means that if developers wish to damage an area where the native vegetation is threatened, they must offset with either the same threatened vegetation credits, or they can offset with credits of a more endangered vegetation type. This rule does not apply to species credits, (i.e. developers must offset with credits of

the same species). This rule has ramifications for developers unable to find credits for a specific offset as they may be eligible to choose credits of a more endangered type which is acceptable as a substitution. Not one of the schemes seems to address this problem except EBB. All schemes require the governing body to identify the credit types needed to offset. This assumes developers will either look for credits to offset with the same name or have a full understanding of the 'equal to or improvement' rule.

7.3.4 Preference

Preference, as mentioned in section 4.1.2.4, really refers to sellers' preference as buyers' preferences are negated by being obliged to purchase. Preference here therefore refers to sellers being able to 'choose' the buyer to whom they sell their credits[11]. This scenario could arise if sellers believe a development is so destructive it should not go ahead (even with offsetting) and by refusing to sell credits, hope that the development will be stopped. It is unlikely that sellers of credit would chose to only sell credits to buyers with altruistic purposes, as surely their participation in the offset market indicates a desire for developers and environmental concern to not be mutually exclusive.

The two Australian approaches to Biobanking (cells I3-4) have received high scores because they are best equipped to deal with seller preference. The NSW scheme allows credit sellers to specify in the sale contract that these credits are only to be sold to parties in search of credits for conservation purposes (State of New South Wales, 2007). Currently the Queensland Government matches buyers and sellers on a case-by-case basis (Driml et al., 2009), so presumably seller preference could be recorded here. The other Australian scheme has received a low score as there is no way of recording seller preference in the EBB program. Other preferences are able to be displayed (such as preferences for packages of offsets (Nemes et al., 2008)) but a preference regarding who is buying for what purpose (altruistic vs. developer) cannot be displayed and communicated before a transaction takes place. Both WMS and CB have received partial scores because there is no formal method of recording seller preference. However the ad-hoc matching method employed in the USA would allow more communication between buyers and sellers before a sale takes place. Thus if a seller was pro-conservation, there is an opportunity to discover the buyer's purpose before the transaction takes place.

7.3.5 Thin market

The thin market problem is dealt with adequately by all the schemes and particularly well by EBB (cells J 1-5). A thin market can arise when there is little demand and supply (or too few buyers and sellers) (Brueckner & Pai, 2009). Demand is stimulated because of the legislation; and supply (asset creation) is at least partially a focus for all of the schemes. A thin market however also refers to the probability of

[11] Being able to record preference in an offset market could actually result in a transaction not going ahead. If buyers can choose to whom they sell their credits (based on motivation for purchasing) then really environmentally aware sellers will not sell to buyers who will carry out very destructive projects (a negative effect on the likelihood of a transaction occurring). No way of recording preference however could deter sellers from entering the market which will also have a negative effect on the likelihood of a transaction occurring. It was decided that overall the ability to record preference would positively influence a transaction occurring which is why schemes with this function received a high score. Further research in buyer preference and the effect on transaction however would be fruitful.

matching buyers and sellers (see section 4.1.2.5). As mentioned previously, the scheme which deals most effectively with the matching specification is EBB, and, to a lesser extent, NSW scheme. The EBB received the higher score because it provides an extra incentive to counteract the thin market problem, as buyers or sellers who execute a match receive any surplus (monetary or vegetation) generated by the transaction (Nemes et al., 2008).

7.3.6 Strategic

Strategic bargaining, as referred to in section 4.1.2.6, is a 'normal' behaviour by players in a market situation; however because of the nature of the market for environmental offsets, this strategic posturing can have a larger impact on the likelihood of a transaction occurring. It is difficult to counteract strategic behaviour as participants in a market, by default, must be self interested players but the EBB programme has several features (some previously mentioned) specifically included in the system to guard against strategic behaviour. Nemes et al. (2008) detail the measures EBB has taken to deter strategic behaviour but they include the previously mentioned market making, the ability to see information which is normally held privately (i.e. willingness-to-pay/accept) and the ability for buyers and sellers to 'band' together an bid for packages of offsets. The four other schemes have no formal methods to combat strategic behaviour. Bots (2006) refers to De Bruijn, Ten Heuvelhof and In't Veld (2003) who write that strategic behaviour can be thwarted by defining the 'rules of the game'. Bots shows with examples that having 'rules' invites participants to cheat. However clear rules in the market for environmental offsets could combat some aspects of strategic behaviour (i.e. only allowing binding offers to be placed on the market). There is much literature on game theory and how to counteract strategic behaviour and further research specifically pertaining to environmental offset markets would be merited.

7.3.7 Policy

Policy is the final criterion on which to judge the five different MBIS. Policy has already been mentioned briefly in relation to asset creation and matching credit types, as policy plays a significant role in both of these actions. With no legal background, it is difficult to pass judgement on the intrinsic worth of the policy. However policy complexity, ease of access to information and process are open for comment.

The WMS scheme has received a low score because there are two policies which must be consulted. The Clean Water Act and the Food Securities Act 1985 both seek to protect America's waterways but not necessarily in the same way and to the same extent. The NRCS recognises this and advises participants to check with the USACE before conducting any activities which may impact wetlands because '...there are inherent differences in ... the Food Security Act of 1985 and in Section 404 of the Clean Water Act, which occasionally result in areas being subject to the jurisdiction of one agency, but not the other.' (Government of the United States of America, 2005b, p. 2).

The CB approach received a partial score as the policy surrounding credit creation is straightforward. Landholders contact FWS (only one point of communication) to start the accreditation process. The CB approach did not receive a full score because the legislation dictates that credits can only be established

as a ‘bank’. This may deter some individuals from applying for accreditation as running a bank could be seen as more difficult than merely establishing credits.

The QLD scheme received a high score regarding policy complexity because it has a single overarching policy on upon which all other specific-issue policies are based. Out of all the schemes studied, the Queensland model is the most ambitious as it attempts to provide three different credit types. The only other scheme which provides different credits is the NSW scheme (which differentiates between species credits and ecosystem credits). The Queensland government should be lauded for its attempt to include a range of credits. Also the Queensland method is the only approach to have one overarching policy (QGEOP) and then specific policies for different issues. This provides a level of consistency and Queensland is perhaps in a better position than the other examples to establish new legislation for other types of credits. At the time of writing there was a consultation draft for a specific-issue policy for Biodiversity (see State of Queensland (2009a) for more information). The environmental metric used for each specific-issue policy is vague but perhaps once the schemes have commenced the method for evaluation using the metric will become clearer.

The NSW scheme is the only approach where participation is not mandatory, and because of this receives a low score. The supporting policy and trigger legislation play an equally important role in the success of MBIS and voluntary participation can be seen as a ‘soft’ approach from the NSW Government. Farrier et al. (2007, p. 428) argue that the EPAA legislation is ‘disjointed, haphazard and confused’ and that the implementation of a biobanking scheme will add to the confusion as long as the scheme is voluntary.

EBB receives a high score because not only is the trigger legislation easy to understand, and the application process streamline, but also the intricate policy rules regarding trading are built into the system to decrease the amount of information participants must understand.

8 Conclusions

From looking at Table 2, the scheme which received the highest rating for consideration of factors in the transaction space is EBB. In the pre-transaction time period, all four biobanking approaches received a better score. The EBB received seven 'good' grades overall, with the QLD scheme coming second and receiving four good grades.

The USA's approaches received poor scores overall. Whilst no single factor can be pinpointed as a reason for this, there are some general differences between the Australian and the American schemes. Firstly all the Australian schemes have been set up in a state-by-state process, so that it is state law which governs the use of these schemes. In the USA, federal policies provide the legislative background. The WMS was reviewed in 2001 by the National Research Council: suggestions included that a watershed approach be taken for on-site mitigation, as opposed to the federal approach which has a preference for on-site mitigation (i.e. creating a wetland as near as possible to site of the one destroyed) (National Research Council, 2001). This indicates that a more local approach would be better in some cases. The American political environment is however vastly different from the Australian political scene. America has 50 states, a much greater population and higher population density and has chosen a federal approach. Australia has only six states, the lowest population density in the world and has chosen to take a state-by-state approach. Both of these approaches have benefits. The federal system allows for a predictable national policy and natural environment to be created, but the ability for local adaptation is then constrained. Australia's state approach allows for more local adaptation but requires potential developers to understand at least three different sets of policies. Future users of MBIS who wish to create a market for environmental offsets should carefully consider the political environment in which their scheme will operate.

Secondly, the USA's schemes have been in use for over twenty years and the Australian ones are just starting. When establishing a process, there is often more information available because not only is it new to the people participating in the scheme, but also it is new to the people running the scheme (i.e. the government). Because the American schemes have existed for a significant period of time there is perhaps less information available overall and specifically for new entrants to the market. The National Research Council (2001) recommended that more information be made available in the form of a reference manual to be published for wetland mitigation.

The banking schemes, whilst being the more common approach; do not appear to have considered the critical functions identified to the same extent as EBB as per the scores they received in Table 2. Banking schemes in the USA have however existed for more than 20 years which means that whilst biobanking schemes might not consider all twelve critical functions, something is obviously working because there is a functioning offset market in the USA. This does not mean that the schemes in the USA could not be improved. The next logical step would be to examine the statistics regarding the USA's schemes (i.e. the number of buyers and sellers, credit prices and number of transactions) and compare them to the Australian schemes (once started). This next step would aim to determine the economic efficiency of the respective offset markets. Economic efficiency has only been mentioned briefly in this thesis however it is important as a high level of economic efficiency means more goods (and services) are provided

without using more resources (Nemes et al., 2008). Combinatorial double auctions have close to 100 per cent levels of economic efficiency (Huang et al., 2002; Nemes et al.) and further study linking the twelve critical functions identified in this thesis and economic efficiency is merited. The final piece of the jigsaw would involve further study on the links between levels of economic efficiency in environmental offset markets and environmental success.

The research questions have been fully answered. Five schemes which trade in credits including wetland, native vegetation, specific species credits (i.e. koala credits), marine credits, and ecosystem credits in Australia and the United States have been identified. There are four schemes identified which are based on the idea of a bank and one scheme based on the use of a combinatorial double auction. Not only have twelve critical functions vital for consideration by TPFs in the environmental offsets markets been considered, but also a time variable has been included, splitting the functions into a pre-transaction and during-transaction group. It is hoped that this identification and classification of critical functions will assist current and future construction of successful offset markets.

Offset markets are related to sustainable behaviour as they demonstrate a willingness by legislators for sustainable development. If an offset market functions properly, then there will be no net decrease in the type of natural capital that the offset market aims to protect. For an offset market to function properly a transaction between buyers and sellers must occur; this is the area to which this thesis contributes. The scores attributed to the schemes show that a combinatorial double auction approach appears to consider more of the critical functions than the more popular banking approach and thus has a higher chance of a successful transaction occuring. Huang et al. (2002) write that the most important part of a combinatorial double auction is the mechanism design (or trading rule). The mechanism design should structure the rules and trade-environment so that it is in participants' individual interests to act in a way which will benefit the whole market. EBB has been explicitly designed to alter the behaviour of buyers and sellers as much as possible in a way which will benefit the whole market. The banking approaches do not appear to have been designed in a similar fashion.

An inherent risk of any market is the risk that the price will fall (and make it unprofitable for sellers to participate) or the rules and regulations change and the nature of the goods traded will suddenly change (i.e. there will be no market for a certain species credit). Because the TPF (at least to some extent) in all of these cases is the government, this risk can be lowered or even absolved. The government can guarantee that the law will not suddenly change. There may also be problems of oversupply (i.e. it is very cheap to create credits for species X) and a resulting price decrease. The government can also intervene if necessary and control the number of species X credits.

This thesis aims to provide policy makers constructing MBIS specifically for the environmental offset market information which will ensure their market mechanism has the highest possible chance of success. Not only does the market mechanism need to consider the twelve critical functions identified, but also consider the different political and legislative environment in which they want to operate.

In conclusion, MBIS which aim to create a market for environmental offsets are by no means a perfect solution to the problem of sustainable development. There is little research on the environmental

success of these schemes and more investigation is urgently needed in this area to ensure these markets achieve their initial goals of environmental protection. These offset markets are an important step towards proving that development and environmentally conscious behaviours are not mutually exclusive. If these markets function in practice as they do in theory then environmental offset markets will be a crucial tool for policy makers who seek to encourage more sustainable behaviour.

9 Recommendations for further research

As mentioned previously the next logical step is determining the economic efficiency of the different schemes and then making comparisons between countries. The Australian schemes, yet to start, will be of particular interest will over the next few years. The environmental success of MBIS and offset markets is also an area where further research is needed. A statistical analysis over a period of time of environmental areas created/protected is needed to determine if offset markets achieve their goal of 'no net loss' and to demonstrate if net gain is achieved.

Further investigation of the EU Nature 2000 policy and specific member states would also be interesting. Why has the EU avoided a market-based approach? What have they chosen? Is this more appropriate given the political environment? What is the level of environmental success associated with this approach?

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