Theoretical Issues in Using Offsets for Managing Biodiversity

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Abstract

Analysis of environmental problems involves addressing some of the complexities of economics that arise when departures are contemplated from the theory of perfectly competitive markets and its assumptions of allocated, appropriable property rights. It is currently fashionable to advocate the use of market based instruments, including offsets, to solve environmental problems. In this paper, the theoretical issues involved in using offsets are examined and illustrated in relation to biodiversity management. It is argued that, although offsets schemes have been successfully developed for pollution markets, there are considerably greater challenges in designing them for efficient and widely applicable biodiversity management.

1. Introduction

Environmental management may be undertaken using policy tools selected from the classes of command and control, market based instruments, or persuasion. Market based instruments include taxes and subsidies, and damage caps and permits to damage within a cap. “Offsets”, proposed as an additional environmental management instrument, are evaluated in this paper with particular reference to their applicability for the management of biodiversity.

Offsets may be described as an adjunct to existing environmental management measures. Suppose a cap has been imposed on an environmentally damaging activity, and also that licences have been issued for K units of damage to be permitted to occur per period. Firms organise their production activities so that easily-avoided damage does not occur, and damage which is costly to avoid is covered by a licence to damage.

Suppose also that some environmental damage is unregulated. The easiest example to deal with is to suppose that point source pollution is regulated whereas, at least initially, non-point source pollution is not. As above, firms with pollution licences may organise their activities to prevent easily avoided damage and remain within the cap, and use licences to cover expensive emissions. However, from society's perspective, there may be non-point emissions which are also cheap to reduce but there are no incentives for production to be appropriately organised. Suppose total emissions (T) are:

$$T = K + M$$

where K is the cap on regulated point source emissions, and M is total non-point emissions. Suppose there are Δ non-point emissions which are cheaper to avoid than the last Δ units of K. Ignoring uncertainties which commonly accompany non-point source emissions, then:

$$T^* = (K + \Delta) + (M - \Delta) = T$$

and $$\text{cost}(T^*) < \text{cost}(T)$$

The increased point source emissions ($K + \Delta$) are said to have been "offset" by the reduced non-point source emissions ($M - \Delta$).[1] The principles for offsets outlined in a NSW paper are summarised in Box 1.

Murtough et al's (2002) paper *Creating Markets for Ecosystem Services* dealt with offsets as one form of market-based instrument for managing natural resources. They note (pXI) [2]:

> The term *market creation* is used in this paper to refer to government intervention to form markets for ecosystem services that are nonexcludable in consumption. Such intervention involves the definition of a new *property right* that is both linked to an ecosystem service and can be exchanged for reward. A property right is an entitlement to use a particular good or service in a certain way

It has been proposed that offsets may be used to manage biodiversity as well as pollution. The principal objective of the paper is to elucidate the economic issues that are raised by offsets, especially with respect to biodiversity. Murtough et al. (2002) explained links between market creation and offsets via a table similar to Table 1 (which is an expanded version of the original table). In this paper, two types of tradeability conflated by Murtough et al. (2002) are distinguished (see Table 1) - tradeability in the underlying emission right, and tradeability in the offsetting activity. The pollution example of offsets is considered first as biodiversity introduces considerably greater complexity (cf. below). No final determination is reached as to the value of offsets for biodiversity conservation because many of the issues are empirical not theoretical – for example, how much does it cost to describe biodiversity damage and potential offsets for this damage. However, the discussion in this paper is relevant in determining the issues to address empirically.

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[1] There are various possible combinations of offset policy. An alternative to the example in the text where total emissions are unchanged, is to allow additional point source emissions (e.g. $K^* = K + \Delta$) in return for a greater reduction in non-point emissions (e.g. $M^* = M - k.\ \Delta$, $k > 1$), and thus an overall reduction in emissions.

[2] Note that at times Murtough et al's language may be imprecise. For example, a property right is much more than simply "an entitlement to use" - this definition is closer to a "usufructuary" right.

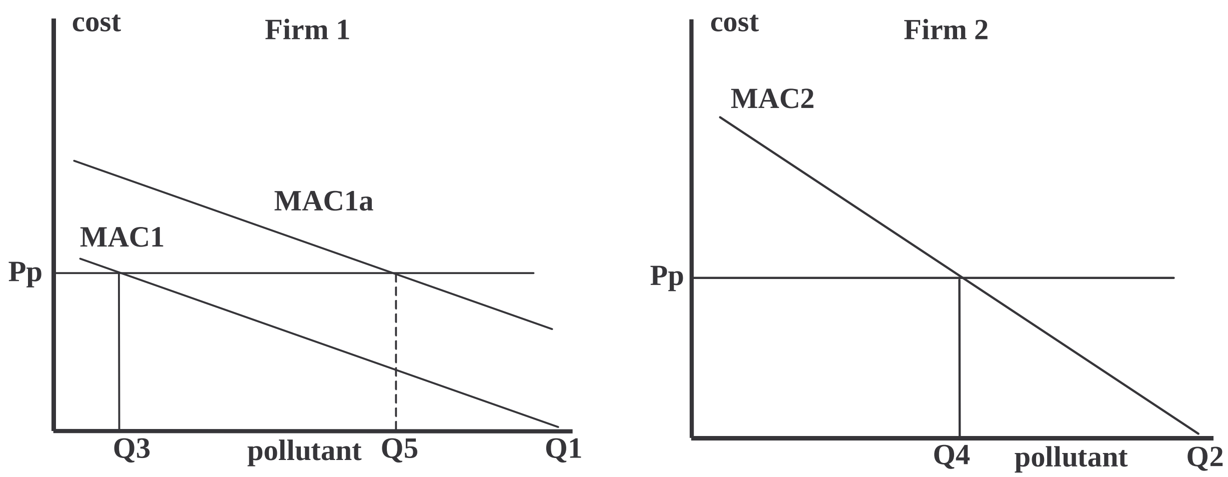
2. Offsets for pollution

2.1 Analytic framework for pollution offsets

The economic role of offsets can be illustrated in the context of other economic instruments for managing environmental degradation. Figure 1 illustrates the standard pollution permits model with two firms – firm 1 has low marginal abatement costs (MAC1) whereas firm 2 is a high cost firm (MAC2). The privately optimal level of pollution for the firms is Q1 and Q2 respectively. Suppose pollution were capped at some level Q* and firms had to buy permits to "cover" any residual pollution. Then pollution would be optimally distributed between the firms if Q*=Q3+Q4 (with corresponding pollution permit price Pp). In this case, the low-abatement-cost firm would reduce its pollution by (Q1-Q3) and acquire permits to cover its residual pollution Q3. The high-abatement-cost firm would reduce its pollution by (Q2-Q4), and acquire permits to cover its residual pollution Q4.

Now suppose that, as well as implementing abatement technologies to reduce their own pollution, firms were permitted to undertake pollution reduction elsewhere to offset their own pollution. For example, sewage treatment plants might be permitted to increase their phosphorus and nitrogen emissions as long as they reduced, or helped reduce, diffuse source P and N emissions from other than their own activities, e.g. from agriculture. Thus, for example, in Figure 1 suppose firm 1 increased its production so that its marginal abatement cost curve rose from MAC1 to MAC1a. Assuming a fixed stock of permits, firm 1 could only buy additional permits if the permit price also rose. However, if pollution reduction could be undertaken elsewhere at a cost less than Pp, it would be economically more efficient to allow the firm to increase its pollution from Q3 to Q5 as long as it reduced emission elsewhere by at least the amount (Q5–Q3).

Figure 1: Standard graphical analysis of pollution permits



Offsets expand the domain of environmentally damaging activities that may be managed to effect environmental improvement. Rather than a firm just managing its own (point source) emissions, offsets provide firms with incentives to manage emissions otherwise-unmanaged through existing incentives/regulation.

2.2 General characteristics of pollution offsets

The generic characteristics that make offsets a potential management/policy tool in the pollution context are:

- the (pollution) externality is capped – thus a unit of abatement, however occurring, has value
- polluters are permitted to select least-cost options for managing pollution emissions
- offsets are a permitted option
- offsetting activities are tradeable.

The technical conditions that allow offsets to be a viable policy tool are:

- the pollutant is readily measurable, whether point source or non-point; and thus
- the impact of abatement strategies, including offsetting as an abatement strategy, is readily measurable; and thus
- the relative costs of abatement strategies, including offsetting, are readily measurable allowing polluters to readily choose an optimal mix of pollution management strategies, including offsetting; and
- the impact of pollution is reversible.

The efficiency of offsets is affected by the ability of firms to seek out and compare off-site damage reduction opportunities with their own on-site pollution. A sufficient condition for efficient offsetting is therefore efficient offsetting markets.

2.3 Markets and offsets

Impersonal markets

Usually, when economists discuss “markets”, they mean the kind of visible, day-to-day “impersonal” markets in which producers and consumers routinely participate. The key <u>legal</u> characteristics of such markets are defensible property rights, with clear specification of what privileges (and responsibilities) are conferred by the property right. In particular, this specification includes being able to clearly describe the right and its benefits. The key <u>economic</u> characteristics of satisfactorily-functioning markets are that:

(i) there is a <u>descriptor(s)</u> in which trades can be denominated (e.g. mass in kg);
(ii) there is <u>sufficient information</u> about each individual item traded that buyers have confidence in its character; and
(iii) there is a <u>sufficient number</u> of buyers and sellers in the market that returns cannot be corrupted by dominant players.

In general, resource property markets such as land have these legal and economic characteristics.

If offsets are to function in impersonal markets then they will also require these characteristics. Thus offsets will require:

- ability to produce (i.e. create or choose) an offset - e.g. the ability to create/choose a biophysical process which will prevent, mitigate or rectify environmental damage; in the pollution context, this will range from the technically easy (e.g. find alternatives to CFCs in refrigeration) to the technically demanding (e.g. prevent dryland salinity);

- clear descriptor(s) of the offsetting and damaging activities - e.g. a damaging action might be “emitting y kg of pollutant Y at site S” and an offset might be “reducing pollution by x kg of pollutant Y at site R”;

- clear specification of what rights are conferred by the offset - e.g. “undertaking offsetting activity which reduces x kg of pollutant Y at site R” entitles the agent to “undertake environmentally damaging activity which emits y kg of pollutant Y at site S”;

- adequate information about the descriptor of every offsetting and damaging activity (potentially) traded;

- definition of duration and repeatability of damage and offset - conventionally, pollution is defined in emissions per time period, and corresponding offsets are similarly defined; however slowly decaying or stock pollutants may require an offset to be enduring (possibly, in perpetuity);

- adequate numbers of buyers and sellers.

For example, agent A may offer to provide an offsetting activity that reduces pollution emissions by K kilograms per year - they will complete the trade if the cost of acquiring the offset is less than the benefits of doing so. Conversely, agent B will sell the offset activity if the price offered exceeds their valuation of the offset (probably its opportunity cost). At market equilibrium, the value of an additional unit of offsetting will be equal for buyer (agent A) and seller (agent B). Where environments are stressed, the cost of on-site pollution control is high, thus the value of offsetting action is high, and the willingness to provide offsetting activities will be commensurately high.

If the requirement to offset endures for longer than one period, and the offset activity continues to provide the offset action, then A will continue to utilise the offset. If for any reason, the offset falls in value to agent A (e.g. because a new abatement technology becomes available to manage point source pollution), but the offset activity continues to provide offsetting action, then A may on-sell the offset to another agent who offers an adequate price.

As an example, suppose there is a trading scheme for pollution permits (e.g. emissions of SO2), and firms may also exceed their own individual permit cap only if they take an offsetting action which reduces SO2 emissions elsewhere. Suppose a firm that undertakes offsets changes its technology so that its plant sufficiently reduces SO2 emissions that the offset is no longer required. Then the firm could either sell SO2 permits, or sell its SO2 offsets activity, to other firms who have a demand for permits or offsets.

"Personal" markets

While the focus of economic analysis is generally on "impersonal" markets, there are some markets which operate differently – e.g. markets for intellectual property. While there may be property rights in some information - i.e. intellectual property such as patents, copyright, trademarks etc. - these forms of intellectual property are usually not traded in "impersonal" markets. In general, it is difficult to specify the value of an item of information or intellectual property; it is difficult to provide information about information; and the market has few buyers and sellers. Thus, intellectual property is generally traded by one-on-one negotiations between a seller and likely buyer(s). The key explanation for the difference between "impersonal" markets and one-on-one negotiations is transactions costs. The costs of creating impersonal markets in intellectual property are generally very high and as a result there are few examples.

There are similarities between information markets, and offsets markets. If the transactions costs of offsets are high - e.g. because it is difficult or impossible to specify the value of the offsetting action in quantitative terms - then "impersonal" offsets markets may fail even if they are established. However, even if such "impersonal" markets were unsuccessful, it is conceivable that offsetting actions could still occur. For example, if agent A was required to provide a defined offset for activity Y, agent A might provide that activity, or search for a partner to provide activity Y on A's behalf. This "personal" market is similar in character to those idealised arrangements envisaged in the pollution context as "Coasian" bargains.

3. Biodiversity offsets

The term "biodiversity" "encompasses the variety of life at the gene, species and ecosystem levels" (Williams et al 2001, p.3) including plants, animals (both vertebrates and invertebrates), and fungi, algae, single-celled organisms viruses etc. While elements of biodiversity are marketable goods – e.g. individual genes and organisms are tradeable and traded – biodiversity in the sense of the *variety* of life is a non-marketed good. It has elements of both non-rivalry and non-excludability, and is commonly regarded as a "public" good.

It is useful to distinguish "biodiversity" from, and also recognise its interrelationships with, *habitat* (living space for domesticated, feral and native plants and animals); *vegetation* (particular plants growing in a particular ecosystem); and *shelter* (vegetation providing a climatic refuge principally for domesticated animals). Habitat and vegetation are mixed public-private goods, and shelter is a private good with externalities which could be positive or negative depending on whether beneficial or detrimental organisms are being sheltered.

3.1 Economics of biodiversity

Evaluation of offsets for biodiversity requires an understanding of the economic dimensions of biodiversity including its economic valuation and how this value changes with anthropogenic activity and knowledge.

In Figure 2a, the “total social value of biodiversity” of a particular site is depicted as a functional relationship between the total biodiversity value of that site and the intensity of land use. Behind this relationship lie:

- a biophysical relationship between the extent and quality of biodiversity on the site, and its resilience to anthropogenic activity; and

- the value of a particular level and quality of biodiversity, which depends on this level and quality, and the amount of extant biodiversity of the same type – the more of this type of biodiversity that remains, the less valuable is this particular example.

This functional relationship between the total biodiversity value of a specified site and the intensity of land use is to be understood as the consequence of consistent application of the corresponding level of land use intensity - i.e. it is a steady-state curve. The interpretation of the “total social value of biodiversity” curve in Figure 2a is that biodiversity value is resilient to land use until a relatively high intensity of land use is achieved when biodiversity values at that site rapidly collapse (cf. discussion of Figure 2b below). The shape of the “total social value of biodiversity” curve is an empirical matter. The “marginal social cost of biodiversity loss” (MSCBL) is the derivative of the “total social value of biodiversity”

The “marginal net private benefit of land use” (MNPBLU) is the marginal increase in the private profitability of land use as its intensity increases, and is the difference between marginal revenue (constant for a competitive firm) and marginal cost. The optimal private level of land use intensity is at point “a”, where MNPBLU = 0 (i.e. MR=MC); at this point in Figure 2a, private profits are maximised, and there is also some residual biodiversity value. The MNPBLU curve will shift (intercept and/or slope) as output prices, input costs, and/or production technologies associated with the land use change, thus changing marginal revenues or marginal costs, or both. The outcome may be different depending on the shape of the “total social value of biodiversity” curve (cf. discussion of Figure 2b below).

The socially optimal level of private land use intensity is point “b” – i.e. where the marginal private value of land use intensity exactly equals the marginal social cost of land use intensity, and b < a.

Figure 2a: Standard steady-state analysis

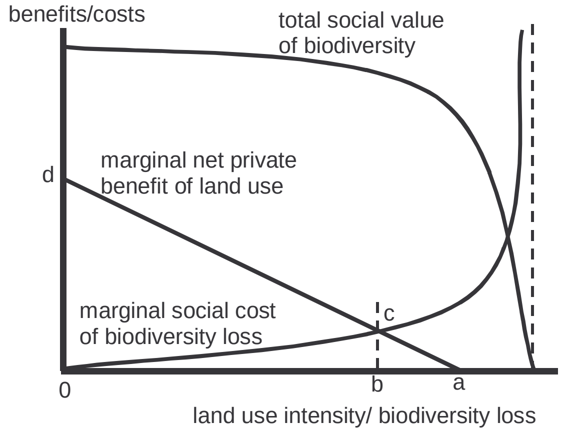
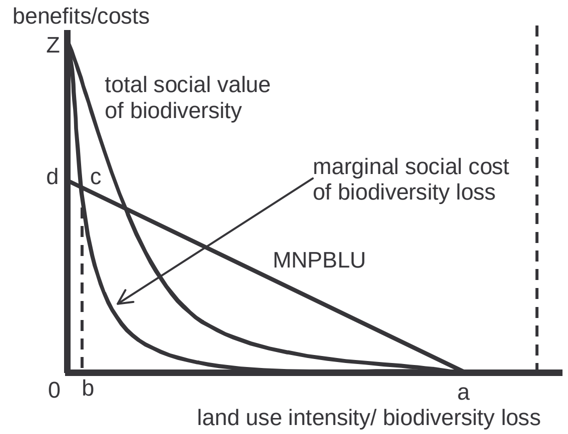


Figure 2b: Standard steady-state analysis with alternative total social benefits curve



Analogously to standard pollution analysis, policy mechanisms for shifting land use towards the socially optimal level of biodiversity conservation may be understood as (cf. Figure 2a):

(a) compensating land users for the loss of productive value of the land - e.g. a minimum payment "abc" may be used to induce land users to reduce intensity of land use from the privately optimal "a" to the socially optimal "b";

(b) shifting MNPBLU down (e.g. by a tax on intensity of land use, outputs or inputs) so that, in the limit, an MNPBLU curve as modified by the tax crosses the horizontal axis at "b" (or, at least, "closer to" "b");

(c) for land that has not been developed, preventing development might be the optimal policy – this may, at least for distributional reasons, require compensation; alternatively, payments equivalent to compensation may be seen as a tool to obtain voluntary compliance. In Figure 2a, the minimum payment to ensure voluntary compliance with no development is da0.

In Figure 2b, an alternative shape for the "total social value of biodiversity" curve is presented. In this case, any land use rapidly reduces biodiversity value – i.e. biodiversity in this environment is very sensitive to landuse. With this "total social value of biodiversity" curve, the MNPBLU intersects the "marginal social cost of biodiversity loss" from below at "c", which is therefore not an optimum. In this case the optimum level of land use intensity (or biodiversity loss) is either 0 (if the total social value of biodiversity at its maximum [Z] is greater than its private value through exploitation, eg for agriculture [represented by the area da0]); or, a (if Z < area da0).

Issues

The preceding conceptual analysis has the following implications

1. identification of the "optimal" level of land use intensity and the corresponding optimal level of retained biodiversity requires identification of the "total social value of biodiversity" curve - this represents a major challenge, requiring information on both the biological response of the ecosystem to land use intensity, and the economic value of the extant biodiversity.

2. similarly, the "optimal" level of land use intensity requires an ability to identify the MNPBLU curve - again, this may not be a trivial matter.

3. if it is assumed that land holders are at or near the private optimum (point "a" in Figures 2a and 2b for example), then it may be sufficient to identify policies that will move landuse towards the social optimum (point "b" in Figure 2a);); difficulties are likely to be encountered in defining the social optimum 'target zone' and in ensuring that the policy is effective in guiding resource use towards the target

4. there will be a variety of available policies to implement movement towards the social optimum – similar in concept to policies to manage pollution; presumably the least cost strategy is the most desirable.

5. if limited funds are available for biodiversity conservation, choice will also be required for targeting biodiversity types, and whether to target retention of existing high conversation value biodiversity or biodiversity improvement.

6. the preceding analysis highlights the importance of a sound understanding of biodiversity and land use relationships as the analysis assumes relationships are known with certainty, and there is no risk (e.g. environmental variability).

3.2 General framework for biodiversity offsets

The objective of biodiversity offsets is to conserve biodiversity over time. This management can be illustrated in Figure 3. Suppose, in the current time period (*t0*), the extant biodiversity (e.g. of a particular ecosystem) can be represented as being at *B0*. With existing policies, suppose that the time path of biodiversity decline was that designated by "business as usual" so that, by time *tn* only *Bn* biodiversity would remain, but of which only *BSn* was "secure" in the sense that its continued integrity was assured by being in some form of conservation reserve. Then suppose that, with offsets the rate of decline of biodiversity was still "business as usual" but that an offset policy required that, for each hectare of biodiversity damaged, K hectares of equivalent value had to be transferred to a secure conservation status. Then, by time *tn*, still only *Bn* biodiversity would remain, but now *BSn** would be "secure". The gain from the offsets policy would be the difference between *BSn** and *BSn*. Further, were K>1, then the total amount of biodiversity *Bn** at *tn* might also exceed *Bn*.

Figure 3:

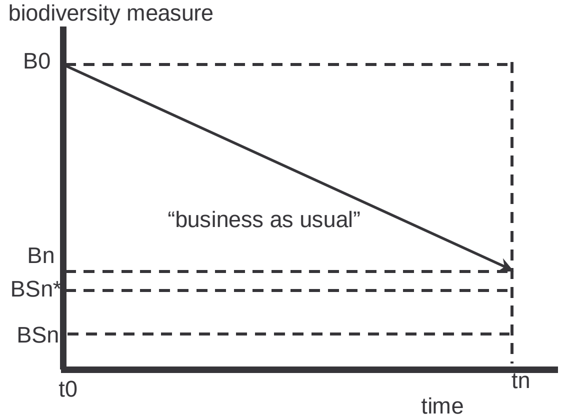
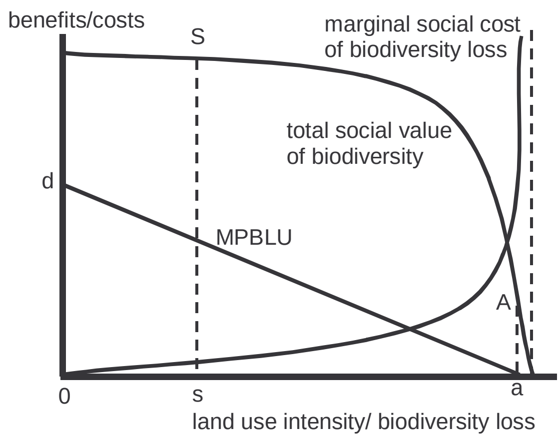


Figure 4: Biodiversity offsets



The economics of offsets for managing biodiversity conservation can be illustrated with reference to Figure 4. Suppose a landowner is operating at level of land use intensity *s*, with corresponding value of biodiversity of *S*. The landowner decides to intensify land use to the privately optimal level a, with a corresponding substantially lower level of residual biodiversity of A. In return for approving an intensification of land use at the site from *s* to *a*, the consent authority might require that an equivalent area – an "offset" – with total social value of biodiversity of *S* be preserved in perpetuity. Unless an equivalent area of social value of *S* were created, the total social value of biodiversity over all sites would decrease. However, it is improbable that biodiversity can be created in this way – at least in the short run. Thus, an offsets policy with regard to biodiversity is about either minimising the rate of loss of biodiversity, and/or increasing the expected level of secure biodiversity at some point in the future (cf. Figure 3). Where no biodiversity losses are contemplated offsets are inapplicable.

When considering biodiversity offsets, a table corresponding to Table 1 becomes more complex. Biodiversity occurs intertwined with rights in other property – especially land ownership – and, conceptually at least, it is desirable to consider their tradeability separately. Thus Table 1 expands into Table 2.

3.3 Markets for biodiversity offsets

Analogously to the preceding discussion about pollution offsets, the key issues for creating biodiversity offsets in impersonal markets are:

- ability to create an offset;
- clear specification of what rights are conferred by the offset;
- a clear descriptor of the offsetting and damaging activities;
- adequate information about the descriptor of every offsetting and damaging activity (potentially) traded;
- definition of appropriate duration and repeatability of damage and offset;
- adequate numbers of buyers and sellers.

Creating an offset

In the case of pollution, offsets are a potential abatement tool if pollution is capped, and firms are permitted to seek the lowest cost abatement option. Pollution is likely to be capped in stressed environments to reduce pollution damage costs. Offsets therefore provide an incentive for pollution reduction where the offsetting action provides a lower-cost alternative than further on-site abatement.

Biodiversity offsetting requires that, where biodiversity damage is permitted to occur, some “offsetting” mechanism must exist or be created. Offsetting mechanisms might include:

- protecting another site(s) of the same biodiversity type and value (known as “like-for-like” offsetting):

    in this case, the net benefit of offsetting arises from accepting the cost of a reduced total area of biodiversity against the benefit of obtaining a greater certainty of protection over the offset area;

    this option requires the ability to assess the cost of the certain damage to one specified area, and the benefit of the greater certainty of protection over the offset area.

- protecting another site(s) of the same biodiversity type but different (probably lower) biological value:

    the net benefit of offsetting comes from the cost of a reduced area of biodiversity being traded for the benefit of a greater certainty of protection over the offset area and, probably, a greater protected area albeit of lower biological value;

    this option also requires the ability to assess the relative worth of different areas and sizes of a particular biodiversity type.

- protecting another site(s) of a different biodiversity type:

    the net benefit of offsetting comes from the cost of a reduced area of biodiversity being traded for the benefit of a greater certainty of protection over the offset area of a different biodiversity type;

    this option requires the ability to assess the relative worth of the two different biodiversity types, and possible different areas of these biodiversity types.

- protecting another site(s) of the same or different biodiversity type, and lower biodiversity value, and attempting to improve this value by rehabilitation of the extant biodiversity (principally vegetation), or resuscitation of the former biodiversity (principally vegetation):

    the net benefit of offsetting comes from the cost of a reduced area of biodiversity being traded for the expected benefit of a greater certainty of protection over the offset area, less the costs of rehabilitation/resuscitation;

    this option requires the ability to assess the relative worth of the two different biodiversity types, and possibly different areas of these biodiversity types;

    also requires some indication of the probability of the successful rehabilitation or resuscitation of a site to some preferred and defined biodiversity status.

- undertaking environmentally improving works of a completely different type to biodiversity conservation:

    this option requires a mechanism for assessing the "willingness to accept" for damage to the particular biodiversity.[3]

- making a monetary payment to offset the biodiversity damage:

    this option also requires a mechanism for assessing the "willingness to accept" for damage to the particular biodiversity.

Where there has been severe degradation of an ecosystem, sites may not be available to reserve. Thus, offsetting for biodiversity conservation has a substantially different character from pollution offsetting. In the latter case, offsetting is a viable management option because the stressed environment creates a value in the offsetting activity, and mechanisms are available to abate the damage. With biodiversity, stressed environments are those where the biodiversity is under substantial threat, and the marginal value of biodiversity is likely to be so high that allowing any destruction of biodiversity would be socially inefficient. Thus biodiversity offsetting of a "like-for-like" form is likely to be economically appropriate only when the marginal cost of biodiversity damage is low – i.e. where there are substantial extant areas of a particular biodiversity type available to protect. Other forms of offsetting are possible – e.g. using lower-valued sites, other biodiversity types, or other environmental works – but the eventual effect could be disappearance of the a particular biodiversity type.

[3] Note that the willingness to accept for the damage should be assessed not only for the current generation but for all future generations if the damage is irreversible.

Whether or not biodiversity offsets of forms other than “like-for-like” are feasible depend on additional characteristics outlined below.

Specification of rights conferred by offset

Property rights other than offsetting are specified in terms of the extent to which the beneficial owner may enjoy use of the property, how non-beneficial owners may be excluded from use, and the conditions under which the right may be transferred to other owners. Determination of rights for offsets is somewhat different. Only *conditional* rights are created for offsets – i.e. a person may do damaging activity Y *only if* they also do offsetting activity X.

The management of a conditional right is less complicated where both damaging and offsetting activities occur within the same property rights domain – e.g. on the same “site” (e.g. on the same land title lot number). The more removed in space are the damaging and offsetting activities – e.g. in different local government areas implying different consent authorities and compliance regimes for damaging and offsetting – the more difficult (expensive) offset management is likely to be. Spatial separation increases the potential transactions costs of managing offsetting.

Separation in time is an additional complication. The permitted damage is certain and immediate, whereas the offset is continuing, and requires on-going management (and thus associated costs). Where offsetting requires rehabilitation or resuscitation of sites of lower biodiversity value that that being damaged, the outcome is also uncertain. This uncertainty requires defining who bears the cost of the uncertainty – the agent responsible for the damage and arranging the offset, or the public on whose behalf the offset is demanded.

Descriptor of offsetting and damaging activities

Because offsetting is defined as a relationship between a damaging activity and an offsetting activity, it is necessary to be able to describe both. At minimum, description requires delineation of the location and area over which the damaging and offsetting activities would occur, and the type and quality of biodiversity on the relevant sites. Preliminary indexes of biological value of sites have been developed (e.g. Oliver 2002 and Department of Natural Resources & Environment 2002).[4]

Adequate information about descriptors

Except in the case of like-for-like offsetting action – i.e. where it is known that areas of particular types of biodiversity are of equivalent biological values – offsetting requires an ability to measure the biodiversity status of (different areas of) at least one type of biodiversity. Different areas of the same biodiversity type, different areas of the same biodiversity type in different conditions, or different areas of different biodiversity types in the similar or different conditions need to be described in such a way that the relative values of different areas, types and qualities can be established. These relative values are equivalent to general equilibrium prices. However, because biodiversity is a public good, there are not – and may never be – markets which translate these descriptors in relative values. Where quasi-markets are created in activities to conserve[5] biodiversity

[4] See also http://www.npws.nsw.gov.au/science/research/woodland_ecology/benchmarking.html
[5] Note these tendering markets determine the value of the activities to conserve biodiversity, they do not value the biodiversity per se.

– e.g. Victoria's BushTender – the absolute value of biodiversity conservation revealed by these markets is contingent on the level of government funding. Relative biodiversity values, especially those which involve comparing biodiversity values to non-biodiversity environmental values, will also depend on the level of government funding available.

Because of the heterogeneity of biodiversity - both in type, quality and extant area - defining clear descriptors for biodiversity is likely to be expensive. Again, there are likely to be high potential transactions costs of managing offsetting.

Because the quality of biodiversity changes over time, a once-for-all description of biodiversity status is not possible. When it is proposed to damage biodiversity and offset this activity, it would then be necessary to assess both damage and offsetting sites at that point in time.

Definition of appropriate duration and repeatability

Biodiversity damage is generally once-for-all (e.g. clearing) and thus the offset must be enduring (ideally, in perpetuity). Hence there will only be once-for-all trades in biodiversity offsets, and no repeatability as there is with pollution offsets. Indeed, once an offset is created, it will become a private liability[6] because the opportunities for using the site to produce marketable goods are likely to be severely curtailed. Thus opportunities for utilising or on-selling the offset will be limited or non-existent. Further, the offset must be managed into the future to continue to provide the enduring offsetting action, thus incurring continuing management costs.

Adequate numbers of buyers and sellers

In stressed environments where the standard requirements of offsets of trading – i.e. "like-for-like" and that offsetting actions be "local" – are imposed, the size of the market is likely to be too small to permit impersonal markets to emerge because there will be little of the threatened biodiversity type to trade. Greater numbers of buyers and sellers are more likely to emerge where trading does not involve "like-for-like", where offsetting actions need not be "local", or where biodiversity types are not stressed. However, without "like-for-like" offsetting, the transactions costs are likely to be very high to ensure that environmental values are not diminished by offsetting. Biodiversity offsets are likely to be most valuable where biodiversity is <u>not</u> stressed, and where there are good opportunities for permanent protection by permitting damage to some areas which are offset by permanently-protected areas of high value.

However, these limitations on the emergence of *impersonal* markets for biodiversity do not necessarily carry over into *personal* markets. Personal markets in biodiversity *may* take the form of a contractual arrangement between interested parties. While the negotiation transaction costs are higher in the case of personal markets, other costs - particularly the information costs of defining the nature of the offset - may be substantially reduced. For example, rather than a complete specification of the biological characteristics of the damaging and offsetting actions, the parties to the trade may agree that the offsetting action does indeed offset the damage. In this case, one of the parties to the trade (eg agency, community jury, etc) would need to have a concurrence role and would certify - perhaps on the basis of judgement or partial, rather than complete, description - that the offset was "appropriate".

[6] While the offset is a private liability, it will be a public asset because it provides the environmental services that were previously provided by the damaged asset.

4. Conclusion

The property right and economic characteristics of environmental activities are crucial in defining the types of market activities that may improve environmental outcomes. Many of the characteristics of pollution are different from biodiversity, and thus due care needs to be taken in translating market instruments relevant to pollution into the biodiversity domain. Three key contrasting issues are the description of the damaging and offsetting activities, the ability to create offsetting processes, and the duration of damage and offset.

Most polluting activities are defined in terms of a single pollutant (e.g. SO_2, CO_2), whereas biodiversity is difficult to characterise via a single variable and is highly heterogeneous. Polluting activities are conventionally defined as emissions per time period, and offsetting activities similarly; these activities are repeatable over multiple time periods. By contrast, biodiversity damage is once-for-all, and offsetting actions need to endure over multiple time periods, and preferably in perpetuity.

The conditions for *impersonal* markets that are readily found with many pollutants - both for permits and offsets – are less readily available for biodiversity. Indeed, biodiversity offsets are likely to be a private liability to the holder, which means that a secondary market in offsets is unlikely to emerge. However, *personal* markets for offsetting arrangements for biodiversity may emerge as contractual relations between parties who seek or require offsetting activities, and parties who may hold environmental assets which are suitable for offsetting.

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Box 1: Green Offsets in NSW

A green offset is action taken outside a development site (but near to it) that reduces pollution or environmental impacts. The developers either take the action themselves or pay for others to do it on their behalf.

A green offset scheme ensures that there is a net environmental improvement as a result of development. Any additional environmental impact that is generated by a development is offset by action taken off-site that reduces a greater amount of environmental impact, so the net effect of development is positive.

The principles of green offsets enunciated in the concept paper are (p.4):

- Environmental impacts must be avoided first by using all cost-effective prevention and mitigation measures. Offsets are then only used to address remaining environmental impacts.
- All standard regulatory requirements must still be met.
- Offsets must never reward ongoing poor environmental performance.
- Offsets will complement other government programs.
- Offsets must result in a net environmental improvement.

Offsets must be:

- enduring – they must offset the impact of the development for the period that the impact occurs
- quantifiable – the impacts and benefits must be reliably estimated
- targeted – they must offset the impacts on a ‘like for like or better’ basis
- located appropriately – they must offset the impact in the same area
- supplementary – beyond existing requirements and not already being funded under another scheme
- enforceable – through development consent conditions, licence conditions, covenants or a contract.

Source: NSW Government (2002, pp.3,4)

Table 1: Offsets in a Pollution Context

Property rights	**No offsets**	**Offsets**	
		Offset Non-tradeable	**Offset tradeable**
None	[various regulatory instruments, taxes & subsidies for managing emissions]	various instruments *AND* offsetting modifies existing instrument - e.g. offsetting reduces a pollution tax - *BUT* offsetting activities not tradeable	various instruments *AND* offsetting modifies existing instrument - e.g. offsetting reduces a pollution tax - *AND* the offset is tradeable
Non-tradeable*	e.g. right to emit a specified quantity of pollutant is created	e.g. right to emit specified quantity of pollutant *AND* emissions exceeding emission permits are offset by actions reducing other emissions, *BUT* offsetting activities not tradeable	e.g. right to emit specified quantity of pollutant *AND* emissions exceeding emission permits are offset by actions reducing other emissions, *AND* the offset is tradeable
Tradeable	e.g. a cap is set on pollution emissions, and rights to these emissions are tradeable	e.g. there are tradeable emission rights within a cap, *AND* emissions exceeding emission permits are offset by actions reducing other emissions, *BUT* offsetting activities not tradeable	e.g. there are tradeable emission rights within a cap, *AND* emissions exceeding emission permits are offset by actions reducing other emissions, *AND* the offset is tradeable

Source: developed from Murtough et al (2002).
Note: * In both cases of “non-tradeable” property rights, Murtough et al (2002) envisage a once-for-all trade in the property right to emit (in the case of no offsets) or a once-for-all trade in the offsetting activity. These activities could take place with no trades - as “non-tradeable” property rights infer. For example, emitters could be given rights to emit, and offsetting activities could occur without the emitter needing to purchase an offsetting activity.

Table 2: Offsets in a Biodiversity Context

Property rights in resource supporting biodiversity	**Property rights in elements of biodiversity**	**No offsets**	**Offsets**	
			Offset Non-tradeable	**Offset tradeable**
None - e.g. marine waters	None	open access fishing	n.a.	n.a.
	Non-tradeable	non-tradeable fishing right	availability of non-tradeable fishing right conditional on observing gear restrictions or size limits	
	Tradeable	tradeable fishing right	availability of tradeable fishing right conditional on observing gear restrictions or size limits	
Non-tradeable -e.g. extensive impounded freshwater	None	open access fishing	n.a.	n.a.
	Non-tradeable	non-tradeable fishing right	availability of non-tradeable fishing right conditional on observing gear restrictions or size limits	
	Tradeable	tradeable fishing right	availability of tradeable fishing right conditional on observing gear restrictions or size limits	
Tradeable - e.g. land	None - i.e. biodiversity only tradeable simultaneously with land	resource holder cannot harvest native biodiversity; regulatory approval required for interference; may be incentives/penalties for actions affecting biodiversity	resource holder cannot harvest native biodiversity; regulatory approval required for interference; may be incentives/-penalties for actions affecting biodiversity *AND* biodiversity-affecting actions may be permitted with offsets, *BUT* the offset is non-tradeable	resource holder cannot harvest native biodiversity; regulatory approval required for interference; may be incentives/-penalties for actions affecting biodiversity, *AND* biodiversity-affecting actions may be permitted with offsets, *AND* the offset is tradeable
	Non-tradeable	resource holder may harvest (specified) native biodiversity for own use	resource holder may harvest (specified) native biodiversity for own use *AND* required to undertake offsetting action (e.g. rehabilitate specified vegetation)	resource holder may harvest (specified) native biodiversity for own use *AND* required to undertake offsetting action (e.g. rehabilitate specified vegetation) *AND* trading permitted in offsetting action
	Tradeable	resource holder may harvest and trade in (specified) native biodiversity	resource holder may harvest and trade in (specified) native biodiversity *AND* required to undertake offsetting action (e.g. rehabilitate specified vegetation)	resource holder may harvest and trade in (specified) native biodiversity *AND* required to undertake offsetting action (e.g. rehabilitate specified vegetation) *AND* trading permitted in offsetting action

Source: developed from Murtough et al (2002).