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PRIVATE INCENTIVES FOR ENVIRONMENTAL PUBLIC GOODS^{*}

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January 1999

^{*} Paper presented at the 43rd Annual Conference of the Australian Agricultural and Resource Economics Society, Christchurch, New Zealand. Funding for the research presented in this paper has been provided under the National Wetlands Research and Development Program by Environment Australia and The Land and Water Resources Research and Development Corporation.

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Abstract

Private land managers make decisions regarding the use of their environmental resources in response to information and incentives contained in the price mechanism. However, the price mechanism often fails to reflect adequately the information relating to the public good attributes of environmental resources. Hence decisions made by private land managers do not necessarily reflect the desires of society as a whole. In this paper the incentives of wetland owners are explored in conjunction with some of the constraints imposed by the production process and the institutional framework. Specifically three aspects of the resource allocation problem faced by society are explored. Firstly, the institutional framework within which private wetland managers operate is examined. Secondly, the nature of private and public outputs produced by a specific environmental resource, wetlands, is analysed. Finally, the nature of the production process that uses wetlands as inputs and jointly produces both private and public goods is investigated. The theoretical construct developed in this paper will be tested as part of the 'Private and Social Values of Wetlands' research project currently in progress.

Key words: Environmental public goods, incentives, institutions, environmental resource decision making.

1. Introduction

Environmental natural resources are inputs into numerous production processes including agriculture, energy generation and tourism. In many cases, the natural resources can be used to produce both commercial and non-commercial goods and services. The price mechanism reveals demand for commercial goods and services, generally private goods. The demands revealed by the price mechanism provide external information in the form of monetary incentives. This information is used in resource management trade-offs made by producers. However, the same production process, or the same inputs, may produce non-commercial products. The price mechanism does not reveal information or provide incentives for this class of goods, generally public goods. Hence decisions about environmental natural resources which can be used to produce both commercial and non-commercial goods may not completely reflect the desires of society.

Wetlands represent a specific bundling of resources (land, water, location, flora and fauna) (Bennett 1998). These resources can also be bundled in other ways to yield other types of benefits. For example, the water can be removed to irrigate crops or the land can be drained for cropping or grazing. Some wetland resource allocations produce commercial products such as grazing and timber production. Other wetland resource allocations yield non-commercial products, for example biodiversity conservation and pollution reduction. When making decisions about how to use their wetlands, owners and managers use the information delivered by the price mechanism. Price information contains incentives for the production of commercial goods and services. These price incentives are traded-off against other monetary and non-monetary benefits and costs wetland owners and managers receive from alternative uses of their resources.

Price information and incentives are often not available for non-commercial wetland resource allocations, especially allocations that maintain environmental integrity. Society may wish to provide the missing information and incentives in order to improve the overall level of societal benefit. By understanding the flows of price information and incentives in markets, and its use by consumers and producers, supplement information and incentives (that is, wetlands policy) can be more effectively targeted.

The use of wetland resources in production and consumption processes, and hence the potential for incentives, can be analysed at three interlinked levels:

1. The institutional framework underlies production and consumption. The institutional framework can constrain or modify the flow of information and incentives from consumers to producers and hence can constrain consumption and production.
2. The institutional framework defines the nature of the goods and services produced using wetland resources. Specifically, institutions define property rights and transaction costs via rules of exchange. The nature of the goods and services determines the extent to which price signals, and hence information, are transmitted to wetland owners and managers.
3. The institutional framework and the range of resource allocation possibilities determine the nature of the production process. The production process

determines how the information and incentives contained in the price signals influences the mix of commercial and non-commercial wetland resource outputs. Each of these levels contains opportunities for providing missing information and incentives. The three levels can be viewed as aspects of the societal decision making process.

In this paper, the role of information and price incentives in the three broad regions of the decision making process is examined with the aim of exploring a range of potential incentives for wetland policy. In the next section, definitions of public goods, institutions and transactions costs are provided. The definitions provide a framework for the analysis. The flow of information and generation of incentives in the institutional framework that underpins the production and consumption processes is then examined with emphasis on transaction costs. In the fourth part, the institutional framework is used to examine the nature of the private and public goods produced using wetland inputs. The nature of the production process is examined in the fifth section with particular focus on the bundles of outputs produced by wetlands and how this mix may be altered by differing incentives. An overview of the range of opportunities for incentives in wetlands policy processes concludes the paper, together with some goals for further research.

2. Some definitions

2.1 Public goods

The development of the concept of public goods has a long history in economic literature. Initially the concept of public goods was related to the notion of collective provision. Classical economists including Adam Smith and David Hume recognised a class of goods that by their nature required government intervention and provision (Cornes and Sandler 1996).

More recent discussion following Samuelson's (1954, 1955) seminal works has focused on the nature of public goods that rendered collective provision necessary. Public goods are characterised as exhibiting non-rivalry in consumption in this literature. Non-rivalry in consumption can be expressed in two equivalent ways:

1. My consumption leaves no less available for others to consume (Samuelson 1954, Layard and Walters 1978).
2. The marginal costs of production or provision of the good to additional consumers are zero (Demsetz 1970, Schmid 1989).

Samuelson defines non-rivalry from the point of consumption while Demsetz defines it from the point of view of production.¹

A more complete definition of public goods characterises public goods as exhibiting both non-rivalry in consumption and non-excludability in consumption. Once produced, individuals cannot be prevented from consuming non-excludable goods. Head (1977) regards non-excludability as a standard characteristic of public goods as do modern texts (see for example Layard and Walters 1978, Hyman 1990 and Varian 1992). Perhaps more importantly, current environmental economics texts also clearly

¹ Demsetz (1970) defines non-rival goods as public goods and considers goods with non-excludability characteristics as 'collective goods'.

define public goods as displaying non-rivalry *and* non-excludability in consumption (see for example Wills 1997, Turner, Pearce and Bateman 1994 and Jacobs 1991). The notion of non-rival and non-excludable goods is commonly referred to as a definition of ‘pure public goods’.

The difference between the non-rival goods and non-rival and non-excludable goods relates to whether it is possible for a market to exist. Where goods are non-rival, but are excludable, markets are possible (for example pay television). Where cost effective excludability is not possible markets cannot operate (for example the existence value of wetlands). Cornes and Sandler (1996, p.4) define exclusion costs as ‘the value of the resources expended to erect and man the barriers that force preference revelation.’ Once a non-excludable, non-rival good is produced everyone is able to consume the full quantity of the good. However, there are no technical constraints to the production of the good.

2.2 Institutions and public goods

The refinement of the definition of public goods coincided with a broadening of the spectrum of goods recognised by economists. Initial analyses, such as Samuelson (1954, 1955), explicitly recognised two classes of goods; pure public goods as defined above and purely private goods that are rival and possess no exclusion costs. Later analyses recognised a spectrum of goods between private and public goods that exhibited some rival characteristics or increasing costs of exclusion. For example club goods and common access goods. The difference between these goods and pure public or private goods generally depends on the existence of an exclusion mechanism.

The existence of an exclusion mechanism is essentially dependent on the institutional base. Institutions are defined as ‘rules of human conduct whose violations carry sanctions’ (Kasper 1998, p. 44). Institutions serve three key roles in facilitating information and monetary incentives via the price mechanism: they specify property rights; define the rules of exchange; and, otherwise shape behaviour via ‘norms of behaviour or politeness’ (Wills 1997 p. 20-21). That is, institutional factors assist in defining the production and consumption attributes of goods. Hence whether a good is public or private also depends on the institutional framework. For example, common access goods are rival in consumption but no rules exist to facilitate exclusion.²

The institutional framework also influences the transaction costs. Transaction costs comprise information (search) costs, bargaining (contract) costs and enforcement costs (Bromley 1991). When transaction costs occur within a single organisation (such as a firm, cooperative or club) they are referred to as organisational or agency costs. Where transaction costs are sufficiently high as to prevent transactions taking place the price mechanism will also fail despite a demand for these goods existing. While this class of goods is not directly examined in this paper, the institutional framework is a key factor in determining the level of transaction costs.

² See Schlager and Ostrom (1992) for an extended discussion of the relationship between property rights and the market attributes of goods and services.

In the context of this paper, the key defining attribute of public goods is non-excludability. The essence of non-excludability is that it precludes wetland owners and managers from receiving monetary benefits from producing the good or service. Once the price mechanism fails, information and monetary incentive flows between consumers and producers are removed. Non-rival (but excludable) products may support a market and hence flows of information and incentives, although the flow is likely to be incomplete and the outcomes inefficient. That is, for goods with zero marginal costs of production the price must also equal zero for Pareto efficiency, but a market can't work when price equals zero.

2.3 Additional public good characteristics

Pure public goods are sometimes also characterised as non-rejectable or non-optional goods (see for example Bannock, Baxter and Davis 1987). That is, the notion that individuals cannot abstain from consumption of the good or service even if they wanted to. Non-rejectable goods can be regarded as an extreme case of non-excludability. James (1971) defines non-rejectable goods (non-optional goods) as goods for which a positive level of consumption is imposed and any attempt to deviate from this level of consumption involves additional expenditure. For example, in order to reduce your consumption of street lighting you may need to purchase heavy curtains or move house.

Two additional attributes commonly (but not always) attributable to environmental public goods are lumpiness and non-separability in production. Firstly, environmental public goods are commonly lumpy. Lumpiness implies that it becomes more and more difficult (if not impossible) to supply particular public goods from smaller and smaller areas of wetlands. Secondly, environmental goods are often non-separable in production (jointly produced). A single wetland production process provides a number of goods and services. Often the non-commercial goods and services are referred to as externalities. These points are expanded further in the fifth part of the paper.

Where environmental goods are not true public goods they often possess some characteristics of public goods such as non-excludability, for example open access or common goods. Wetland resources can be used to produce goods with characteristics ranging from pure private goods to pure public goods. For example deep-rooted native vegetation may produce native seed (private good), reduce groundwater recharge (open access), provide a pleasant view and maintain biodiversity (public goods).

3. Institutional framework of wetland resource use

Wetland resources can be used in a variety of ways to produce a multitude of differing outputs. The focus here is on the institutional framework within which consumption and production decisions are made. In this paper the division between goods for which price signals function adequately and goods for which price signals fail are of particular interest. Or as Kasper (1998 p. 89) writes:

The key signalling device in the market is the price. It conveys much complex knowledge in condensed, coded form. ... As long as buyers are able to appropriate the gains, this will be an incentive to provide more of what buyers want.

The information flows about some of the goods and services provided by wetlands either do not exist or are distorted. While the institutional framework facilitates flows of information and incentives via the price mechanism for some goods, it is not effective for all goods. Specifically the institutional framework does not facilitate flows of goods, money and information for environmental public goods. Hence one potential avenue for improving wetland policy lies in facilitating flows of information and price incentives via alternative institutional structures. In this section the main aspects of the market specified by the institutional frameworks are explored, namely; property rights, rules of exchange and norms or conventions about behaviour.

3.1 Property rights and market information

Bromley (1991, p.15) defines rights as: *‘the capacity to call upon the collective to stand behind one’s claim to a benefit stream ...* Rights are not relationships between me and an object, but are rather relationships between me and others *with respect to that object’* (Bromley’s emphasis). Kasper (1998) notes rights do not only cover physical objects but also apply to our bodies and labour and to intellectual creations. Hence, ‘property’ refers to the income stream rather than the object itself (Bromley 1991). For example, when land is purchased, the rights to the benefit stream are the actual purchase rather than the physical ‘property’. Property rights, to be effective, must be excludable, divisible (in both space and scope) and alienable (or transferable) (Kasper and Streit 1998).

The importance of property rights lies in the way by which they enable individuals to benefit from activities. Property rights allow passive use of assets, for example exclusion of others from an asset. Property rights also allow active use of assets, for example in combination with other assets as part of a productive process in return for expected gains. Kasper (1998), among others, notes that active use of assets involves transaction costs.

Well defined property rights can reduce transaction costs by clearly defining benefit streams and reducing the need for ongoing negotiation costs over these benefit streams (via a permanent transfer of rights) (Binning and Young 1997). Or as Kasper (1998) writes, ‘Institutions serve to reduce transaction costs by allowing members of society to depend on broad behavioural patterns, reducing the range of outcomes without making a particular outcome certain.’ Hence search costs are reduced as owners of benefit streams are identified, bargaining costs are reduced as the benefit stream is defined and enforcement costs are also reduced due to identified and defined benefit streams. Each of Kasper and Streit’s (1998) key property right characteristics (excludability, divisibility and alienation) is important to reducing transaction costs and improving information and incentive flows within markets.

The most important aspect of property rights is excludability. By definition, excludability confers exclusive access to a benefit stream upon the owner of the property right. By offering to sell part, or all, of the benefit stream, property right owners are able to obtain information about the relative value of the benefit stream compared to alternative benefit streams. For example a wetland owner may compare the benefit stream arising from ‘renting’ the benefit stream to eco-tourists or hunters against the benefit stream received via grazing. The problem with many wetland

benefit streams is they are essentially non-excludable, for example bio-diversity and scenic vistas. For these benefit streams the cost of exclusion is too great.

Other potential benefit streams have been reduced or removed for example via land clearance regulations (in most Australian States) and banning duck hunting (in New South Wales). Still other property rights over other potential benefit streams, such as from ranching native fauna (for example for sale as pets or for game production), are vested in the Commonwealth. Hence one possible policy initiative is altering the property right regime to facilitate exclusion and thereby allow property right holders to derive monetary benefits. That is, by allowing access to benefit streams that require conservation, the flow of information and incentives to landholders may be improved. Buchanan (1965) indicates the importance taking into account transaction costs when designing exclusion rights. That is, property rights designed for optimal exclusion may impose prohibitive exclusion costs while an alternative arrangement may facilitate market exchange and hence transfer of information and incentives.

Kasper and Streit (1998) also suggest property rights should be divisible in both space and scope. Property rights over a number of different benefit streams are commonly bundled together. For example rural blocks of land cannot be subdivided below a certain size (if at all), that is the benefit stream arising from the land cannot be subdivided. Alternatively, separate benefit streams from the same resource cannot always be traded individually. For example wetland owners may be unable to separate and sell the right to drain a wetland while maintaining other rights such as grazing. Where a number of separate benefits, desired by different consumers, are bundled together, signals within the market may become distorted, or transaction costs become too high. For example, potential wetland buyers may not be interested in pastoral production but unable to bid for a relatively small wetland area, while the costs of forming a coalition with a pastoralist may be prohibitive. Hence market information does not reach wetland owners and managers. Therefore a second potential incentive strategy relates to facilitating information and incentive flows via revelation of demands for, and transfer of, benefit streams between differing individuals by increasing their divisibility.

Property rights should also be alienable (Kasper and Streit forthcoming). Clearly where property rights are not divisible they cannot be alienable. For example while wetland owners can rent access to wetlands to hunters they cannot sell hunting rights. Where benefit streams are non-alienable, markets for short-term access to benefit streams may still exist, however these markets may be constrained and the movement of information incomplete. Hence another potential incentive strategy relates to facilitating information and incentive flows by increasing the alienability of benefit streams.

3.2 Institutions, organisational structure and rules of exchange

Historically much of the debate surrounding optimal production of public goods has centred on the search for information about consumer preferences. The search for information focused on the difficulties involved in determining the marginal benefits relative to the marginal costs and hence the efficient level of supply. Often government was seen as the only organisational structure able to provide an optimal quantity of public goods. Buchanan (1965) indicates that a variety of providers may

be optimal depending on the form of the public good. Clubs, cooperatives, government and profit-seeking firms are among the potential organisational structures recognised by Buchanan.

Decisions about production within alternative organisational structures such as clubs, cooperatives, government or firms are essentially planned on a collective basis. Hence a trade-off exists between the transaction costs associated with acquiring market information and the agency or organisational costs associated with alternative organisational structures. Since alternative organisational (and hence decision making) structures may reduce net costs, facilitating participation of alternative organisational structures via varying the rules of exchange is one potential institutional change. This idea is returned to in section five.

Other institutional systems can also contribute to information flows and reduced transaction costs. Conventions, codes of behaviour, or norms, are generally accepted behaviour such as customs and tradition.

A convention is a regularity in human behaviour which everyone prefers to conform to R on the expectation that all others will also conform to R. A convention is a structured set of expectations about behaviour, and of actual behaviour, driven by shared and dominant preferences for the ultimate outcome as opposed to the means by which that outcome is obtained. (Bromley 1989, p.42)

Conventions reduce transaction costs by reducing contract negotiation costs. They are useful where the preferred outcome is shared and dominant (Bromley 1991). As indicated above, conventions are generally accepted or repeat behaviour. The behaviour does not have to be re-learned or re-negotiated as part of each contract. Mohr (1994) notes the possibility that norms (conventions) can be altered by deliberate policy intervention, hence altering transaction costs (for example, the use of Landcare to advocate the notion of stewardship in encouraging particular land management practices).

4. The nature of wetland outputs

The way institutional factors shape the attributes of public goods, and hence society's decision making processes, has been explored in the previous section. The way the attributes of environmental public goods shape consumption decisions is examined in this section. The focus is on how consumers use the price system to transmit information and incentives about wetland outputs. By examining the way consumers transmit this information we may enhance our knowledge of how incentives may be targeted towards wetland protection.

There is a number of ways of analysing the outputs of wetlands. For example wetland resources produce commercial and non-commercial products, use, non-use and indirect use values, consumptive and non-consumptive products. Bromley (1997 p.36-39) divides the environmental benefits from agricultural land, or the class of goods and services for which price signals fail, into three groups; amenity implications; habitat implications; and, ecological or extra-boundary implications. These classes are not mutually exclusive and may be non-separable in production.

Amenity implications relate to the visual attributes of wetlands within agricultural systems. Specifically, amenity implications refer to those attributes of wetlands making them pleasing (or annoying) to the beholder. Aspects such as vegetation, water and wildlife, or conversely dead trees, bare land or drowned pasture. While a market exists supplying flows of information for various commodities produced from agricultural landscapes there is no market for the amenity aspects of those landscapes (Bromley 1997 p. 36).

Habitat implications are those aspects of wetlands providing for plants and animals not contributing to agricultural production. Once again these may be positive (such as some species of waterfowl) or negative (such as feral animals or pasture damaging waterfowl). The boundaries of markets and hence information and incentive flows are less well defined in this case. For example, limited markets exist for duck hunting and eco-tourism. However no market exists, and hence no price based information and incentive flows exist, for many other wetland outputs such as the existence values of flora and fauna.

The ecological or extra-boundary implications relate to aspects of wetland resources that have impact beyond the farm boundary. That is, the actual benefits arising are not located within the boundary of the farm. For example, flood and pollution control benefits of wetlands may be located downstream of the wetland area. Markets do not generally exist for this class of goods and services.

The market attributes of each of these three groups of wetland resources are likely to decrease from relatively undisturbed wetland areas. That is, price signals tend to fail for relatively intact bundles of wetland resources (with the limited exception of eco-tourism). The range of wetland outputs for which price signals are available is considerably restricted and relates to unbundling the resources that go together to make up the wetland. For example: use of water for irrigation elsewhere; use of land and vegetation for agricultural production (such as grazing or cropping); and, extractive uses (such as timber harvesting or peat mining). Other resource uses focus on particular components of wetland outputs rather than wetland resources as a whole, for example hunting and eco-tourism.

The reason that the price signals fail for many wetland products can be traced to the institutional framework. In some cases, as discussed in section 3.2 wetland owners and managers are not able to access the benefit stream from particular uses of wetland outputs. In other cases the access to a potential benefit stream is vested elsewhere (for example hunting in NSW). That is, price signals do not exist because of a property right problem. Hence one potential incentive strategy is to facilitate access to benefit streams from intact bundles of wetlands by altering property right structures.

In other cases, even if property rights exist, the costs of exclusion are too high. For example, the cost of constructing a fence to prohibit enjoyment of scenic vista would be prohibitive. New technologies can reduce exclusion costs or allocate benefits more accurately. Facilitating research, design and adoption of such mechanisms is a potential incentive strategy allowing wetland owners and managers to capture benefit streams. An alternative strategy is to directly supply supplementary information and incentives that allow benefit streams to be captured (for example eco-tourism).

Finally, transaction costs may prevent market formation. For example, even if wetland owners and managers could levy individuals according to their existence values the costs associated with identification and collection would most likely outweigh the benefits. Hence a third potential incentive strategy is to facilitate improved flows of information and incentives by reducing transaction costs. For example eco-tourism transaction costs may be reduced via use of government economies of scale in promotion and regional infrastructure.

5. The nature of the production process

In the previous section the nature of environmental public goods produced using wetland resources has been described. The key consumption characteristic of goods produced using wetland inputs is excludability. Where exclusion is not possible, there is no potential for generation of accurate price signals within the market. In this section, the impact of market information and incentives on the production process is discussed together with the direct impact of some environmental public good attributes on the production process. Non-separability in production and lumpiness are two such attributes of environmental public goods important to the production process.

5.1 The information and incentive problem

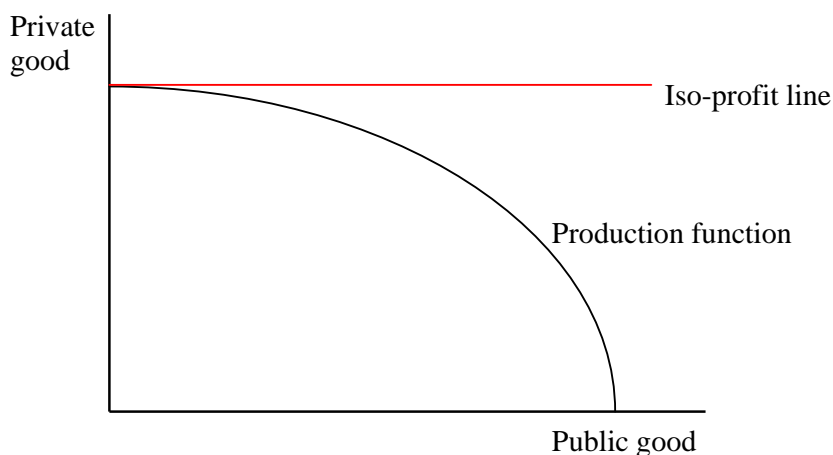
Samuelson (1954, p. 387) is credited with the explicit division between private and public goods:

Ordinary *private consumption goods* (X_1, \dots, X_n) which can be parcelled out among different individuals, $(1, 2, \dots, i, \dots, s)$ according to the relations $X_j = \sum_i X_j^i$; and *collective consumption goods* (X_{n+1}, \dots, X_{n+m}) which all enjoy in common in the sense that each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good, so that $X_{n+j} = X_{n+j}^i$ simultaneously for each and every i th individual and each collective consumption good.

Samuelson further showed that, given a set of consumption preferences, a market pricing system cannot yield an optimal supply of public goods. Oakland (1974) and Head (1977) confirmed Samuelson's findings also applied to the more limited case of excludable public goods.

The relationships between information, incentives and production within market economies form the key to Samuelson's findings. Where exclusion is not possible the flow of information and incentives to producers about public goods from other members of the community is distorted. For example, Figure 1 shows the production possibility frontier for a two good economy, a private consumption good and a public good. Since consumers are able to consume any production of the public good without any payment the price ratio facing the producer is horizontal. Hence the price signal fails for the public good. Of course in the real world other information flows also exist. For example, the producer is also a consumer and their production decisions will be influenced by their own consumption desires. Samuelson (1954) also noted the unsatisfactory nature of other signalling mechanisms such as voting.

Figure 1: Information received by producers from the market



5.2 Can we escape the information and incentive problem?

Essentially, the information problem relates to the removal of the flow of information and incentives between consumers and producers. Escaping the information and incentive problem leads to a restoration of the flow for public goods. One potential solution is alluded to above, namely combining the roles of producer and consumer, for example via the formation of a coalition of consumers. As previously mentioned the production of public goods was initially thought to require government intervention. That is, government action via a coalition of consumers. However government action is beset by a multitude of potential problems arising from potential decision making processes through to rent seeking and other behaviour. In particular the centralised decision making structure of governments leads to a standardised response hence reducing the flexibility commonly associated with market mechanisms.³

Governments are not the only potential coalitions of consumers. Clubs and cooperatives, among other organisational structures, are also potential coalitions as noted by Buchanan (1965). Formation of club structures can combine the role of producer and consumer, hence facilitating a flow of information about consumer demands. In his article, 'An Economic theory of clubs', Buchanan (1965) recognised a range of 'consumption ownership-membership' possibilities ranging from purely private to purely public.⁴ The optimal ownership or sharing arrangement for a private good is clearly one, while for an environmental pure public good the optimal number is infinite. The essence of club formation is the revelation of consumption preferences when decisions are being made about production of the public good. Therefore efficient provision of public goods can occur, providing non-members can be excluded and so long as members reveal their preferences honestly.

Returning to the key aspect determining whether a market for public goods can exist (albeit inefficient), that is, excludability. Whereas Buchanan (1965) restricted his

³ Kasper (1998) details the relationship between the institutional structure and some of the problems relating to government decision making.

⁴ Pigou (1920) and Knight (1924) had also undertaken some work relating to group size and optimal pricing for tolls on congested roads.

analysis to excludable goods (for example non-rival goods), Olson (1965) in ‘The logic of collective action’ sets out to explain the behaviour of clubs and other groups. Olson specifically examines the incentives to individuals to join clubs (or coalitions). A key membership distinction arises between inclusive clubs, with no membership size restrictions, and exclusive clubs, requiring size restrictions. Inclusive clubs supply benefits that are non-rival while exclusive clubs supply goods that are rival, at least beyond some level of use. Hence optimal club size is a trade-off between the costs and benefits of provision and the degree of rivalry in consumption. For example, use of wetlands for eco-tourism involves opportunity costs (as other potential uses are foregone) and the recreation benefits to tourists are partly dependent on the number of other tourists seen (see for example Cicchetti and Smith 1973).

For some environmental public goods rivalry in consumption becomes increasingly important as club size increases (for example eco-tourism, hunting, fishing and to a lesser extent enjoyment of the scenic vista). These goods are closer to Olson’s exclusive clubs, and for these goods the use of clubs may allow for production of the public good, providing non-members can be excluded from consumption of at least some outputs. Other environmental public goods are pure public goods and hence Olson’s inclusive clubs in the sense that infinite club membership is possible without rivalry in consumption. However, with larger optimal club size there are additional opportunities for free riding and larger organisational costs. These transactions costs (sometimes called agency or organisational costs) of organising large groups may be prohibitive (Olson 1965, Buchanan and Tullock 1965). However, Olson offers a way out – joint provision of related or unrelated private goods reducing organisational costs and enabling club formation.

The distinction between group sizes hinges on the degree of excludability in conjunction with the potential for congestion or rivalry in consumption. For example, a large body of literature refers to local or regional club goods commencing with Charles Tiebout (see for example Sandler and Tschirhart 1980). That is, goods effectively excluded from individuals living outside a region by transport costs or service boundaries. There is no reason why a large number of clubs cannot provide a good exhibiting some public good characteristics where the appropriate excludability conditions are met (eg. hunting facilities). Hence facilitating alternative decision making structures via the formation of coalitions of consumers for the production of environmental public goods is another potential incentive strategy.

5.3 Joint supply of environmental public goods

Formation of a coalition of consumers offers one potential avenue for circumventing the information and incentive problem by combining the role of consumer with producer. However, as noted by both Buchanan (1965) and Olson (1965), exclusion of non-members from enjoying the benefits is a prerequisite for club formation. Olson (1965) suggests a potential way of overcoming the excludability by jointly supplying an excludable good with the non-excludable good. Hence sufficient incentive may be given to individuals to join ‘inclusive’ clubs rather than ‘free-ride’. Demsetz (1970) offers a related but separate idea. Demsetz suggests the information and incentive problem may be overcome by tying production or consumption of

otherwise unrelated public and private goods together. The concept of supplying public and private (or excludable public goods) together is termed *joint supply*.⁵

Olson (1965) shows that inclusive clubs supplying pure public goods are subject to large free rider problems and organisational costs. However, inclusive clubs may exist due to joint supply of a private good with the public good allowing the free rider problem to be circumvented. Hence the emphasis is on joint supply of an excludable good together with the public good rather than joint production of public goods. The excludable good can be as simple as the 'status' of membership, for example wearing a club t-shirt or displaying a sticker (Bennett 1995). For example, clubs such as the National Parks Associations in Australia frequently offer guided bushwalks or discounted entry to National Parks for members and the Wilderness Society sells t-shirts and stickers. A better, albeit unrelated example is the RSL club in Australia. The excludable benefits provided may be sufficient for the free rider problem to be overcome, group formation to take place and provision of environmental public goods to occur.

Demsetz (1970, p.306) defines a related concept of joint supply:

In many circumstances it may be possible to tie in consumption of a second product with consumption of the collective good, and private incentives may very well exist for the production of the tied-in good because exclusion is possible.

The notion of joint supply discussed by Demsetz facilitates private sector production of a public good. Demsetz uses the example of radio and television broadcasts whereby at least two groups willing to pay for the cost of broadcasting, namely advertisers and producers of radio and television sets. Note that exclusion of advertising and non-purchasers is entirely feasible and logical.

In both cases of joint supply, the demand for the private goods provides a vehicle for supply of the public good. However, demand for the private good does not reveal demand for the associated public good. Hence, as Demsetz indicates, the 'tie-in mechanism' is highly unlikely to lead to efficient production of public goods and is only a partial solution. Likewise provision of a public good by a large group facilitated by a jointly supplied private good will not only be based on information about demands for the public good but rather also for the associated excludable good. Despite an inefficient level of production, in some cases such arrangements may adequately circumvent the information and incentive problem and lead to an adequate supply of public goods. Hence modification of the institutional structure to facilitate information and incentive flows, or strategies that facilitate or encourage joint supply of private and public goods are potential incentive structures.

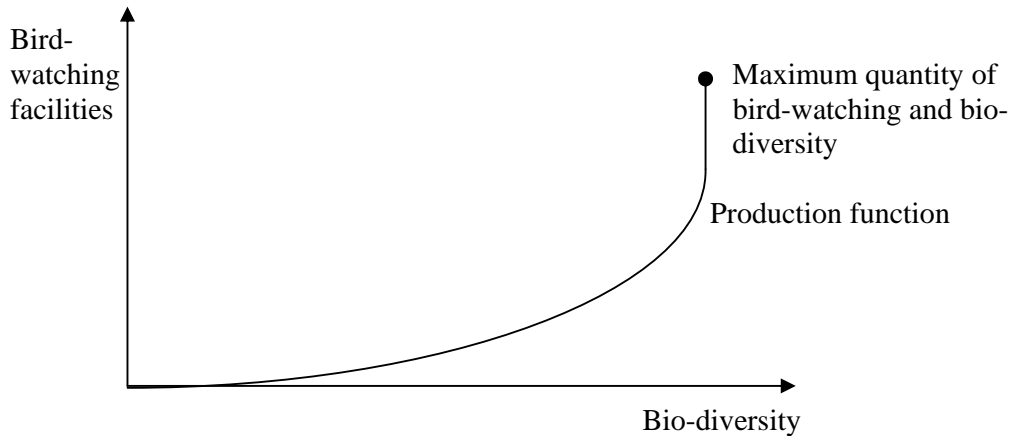
5.4 Joint production of environmental public goods

A second way of circumventing the information and incentive problem is alluded to by Demsetz (1970). Demsetz indicates that both joint supply and joint production of a public and private good is possible. Natural resource production processes commonly produce several distinct outputs together. *Joint production* occurs where, in a single production process, 'a change in the output of one product necessarily

⁵ Olson (1965) refers to the degree of non-rivalry in consumption as the degree of 'jointness of supply'. This is a separate hypothesis and should not be confused with the concept of joint supply of private and public goods as discussed above.

involves a change in the output of another' (Bannock, Baxter and Davis 1987). Figure 2 shows a possible joint production function for biodiversity and the supply of bird-watching facilities. Joint production may circumvent the price information and signalling problem indirectly by utilising price signals and incentives for private goods.

Figure 2: A joint product production function.



A range of joint production possibilities using wetland inputs exists ranging from production of purely private goods (eg beef and leather) to joint production of environmental public goods (eg scenic vistas and bio-diversity). The notion of joint production has also been referred to as non-separability in production. That is, a single production process (such as a natural wetland) provides a number of notionally separate goods and services including both private and public goods. These goods and services can also be referred to as attributes of a single good following Lancasterian demand theory. Normally some potential exists to alter the attribute mix of wetland outputs by using alternative management strategies. That is, to alter the shape of the production trade-off curve. Hence management strategies that increase production of public goods with little change to production of private goods are potential incentive structures.

Jointly produced public goods are often referred to as externalities. Pollution for example can be regarded as a negative externality or a 'public bad'. Wetland conservation due to provision of hunting facilities can be regarded as a positive externality or a 'public good'. Whether an externality is viewed as a public good or a public bad sometimes depends on the property rights covering the asset. For example should a farmer who restores a wetland be viewed as reducing a public bad (or negative externality) or providing a public good (positive externality)?

Samuelson (1969) contrasts the welfare conditions for public goods and joint production but does not consider joint production of a private and a public good. Jointly produced goods can be considered separately for analytical purposes where joint production proportions are not fixed, but vary along a smooth trade-off frontier (Samuelson 1969). That is, joint production of a private and public good in non-fixed proportions can be considered as production of separate private and public goods. Hence where a smooth trade-off frontier between the jointly produced private and public goods exists we return to the information problem created by the complete

failure of the price mechanism as discussed above. However for many joint products using wetland inputs the trade-off frontier is unlikely to be smooth.

The externality issue is a prime example of why the transformation curve for jointly produced wetland outputs will not be smooth. The existence of wetlands creates a positive level of public goods such as a scenic vista. Increased use of wetlands for conservation may increase other public good attributes such as bio-diversity while use of wetlands for grazing may reduce or remove other public good outputs. Essentially the production function for wetland outputs leads to a bounded transformation curve. That is, the existence of wetlands creates a positive (minimum) level of some public goods. More importantly, the transformation curve may also be deformed in other ways. For example, increased grazing or hunting output beyond a certain level may dramatically reduce bio-diversity values leading to a kinked transformation curve. Alternatively, encouraging waterfowl breeding may increase both hunting and eco-tourism outputs. Hence, joint wetland outputs cannot be unbundled in the sense described by Samuelson (1969) and where joint production of private and public wetland outputs occurs, the relationship is more akin to an externality.

The joint production of public and private goods does not ensure efficient production of environmental public goods. The price mechanism only reflects information and incentives about demands for the jointly produced private goods. For example, in Figure 2, the price mechanism may reveal information and incentives relating to demand for bird-watching facilities but not for bio-diversity. This information will determine the production of jointly produced environmental public goods in relation to other private (or excludable) goods. That is, the production of the public good will depend on the ratio of demand types relative to the ratio of joint production.

The discussion regarding joint production suggests two possible avenues for targeting incentives. Firstly, property rights need not necessarily cover the complete range of potential outputs using wetland resources. Facilitating information and incentive flows about jointly produced wetland outputs may be sufficient to encourage some production of joint public environmental goods. Secondly, direct incentives supplementing market information need not be targeted directly toward environmental public goods, but in some cases may be more efficiently targeted towards jointly produced private goods, or management strategies designed to increase public good production without changing production of private goods. These strategies are considered further in the conclusions.

5.5 Lumpy environmental goods

The final production characteristic of wetland production is lumpiness. Lumpiness is a technical constraint to production of some environmental public goods. Wetland resources need to be a certain size before some outputs can be produced. That is, maintenance of a particular wetland output may become more and more difficult (or at least more costly) below a certain threshold. For example, once animal and plant populations fall below a critical level they are no longer self-sustaining and eventually become locally extinct; hunting requires some minimum quantity of land; or, management costs per hectare may fall substantially above a certain size.

Many of the mechanisms outlined above will fail for this class of environmental public goods as their provision requires the cooperation of multiple property right owners. That is, because such large areas are required, some coordination of the actions of multiple individuals is required. Hence a further potential policy role lies in provision of supplementary information and incentives that prevent the development or continuation of 'gaps' in wetland resources.

6. Policy impacts and conclusions

Policy considerations regarding wetlands generally focus on the most efficient means of achieving policy outcomes. In the case of wetlands, policy is focussed on achieving greater wetland conservation. However, rewards for particular desirable actions and penalties for undesirable actions are transmitted via information and incentives contained in the price mechanism. But the price mechanism fails for many of the benefits from wetland conservation. Hence either, an alternative information and incentive mechanism, or facilitation of the price mechanism may be desired. The discussion of the institutional framework, the nature of wetland outputs, and of production processes using wetland inputs, suggests several potential avenues for targeting incentives (and hence for further research). The potential incentive structures for production of environmental public goods can be divided between:

- measures facilitating information and incentive flows by altering property rights;
- measures directly, or indirectly supplementing market information; and,
- measures facilitating alternative decision making structures.

The first group of incentives relates to changing the signals the market is able to transmit to wetland owners and managers and is suggested in sections 3.1, 4, 5.3 and 5.4. By unbundling property rights, either spatially or in scope, the market may be able to transmit signals that were previously distorted by the bundled benefit streams or prevented by transaction or organisational costs associated with multiple benefit streams. For example, a simple spatial incentive may allow granting separate title to remnant vegetation areas, or, facilitating sale of conservation easements or covenants. A strong version of such incentives is re-allocation of property rights via either acquisition or granting of rights to benefit streams. For example prohibiting modification of wetland hydrology or permitting managed hunting in New South Wales. A weaker version can also be effective where a dominant or preferred outcome exists as suggest in section 3.1. In such cases use of peer pressure and informal penalty mechanisms may be sufficient (see Young et.al. 1996, Binning and Young 1997 and Industry Commission 1997 among others), for example promotion of land stewardship via the Landcare movement. Less direct incentives could also be useful. For instance many wetlands are suffering from reduced river flooding. Substantial benefits may arise from designing ways whereby water rights can be purchased for in-stream or wetland uses.

The incentives provided by the price mechanism can also be directly supplemented. This group of incentives essentially focuses on directly altering the structure of alternative benefit streams. As noted above, where non-excludable environmental public goods are produced jointly with private goods the information received from the market indicates the public good is not valued. Market information may be directly supplemented by measures such as management subsidies (eg. fencing, management plans and capital works) and fiscal subsidies (via tax measures and rate

and levy rebates). Market information can also be indirectly supplemented by investigation and promotion of tied in goods, for example promotion of wetland eco-tourism, or by measures to increase the production of public goods in joint production relationships. These incentives can be directed towards reducing the exclusion or transactions costs as discussed in section 4. Alternatively they may directly supplement market information as suggested in sections 5.3, 5.4 and 5.5.

The final group of incentives relates to facilitating direct consumer participation in decisions about use of wetland resources as discussed in sections 3.2, 5.2 and to a lesser extent 5.3. By incorporating public good benefit streams directly into the decision process, groups may be able to more efficiently decide on the balance between private and public goods in a joint production process. Alternatively groups may be able to alter cost/benefit ratios to private producers from joint production processes.⁶ Organisational structures facilitating incorporation of consumers include traditional club structures as well as private firms (examples include Wetlands and Wildlife, Earth Sanctuaries, Australian Bush Heritage Trust and Wetland Care Australia).

Most incentive schemes currently operated concentrate on altering the structure of benefit streams to wetland owners. The 'Private and social values of wetlands' study currently in progress will involve the examination of each of the potential groups of incentives. The aim of the study is to determine the impact of each group of incentives on information and price incentive flows within the market and hence where opportunities exist for adoption of alternative or improved incentives for wetland management.

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⁶ Wetland Care Australia facilitate improved wetland management of both private and publicly owned wetlands by altering undertaking wetland management hence reducing the monetary and non-monetary costs associated with wetlands while increasing the non-monetary benefits.

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