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COMMON PROPERTY, PRIVATE PROPERTY AND REGULATION THE CASE OF DRYLAND SALINITY

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The term 'common property' has frequently been misapplied to situations where no property rights exist. Common property rights have provided a workable alternative to private property in many historical situations. Common property concepts and institutions can also play a major role in analysing and responding to current environmental problems. In this paper, the problem of dryland salinity is examined and solutions based on common property, private property and regulation are compared.

The concept of common property holds an ambivalent status in discussions of the environment. On the one hand, it is widely agreed that the institutions of private property and the market have not coped well with environmental problems. Many of those concerned with the environment, particularly non-economists, have compared modern private ownership unfavourably with older systems of common ownership, such as those of Aboriginal Australia, and have called for public action to protect our 'common heritage'. On the other hand, the notion of the 'tragedy of the commons' (Hardin 1968) has been a major stimulus in the development of a school of thought centred on the idea of creating private property rights as a remedy for environmental problems.

The conflict between these two views of common property is obvious. In particular, they make quite contradictory assertions about the environmental implications of historically (and currently) existing systems of common property. In this paper, it will be shown that the idea of the 'tragedy of the commons' is based on an interpretation of the term 'common property' which is historically inaccurate. More importantly, it will be argued that this interpretation is conceptually misleading when it is applied to modern environmental problems. This inaccurate conception of common property is closely related to major difficulties which have emerged from the private property rights approach. The concept of common property can play a central role in the development of a more adequate analysis of the economics of the environment. Moreover, the creation of common property rights is an important policy option in dealing with some environmental problems.

These ideas are developed with application to the problem of 'dryland salinity' or 'saline seepage'. Dryland salinity, largely due to the

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clearance of deep-rooted tree species, is an increasingly important problem in many parts of Australia. Tree clearance is already the subject of regulation in some areas, and proposals for a management system based on private property rights in tree clearance have been advanced (Hodge 1982). In this paper, the problem is analysed from a common property perspective, and a proposal for the creation of common property rights is put forward.

The 'Tragedy of the Commons'

The phrase, 'tragedy of the commons' is due to an ecologist, Garrett Hardin (1968, 1972), but the argument behind it is derived from debates within the discipline of economics. Hardin drew his illustration from a pamphlet published by an English clergyman (Lloyd 1833) in the course of the Malthusian debate on the checks to population. More recently, very similar arguments have been put forward by Demsetz (1967).

Hardin's argument develops as follows (1968, p. 1245): 'Picture a pasture open to all . . . As a rational being, each herdsman seeks to maximise his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility to me of adding one more animal to my herd?".' Since the benefits are private, while the costs are shared by all the herdsmen, 'the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another . . . But this is the conclusion reached by each and every herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit — in a world that is limited . . . Freedom in a commons brings ruin to all.'

Hardin (1972, p. 111) explicitly identifies the commons system he describes here with that prevailing in England until the enclosure of common fields in the 18th and 19th centuries. He argues that enclosure was a necessary response to overgrazing. It is noteworthy that Lloyd's original paper appeared just around the time that the enclosure process was completed, so that there were no actual commons against which to check his description.

Hardin's description of the commons paints a picture of extreme instability and immediately raises the question of how such a system could last for a great length of time (around a thousand years in much of Northern Europe) without leading to irreparable degradation. The answer is that the system described by Hardin did not exist. The actual commons were not open to all comers but were the property of a defined group, known collectively as 'commoners'. Within this group, there were clearly defined limits on the number of cattle each individual could graze on the common fields. These limits were varied in response to changing seasonal conditions, a process known as 'stinting'. A detailed description of the operation of this common property system is given by Tawney (1912).

The Private Property Rights School

Although the historical inaccuracy of Hardin's description has been pointed out by a number of writers, such as Ciriacy-Wantrup and Bishop (1975) and Dahlman (1980), these refutations have had little

impact on the economics profession. The term 'common property' is still widely used as if it were a synonym for open access. As Ciriacy-Wantrup and Bishop point out, this usage is a contradiction in terms, since the term 'property' is being used for something which is not property at all. Even among writers, such as Runge (1981) and Palmquist and Pasour (1982), who accept that common property is the property of a defined group of owners, it is frequently supposed that each member of the group of owners has unlimited access to the resource in question.

It is possible to argue that the historical inaccuracies in Hardin's account do not matter as long as it provides a useful metaphor for our current situation. This argument is untenable for two reasons. First, the inaccuracy is not merely historical. Many systems of common property still exist, particularly in developing countries, and the myth of the 'tragedy of the commons' may be used to justify their abolition. Examples of this process, in the context of Indian 'land reforms', are given in Jodha (1984, 1985). Second, the use of the term 'common property' to mean 'no property' leads, in many cases, to an analysis of environmental problems based solely on private property rights. As will be argued below, such an analysis involves severe difficulties.

The basic problem is that the property rights required in the Coasian analysis of the environment are substantially different from ownership rights over personal property such as houses and cars, even though they may be attached to such rights. Most of the Coasian analysis is couched in terms of what may be called 'activity rights'. Mohring and Boyd (1971, p.358) described the property rights analysed by Coase as typically characterised 'in terms of A's right to do something to, or to collect damages from, B.'

Thus, for example, it is possible to distinguish between environmental situations characterised by polluters' (or emitters') rights, and those characterised by victims' (or receptors') rights. In the former case, polluters are free to use the atmosphere as they wish, while in the latter, victims can either prevent pollution or collect damages. There is, however, a crucial ambiguity as to whether 'polluters' rights' means that everyone has the right to pollute, or whether the rights are restricted to a particular group, such as those who are actually generating pollution when rights are defined. This ambiguity reflects fundamental contradictions within the Coasian approach.

This contradiction is centred on the key concepts of development and attenuation of property rights. The idea of development is illustrated by the 'tragedy of the commons' myth. While populations were limited, it is suggested, property rights over grazing land were not needed.[1] As pressure on land increased, the definition of private property rights through enclosure became necessary. With further increases in population and technological advances, an increasingly detailed structure of property rights developed. Demsetz (1967, p. 350) argues that 'property rights develop to internalise externalities when the gains of internalisation become larger than the costs'. However, the reality is usually, as in the case of enclosure, that one structure of property rights replaces another.

[1] Recall that, in this analysis 'common property' is equivalent to 'no property'.

The concept of attentuation is normally used in the analysis of particular property rights, rather than structures of property rights. Any limitation on the way in which property rights may be used constitutes attenuation. The ideal, unattenuated state is approximated by private chattel ownership, where the owner has completely free rights of use, exclusion and alienation. The attenuation of property rights will always reduce their value to the owner, and is generally viewed as undesirable (see, for example, Furubotn and Pejovich 1974). This is particularly true when attentuation is the result of actions by governments, such as regulatory limits on the way in which property may be used or restrictions on the sale and purchase of property.

One important form of attenuation is attenuation in duration. This may take the form of a specific limitation of the term of a right (as in the case of Crown grazing leases). Alternatively, it may reflect instability and insecurity in rights, as in the case of licences and quotas which are of indefinite duration, but may be revoked at will. Attenuation of this kind has significant economic and environmental consequences, since it shortens the effective time horizon of the holder of property rights. In addition, it creates the potential for 'rent seeking' activities of the kind described by Krueger (1974).

The tension between the concepts of attenuation and development becomes apparent when changes in property rights structure, such as occurred through enclosure, are considered. If development of property rights is the most important objective, it seems that the structure of rights should be very flexible. As technology and tastes change, so does the most efficient structure of rights and a flexible property rights structure can be altered so as to maintain efficiency. On the other hand, if attenuation of rights is to be limited, then rights should be as secure as possible. In a situation of this kind, reassignment of rights between individuals is possible through voluntary exchange, but the adoption of a new structure of rights (for example, a shift from 'polluter' rights to 'victim' rights) effectively requires unanimous consent, since all holders of rights must voluntarily give them up. For both strategic and distributional reasons this will normally be very difficult to obtain, and inefficient rights structures will be hard to change. The two objectives are thus in conflict.

This conflict has not received much attention in the literature on property rights. This reflects the different ways the concepts have been used. Analysis of the concept of attenuation has largely been confined to static problems, involving given technology and tastes, while analysis of the development of property rights has focused on the emergence of 'new' property rights. Thus the development of property rights is usually assumed to take place in a situation where there are no pre-existing property rights (this situation is frequently referred to as 'common property' and confused with actual common property institutions). In reality, however, the creation of new rights normally involves the abrogation or attentuation of old ones, as in the case of enclosure.

The conflict described above has also been observed by Randall (1983), who distinguishes between two schools of thought, which he labels 'Coase–Posner' and 'Coase–Buchanan'. The Coase–Posner approach arises from Coase's (1960) suggestion that the common law judgments of the courts in tort cases operate to yield an allocation or

property rights consistent with efficiency. Posner (1972) greatly extends the scope of his positive hypothesis and links it with a normative claim that the law should indeed operate in this way. The Coase–Buchanan approach, on the other hand, emphasises consensual processes rather than efficient, or otherwise desirable, outcomes and lays great stress on the inviolable character of rights (a notion ignored in the Coase–Posner approach). Buchanan (1977) gives a particularly strong exposition of this viewpoint. As was noted above, the requirement for the consent of all holders of rights to any change in the structure of rights makes the achievement of an efficient structure of rights under this approach very difficult. However, the intensity of the conflict between the two approaches is significantly affected by the degree to which the structure of rights under consideration permits adaptation to changing circumstances.

In the case of environmental problems, the severity of the conflict between efficiency and security is largely due to the Coasian specification of rights in terms of individual rights to undertake (or forbid) particular activities. In many cases, the conflict may be resolved by using common property rights defined over assets, rather than activities. The pattern of usage is determined by the group of owners and may be adjusted in response to changes in technology or tastes. The relative merits of private and common property rights may be considered in relation to the problem of dryland salinity.

Dryland Salinity

The term 'dryland salinity' is a broad one, including both natural and human induced salting, and covering all forms of salinity not associated with irrigation. The most important aspects of the problem are the formation of salt pans and scalds, yield losses due to salt in high water tables, and the salination of streams. In this paper, attention will be confined to dryland seepage salting resulting from human activity, notably agricultural practices. In a report to the Victorian Parliament (ACIL 1983*b*, p. 16), it is stated that:

> Dryland seepage salinity is caused principally by removal of trees from groundwater recharge areas and compounded by inappropriate agricultural management. Together these cause excessive recharge of groundwater, leading to a rise in the water table and increasing aquifer pressures, which in turn bring groundwater to or close to the ground surface. Water in the discharge zone need not be saline initially but salt becomes concentrated by evaporation over time. Salt scalds are caused by loss of topsoil, due to overgrazing, clearing, or poor agricultural management, which expose a naturally saline subsoil.

Other writers, such as Greig and Devonshire (1981) and Malcolm (1977), concur in the judgment that tree clearance is the main human activity contributing to increasing saline seepage. However, there is considerable debate over the extent, if any, to which reafforestation of affected areas will reverse the process of salination. ACIL (1983*a*,*b*) and the sources cited therein give an extensive discussion of the problem.

Unlike some other forms of soil degradation, the effects of dryland salting are not necessarily felt most severely in the immediate vicinity of

the activity which generates them (in this case, tree clearance). Rather, the effects are spread throughout the catchment area of a given stream, giving rise to what are traditionally termed 'externalities'. Two main categories of costs may be distinguished. First, there are costs borne by downstream (mostly domestic) water users. Second, there are losses in agricultural productivity associated with dryland salinity. There is a considerable range of estimates of the magnitudes of both classes of costs (see, for example, Oates 1978; Greig and Devonshire 1981).

Externalities may be classified either as unilateral or reciprocal. The first category includes the damage suffered by downstream water users, since their activities have no adverse effects on the farmers who generate the increased salinity. By contrast, the effects of saline seepage on land productivity provide an example of a reciprocal externality. A given farmer may be both polluter and victim, generating increased saline seepage through clearance and suffering in turn from the activities of other farmers.

A number of policy responses to the problem have been suggested or implemented. The traditional 'engineering' solution, particularly in irrigation related salinity, has been the provision of publicly financed mitigation works. There are serious objections to this approach, however. First, many proposed engineering schemes show a low or negative net economic benefit when standard evaluation techniques are applied. Second, unless engineering measures are applied in conjunction with policies aimed at modifying farmer behaviour, they may be counterproductive in the longer term. By reducing the costs of dryland salinity to farmers, they may provide a positive incentive to clear land, thereby worsening the problem.

Recognition of the need to modify farmer behaviour is now fairly widespread. However, apart from the provision of information, only a regulatory approach to the problem has so far been tried. Two state governments (South Australia and Western Australia) have introduced restrictions on the clearance of trees in areas prone to dryland salting or other forms of land degradation.

Economists have generally argued that regulation is an inefficient method of dealing with externalities, and that methods allowing the operation of a price system will permit the achievement of environmental objectives at lower cost (Baumol and Oates 1975, Ch. 10). It should, however, be noted that for very complex problems, discretionary regulation may be the only practical solution. It remains to be seen whether dryland salinity constitutes such a problem. The two main alternative approaches offered by economists may be described as Pigovian and Coasian. The Pigovian approach requires the imposition of taxes which internalise the externality by equating the private and social costs of pollution. The Coasian approach, discussed above, is based on the allocation of private property rights with respect to the polluting activity.

Greig and Devonshire (1981) argue for a Pigovian tax solution, suggesting a tax of land cleared on the basis of estimates of external damage. Hodge (1982) criticises both Pigovian tax solutions and the existing regulatory policies. With relation to regulation, he points out how the usual problems may develop. For example, prohibitions on tree clearance effectively freeze the existing pattern of tree clearance,

even though a more efficient outcome might require reafforestation in some areas (for example, areas of high recharge) while permitting clearance in others. The regulatory approach provides no incentive for reafforestation.

Hodge (1982) also points out distributional problems associated with the regulatory approach. If compensation for the loss in productive value is paid, as in Western Australia, the state bears the entire burden of pollution costs. On the other hand, if compensation is not paid, there is an implicit reward to farmers who have already cleared their land when regulations are announced. The knowledge that such policies were likely to be implemented would clearly create a strong incentive for immediate land clearance.

Hodge's (1982) criticisms of the Pigovian tax proposal relate mainly to the difficulty of specifying an appropriate tax base. He first points out that, if reafforestation is to be encouraged, the tax must be on a farmer's current area cleared, rather than on the activity of clearing land. However, a uniform tax will not be appropriate because tree cover in recharge areas is more important than in other areas. Thus the difficulties of specifying a tax base are severe.

Distributional issues, though not raised by Hodge (1982), are also important in explaining why Pigovian tax policies have rarely been adopted. In general, the levying of a Pigovian tax means that polluters will face a higher burden than if they were merely required to adopt pollution control measures yielding the same level of abatement (unless, of course, a highly inefficient abatement technology is specified). In cases of reciprocal externality, we have the paradoxical result that the imposition of an 'optimal' Pigovian tax may make everyone affected worse off (though there is a net gain to society in the form of the tax revenue). It is not surprising that Pigovian tax proposals are rarely adopted in practice.

Another problem affecting both regulation and Pigovian taxes is the information requirements they impose on governments. In the case of regulatory controls, governments are required to specify the optimal pattern of land use which requires not only a knowledge of the mechanics of salinity but also the production functions of firms and utility functions of consumers. Pigovian taxes also require an accurate assessment of the marginal costs of salinity, and this in turn requires knowledge of production and utility functions.

Hodge's (1982) alternative proposal is for the creation of marketable rights in cleared land holdings. An optimal average proportion of cleared land would be determined, taking into account that the desirable degree of clearance would vary over the catchment area. Each farmer would then be allotted 'cleared land' rights determined by their land area and the optimal average proportion of cleared land.[2] These rights would permit them to maintain a given area of land in the cleared state, subject to the requirement that particularly sensitive areas not be cleared. Farmers who wished to maintain a larger cleared area would be required to buy additional rights from others who were willing to accept a lower area, either because they already had uncleared land in excess of

[2] Hodge mentions, but does not discuss in detail, other possible bases for the initial allocation of rights.

the required amount or because they were willing to replant cleared land. These transactions could be undertaken through government intermediaries if a smoothly operating market did not emerge spontaneously.

Hodge's (1982) proposal has significant advantages over other suggestions for the creation of Coasian property rights. Rights to maintain cleared land are awarded to a fixed group of people, rather than to the population at large. Moreover, rights are awarded on the basis of the land area owned rather than the area already cleared. This means that the likelihood of rights being created would not imply the existence of an incentive for clearance (despite Hodge's remarks on p. 199).

The fixed quantity of rights also means that Coasian bargaining may become a serious possibility following the implementation of Hodge's proposal. For example, downstream municipalities might choose to buy land clearance rights (effectively reducing the total cleared area, and hence the total salt load), as an alternative to spending money on water treatment. These 'efficiency' benefits might be offset by the fact that 'occupiers would be likely to resent the need to buy something which had been theirs already' (Hodge 1982, p. 193), assuming that their initial cleared area was greater than their initial allocation of rights. There does not seem to be any easy resolution of this problem.

In other respects, Hodge's proposal encounters the difficulties, discussed above, which are inherent in the Coasian approach. The most important of these is the conflict between stability (or non-attenuation) and flexibility (or efficiency). The crux of this conflict is the extreme uncertainty which pervades the question of dryland salinity. There is considerable doubt over the costs of salinity, the rate at which human activities are aggravating the problem, and the effectiveness of various remedial measures. While an expanded research effort may reduce this uncertainty to some extent, it is unlikely that reliable estimates of salinity costs will be available in the near future. Thus, any estimate of the optimal cleared area will almost certainly be subject to significant revision as more information becomes available. The question then arises whether clearance entitlements should be adjusted in line with the new knowledge.

As Hodge (1982, p. 193) notes, the initial allocation of rights to cleared land takes the form of a partial withdrawal of existing rights, that is, an attenuation of property rights in land. To the extent that clearance rights are subject to the possibilty of further modification, property rights in land are attenuated still further, and their value to owners reduced. Note that this applies even in relation to a possible increase in cleared areas. This would impose windfall losses on those who bought clearance rights under the old regime. Problems of this kind are reflected in Hodge's Table 3, which suggests that the proposal must always involve a net loss to landholders (since gains and losses from trade in rights net to zero, while opportunity costs of uncleared land are always positive)[3]. Thus, if a property rights approach is to be adopted, it is desirable that rights should be as secure as possible.

[3] What is missing from the table is, of course, the collective benefits of reduced salinity. These are difficult to capture in an 'activity rights' framework.

On the other hand, if the initial estimate of desirable cleared areas turns out to be non-optimal, maintenance of a fixed structure of rights could be very costly. For example, if it turned out that restrictions on land clearance were actually unnecessary, maintenance of the existing rights structure would involve (in Hodge's example) an opportunity cost of $84 000, or more than 10 per cent of total land value. If, as seems more likely, the initial allocation allows too great a cleared area, the costs of maintaining it could be even larger.

These problems may be eased somewhat by considering the time dimension of rights. If rights are secure, but of limited duration, then the conflict between efficiency and non-attenuation of rights is confined to the determination of the optimal duration. Concern with efficiency would suggest a short duration and concern with attenuation a long one. If a long lasting rights structure is chosen, it is also necessary to reconsider the timing of introduction of the proposal. As was noted above, Hodge's argument for early introduction does not appear to be valid, provided the initial allocation of rights is independent of the area already cleared. Rather there would appear to be a trade-off between the benefits of early introduction (reduced current levels of salinity) and the increased information available from waiting. In either case, the adoption of a Coasian property rights approach involves costs over and above those inherent in the uncertainty about optimal cleared areas.

The problems associated with Coasian property rights suggest that alternative property rights structures could be considered. In the following section, a common property approach to the problem is described and its policy implications considered.

Common Property in Environmental Assets

As was noted above, writers such as Ciriacy-Wantrup and Bishop (1975) and Dahlman (1980) have defended historical common property institutions against the charges of inefficiency which have been levelled against them. Comparatively little attention has been paid to the possible role of common property institutions in dealing with modern environmental problems.

Quiggin (1983) develops a common property analysis based on the concept of asset value. Environmental problems are characterised in terms of actions which degrade the quality of environmental assets, such as rivers, lakes and air basins. This contrasts with the Pigovian and Coasian approaches where such actions are seen as impinging directly on the utility and/or production functions of victims. The approach used draws on Mohring and Boyd's (1971) distinction between 'direct interaction' and 'asset-utilisation' frameworks. However, by employing common property as well as private property constructs, it avoids the errors which vitiated Mohring and Boyd's analysis, such as their argument for taxing victims of externalities.

Assets are treated as the common property of a defined group of users, who may manage the asset so as to maximise its value (in terms of monetary returns and consumption benefits). This will normally involve controls on asset usage both by non-owners and by group members. These controls may be implemented by direct regulation or by levying usage charges.

In the case of dryland salinity, the 'missing' property rights relate to the catchment area and stream shared by a group of landholders (the problem of downstream urban users will be considered later). In the present situation, non-members of the group cannot generally take actions which would degrade the value of the asset (this would involve trespass), but usage by landholders is uncontrolled, as in the case analysed by Runge (1981). What is required for full common property is a system enabling the group of landholders to control all actions which degrade the quality of the catchment asset.

Economic analysis suggests that pricing measures would be superior to regulation as a means of controlling usage. This suggests that the group should levy charges for activities, such as tree clearance, which degrade asset quality, on the basis of the reduction in asset value to other users. This immediately raises the problem of how the proceeds of such charges should be distributed. It seems reasonable, in the first instance, to use the same basis as in Hodge's proposal. That is, shares in the asset should be proportional to the area of land owned within the catchment area. Problems with this formula might arise if land values varied widely over the area (assuming that the variability was based on some factor other than vulnerability to salting).

This proposal would have a number of advantages over Hodge's proposal for rights in cleared land. First, it would take the form of an expansion rather than an attentuation of rights. Landholders, as a group, would not have to pay for something which was theirs already. *A fortiori*, the common property proposal would be superior to Pigovian taxes on this score.

Second, the proposal would be superior on informational grounds. Whereas the tree clearance rights system would require the government to estimate farmers' profit functions, the common property system would incorporate this information directly into the decision making process. Farmers with a high sensitivity to dryland salinity would support more stringent restrictions on usage and *vice versa*. Of course, farmers may lack expert knowledge on the causes and effects of salinity. However, it seems reasonable to assume that it would be cheaper for the government to disseminate this information than it would be to collect information on individual farmers' profit functions.

The third and most important advantage of this approach would be a resolution of the conflict between stability and efficiency. New information on salinity would not necessitate a restructuring of property rights in order to achieve an efficient use of resources. Rather, common property rights would be exercised in the form, say, of a change in access charges. Changes in the actual structure of property rights would be required only if it was discovered that changes in dryland salinity were not related to changes in the characteristics of a catchment area, but depended on some other mechanism, such as airborne salt.

The major difficulties with the approach relate to decision procedures. These are essentially the same group of problems raised by public choice theorists in their analysis of political democracy. First, if the group of farmers is very large, individuals may have little or no incentive to participate actively in decision making. (See Olson 1965, for general arguments on this point.) Second, there is the possibility that a 'majority coalition' within the group will seek to redistribute income

among themselves. This will usually be associated with a third problem, the waste of resources on rent seeking activities.

Historical and contemporary evidence suggests that there are definite limits beyond which common property (and other systems relying on direct democracy) become infeasible. Conversely, the success of historical common property institutions and contemporary examples, such as bodies corporate in strata-titled housing, suggest that for reasonably small numbers (say, a few hundred) and small decision loads, this problem should not be too severe. (Catchments like Barr Creek in Victoria, with 480 farmers, would be at the upper end of this range.) For larger numbers, recourse might be had to representative systems, but this would raise the question of whether the problem might not be better handled by an appropriate tier of local government.

In order to assess the impact of the majority voting problem, a more formal analysis is required. A general model may be developed on the basis of asset value concepts. Let $V_i(a_i, q)$ be the value accruing to individual i, given the usage a_i and asset quality q, which depends on total usage a. It is now possible to examine the individual's voting decision in setting a usage charge. For simplicity, it will be assumed that revenue is divided evenly among the users. The individual must choose a preferred price p which maximises revenue:

$$(1) \quad R = \max_{a_i} \{V(a_i, q) - pa_i + pa/n\}$$

The first-order condition is:

$$(2) \quad \partial V/\partial q \, \partial q/\partial a \, \partial a/\partial p - a_i + (a + p\partial a/\partial p)/n = 0$$

This condition may be simplified for the case of a 'representative' individual for whom a_i is equal to a/n, yielding:

$$(3) \quad p = -n\partial V_i/\partial q \, \partial q/\partial a$$

Again, for a 'representative' individual, the term in n may be replaced by a summation over all individuals to yield:

$$(4) \quad p = -(\Sigma_j \partial V_j/\partial q)\partial q/\partial a$$

That is, the preferred price is equal to the marginal social damage. Thus, the efficiency of the majority voting decision will depend on the representativeness of the median voter. The common property solution will work best in the cases where damage is perfectly reciprocal (so that all individuals are 'representative') or when the distribution of costs and benefits is symmetrical (for example, normal).

The general analysis given above may be applied to a concrete example, using a very simple model of dryland salinity. In this model, salination is caused exclusively by clearance in recharge zones (areas where rainfall makes a net addition to the water table) and has its effects in discharge zones (those where water is absorbed from the water table). Each landholder i has a total land area L_i of which a proportion θ_i lies in recharge zones, and $1 - \theta_i$ in discharge zones. Thus, the total land area is

L of which $L_r = \Sigma_i \theta_i L_i$ is in recharge zones and the remainder L_d in discharge zones. Each landholder clears proportions a_{ri} and a_{di} of their land area in recharge and discharge zones, respectively. Thus, the total area of land cleared in recharge zones is $A_r = \Sigma_i \theta_i a_{ri} L_i$.

Salinity damage is assumed to increase linearly with A_r. Thus, the salinity damage borne by landholder i is:

$$(5) \quad C_i(A_r) = kA_r(1 - \theta_i)L_i$$

Land quality (in the absence of salinity) is assumed to vary uniformly over both zones. With appropriate choice of units, the range of variation can be made such that the net benefit per land unit is distributed over the range [0, 1]. If a tax of t units is imposed for clearance of land in recharge zones, it is apparent that the profit maximising clearance pattern for each landholder is to set $a_{ri} = 1 - t$, $a_{di} = 1$. That is, land in the recharge zone is left uncleared if, and only if, its yield is less than t.

Using the uniform yield assumption, and integrating, the net profit earned by landholder i is:

$$(6) \quad \pi_i(A_r, t) = \theta L_i[(1-t)^2/2] + (1/2)(1 - \theta) L_i - C_i(A_r)$$

The net tax paid is:

$$(7) \quad T_i(t) = ta_i\theta_i L = t(1-t)\, \theta_i L_i$$

If a standard Pigovian tax approach were used, each landholder would have net income $\pi_i - T_i$. In the common property approach, however, the tax is replaced by a usage charge and the proceeds distributed among the common owners. It will be assumed that proceeds are distributed on the basis of land area. Thus, the receipts for land holder i are given by:

$$(8) \quad Y_i = (L_i/L)t(\Sigma a_{ri} L_i) = (L_i/L)t(1-t) L_r$$

Receipts net of tax payments are:

$$(9) \quad Y_i - T_i = t(1-t) L_i(L_r/L - \theta_i)$$

That is, net receipts are positive for those with a lower than average proportion of land in recharge zones, and negative otherwise. Letting $R_i = \pi_i + Y_i - T_i$, it is possible to evaluate:

$$(10) \quad dR/dt = L_i[(L_r/L - \theta_i)(1-2t) - t\theta_i - \partial C/\partial A_r\, \partial A_r/\partial t]$$

$$= L_i[(L_r/L - \theta_i)(1-2t) - t\theta_i + kL_r(1 - \theta_i)]$$

The three terms in brackets correspond, respectively, to the change in net receipts from the usage charge, the loss of production from the recharge zones, and the reduction in salt damage. As in the formal model, the first term is zero for an 'average' individual. Since the second term is zero when $t = 0$, such an individual will always support a positive usage charge. Furthermore, the most preferred charge will be that satisfying:

$$(11) \quad t = k(L_r/\theta_i)(1-\theta_i) = kL(1-L_r/L) = kL_d$$

so that the charge is equal to marginal social cost. By contrast, if a Pigovian tax approach (without compensation) is used, the individual will always prefer a lower level of tax, and may oppose any positive tax. Even if compensation is paid, the redistribution between 'polluters' (those with high values of θ_i) and 'victims' (those with low values of θ_i) is much sharper than under the common property proposal. Thus, the likelihood of a bimodal distribution of support for the proposal would be increased. The worst case would arise with a bimodal distribution in which one group was mainly generators of pollution and the other group mainly victims. In this case, whichever group formed the majority could make rules to suit itself, leading either to excessive or inadequate controls, and in either case to a sub-optimal asset value.

One important example of a bimodal distribution could arise if both farmers and downstream urban water users were included in the group, or if deforestation had direct effects on non-farmers, for example, by reducing habitat for wildlife valued by conservationists. A common property approach alone would not provide an adequate resolution of the unilateral externality problems suffered by downstream water users. However, it would facilitate the achievement of a solution by alternative means.

One such solution would rely on Pigovian taxes or subsidies. The group of farmers would be levied whenever downstream salinity resulting from their activities rose above a given level, and paid a subsidy whenever salinity was below this level. An appropriately chosen tax–subsidy system will have similar marginal effects to a pure Pigovian tax, while avoiding the massive transfers which have generally made Pigovian taxes politically infeasible. The use of a common property system defeats the major objection raised by Baumol and Oates (1975, Ch. 12) to the use of subsidies; that is, that new firms will be encouraged by the existence of the subsidy to take up the polluting activity. In the present case, the amount of the tax or subsidy depends wholly on the quality of the asset (the river catchment) and is independent of the number of firms.

An alternative, more closely aligned with the property rights approach, would be to create separate common rights for downstream water users (these could perhaps be granted to a municipal council in line with the suggestion of Howe and Lee 1983). Thus, a downstream town could be allocated the right to receive a given volume and quality of water, or perhaps a proportion of total flow. These rights could then be adjusted through Coasian bargaining between the groups of farmers and downstream water users. In the case of a long river system such as the Murray, there might be a whole sequence of groups with rights as regards incoming and obligations as regards outgoing levels of water flow and quality.

Concluding Comments

Economists have generally taken a critical view of common property institutions. This is largely the result of sloppy terminology (in which 'common property' is equated with 'no property'), backed up by an

uncritical acceptance of historical myths. In reality, common property structures involve well-developed rights of exclusion and use, and have outperformed private property rights structures in many agricultural systems.

More importantly, for policy purposes, common property concepts and structures have an important part to play in analysing and responding to externality problems in modern agriculture, such as dryland salinity. In many such problems, neither the traditional Pigovian approach nor property rights approaches based solely on Coasian private property rights are likely to yield adequate solutions. Common property approaches, either alone or in combination with these alternatives, have an important role to play.

Many problems still remain to be solved. In particular, there are the problems of group decision making analysed in the public choice literature. Any successful common property system must overcome these problems, and it will be important to see which features of historical common property systems enabled them to do so. Another outstanding issue is the optimal size of ownership groups. Finally, issues of income distribution within and between groups need examination.

Australian farmers have a long history of involvement in common property institutions through co-operatives and similar bodies. Common property proposals for dealing with environmental problems in agriculture may well be able to draw on this experience.

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