5 Promoting better environmental outcomes through property rights and markets: opportunities and limits

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Abstract

There is growing movement toward adoption of market mechanisms to address environmental and natural resource problems. Using US ocean fisheries and fresh water as examples, I make two key points: One is that despite the attractions of more definite property rights, they remain controversial, limiting or slowing their adoption. They generally are adopted only late, after conditions have deteriorated for many regulated resources. Allocation is one of the most controversial aspects. Accordingly, compensation to parties who expect to be made worse off must be considered in policy discussion. The form of that compensation, especially if it is in the form of preferential access privileges, however, must be designed carefully because it can influence the effectiveness of the property regime adopted. Second, because broader political and social values often are associated with resource use, common property, which involves more stakeholders, rather than narrower private property rights, can seem an attractive alternative. Important trade offs, however, must be kept in mind in policy design. As the number and heterogeneity of the parties increase, common property becomes much less effective. Indeed, it may offer little improvement over regulation. Hence, it may be preferable to adopt private property rights with use restrictions, rather than a more inclusive common property arrangement.

Four direct policy implications are drawn from the main points of the paper:

1. Because property rights institutions are costly and often controversial they often are best implemented late, after a resource crisis reveals their benefits clearly.

2. In devising side payments to address the distributional concerns, where possible avoid constraining the property rights granted or providing preferential, but inefficient rights to certain parties with limits on transferability.
3. Common property as an alternative to private property rights works best if: (a) the number of parties is small; (b) they are similar in the expected net gains of agreement; (c) there is little uncertainty regarding the size and distribution of costs and benefits (information, measurement, bounding, and compliance costs are small); and (d) the aggregate gains of taking action are large relative to the costs.
4. Evaluate the tradeoffs of common property carefully. If too inclusive and complex, common property may offer no advantages relative to the assignment of private property rights with use regulations.

5.1 Introduction

In one way or another, most environmental and natural resource problems — too much air pollution; insufficient investment in natural habitat and biodiversity; too rapid drawdown of groundwater; and overfishing — arise from the incomplete assignment and definition of property rights. Under these circumstances, decision makers do not fully internalise the social benefits and costs of their actions, and hence overpollute, overextract, overharvest as well as underinvest in amenities and other public goods. These are classic externalities.

Until fairly recently, the primary response to externalities has been command and control regulation of inputs and/or outputs in order to bring production to more socially optimal levels. Unfortunately, in many cases, the regulatory record has not been one of much success. For these reasons, there is an accelerated trend toward assigning property rights of some type to resources in order to mitigate the losses of the common pool.[1] A recent survey found that tradable use permits were used in nine applications in air pollution control, 75 in fisheries, three in water, and five in land use control.[2] These institutional innovations have taken place as the resources

1 See Stavins R.N., 2007, 'Market-based environmental policies: What can we learn from US experience (and related research)?', in Jody Freeman and Charles D. Kolstad (eds), *Moving to Markets in Environmental Regulation*, Oxford University Press, New York, pp. 19–47.

2 Tietenberg, T. 2007, 'Tradable permits in principle and practice', in Jody Freeman and Charles D. Kolstad (eds), *Moving to Markets in Environmental Regulation*, Oxford University Press, New York, pp. 63–94, 69.

have become more valuable, as they have faced growing open-access losses, and as dissatisfaction has increased with existing centralised regulation.[3]

There are multiple advantages to property rights and market arrangements, including flexibility, cost savings, information generation, migration to high-valued uses, and better alignment of incentives for conservation or investment in the resource. The more complete are property rights, the more the private and social net benefits of resource use are meshed, eliminating externalities and the losses of the common pool.[4]

By contrast, centralised regulation — which typically relies upon uniform standards, arbitrary controls on access, constraints on timing of use, and/or limits on technology or production capital — suffers from a variety of well-known problems including high cost, inflexibility, ineffectiveness, and industry capture. Further, regulatory decisions take place in the absence of information about alternative uses that market trades generate. Finally, centralised state regulatory rules may or may not align with the incentives of actual users of the resource. Generally, no party involved — actual users, regulators, politicians — is a residual claimant to the social gains from investment or trade.[5]

Accordingly, decisions about extraction, production, investment, and allocation are based on other factors that are apt not to be consistent with maximising the economic or social value of the resource or of conserving it. Indeed, the experience with many central regulatory regimes has not been satisfactory — fisheries continue to be depleted; air pollution abatement targets have not been achieved; and water has not been managed effectively.

I make two points in this paper. One is that, despite the attractions of more definite property rights, they remain controversial, limiting or slowing their adoption. They generally are adopted only late, after conditions have deteriorated for many regulated resources. Allocation is one of the most controversial aspects because of

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3 Stavins, R.N. 1998, 'Economic incentives for environmental regulation', in Peter Newman (ed), 1998, *The New Palgrave Dictionary of Economics and the Law*, Macmillan, London, vol. 2, pp. 6–13.

4 Libecap, G.D. 1989, *Contracting for Property Rights*, Cambridge University Press, New York; Dahlman, C. 1979, 'The problem of externality', *Journal of Law and Economics*, vol. 22, pp. 141–62.

5 Johnson, R.N. and Libecap, G.D. 1994, *The Federal Civil Service and the Problem of Bureaucracy: The Economics and Politics of Institutional Change*, University of Chicago Press, Chicago, pp. 156–71.

the distributional implications involved in moving from open access or central regulation to a property regime.[6]

In many cases, at least some constituencies, including regulators, who benefited from the previous regulatory arrangement, will be disadvantaged under a new rights system. Some parties who previously used the resource will be denied access. Production under a property rights regime has a different composition of inputs and timing from what occurs under either open access or regulation, with negative impacts on certain groups of labour, input sellers, service organisations, and processors. These production changes are inherent in the efficiency gains of privatisation, but not all parties directly benefit from them. Further, as the resource rebounds and becomes more valuable, new owners have wealth, status, and political influence not available to those without access privileges.

Accordingly, compensation of parties who are concerned that they will be made worse off must be considered in policy discussion. The form of that compensation, especially if it is in the form of preferential access privileges, however, must be designed carefully because it can influence the effectiveness of the property regime adopted.

The second point is that, because broader political and social values are often associated with resource use, common property, which involves more stakeholders, rather than narrower private property rights, can seem an attractive alternative. Important trade-offs, however, must be kept in mind in policy design. As the number and heterogeneity of the parties increase, common property becomes much less effective. Indeed, it may offer little improvement over regulation. Hence, it may be preferable to adopt private property rights with use restrictions, rather than a more inclusive common property arrangement.

To sum up, I offer four direct policy implications from the main points of the paper:

1. Because property rights institutions are costly and often controversial, they are often best implemented late, after a resource crisis reveals their benefits clearly.
2. In devising side payments to address the distributional concerns, where possible avoid constraining the property rights granted or providing preferential, but inefficient, rights to certain parties with limits on transferability.
3. Common property as an alternative to private property rights works best if: (1) the number of parties is small; (2) they are similar in the expected net gains of agreement; (3) there is little uncertainty regarding the size and distribution of costs and benefits (information, measurement, bounding, and compliance costs

[6] Definition and enforcement costs for mobile, unobserved resources are also issues, as discussed below.

are small); and (4) the aggregate gains of taking action are large relative to the costs.

4. Evaluate the trade-offs of common property carefully. If too inclusive and complex, they may offer no advantages relative to the assignment of private property rights with use regulations. Other more detailed recommendations regarding common property also are provided in the text.

The arguments of the paper are presented as follows: I briefly summarise the problems with command and control regulation that can arise and the benefits of property rights. I then turn to delay in the assignment of property rights to address environmental and natural resource concerns due to limited information, uncertainty, and distribution disputes. Finally, I discuss the conditions under which common property will be useful and when it might not be. I illustrate these points by reviewing experiences in US fisheries and water allocation controversies in the western United States. I conclude with a short discussion of the use of markets in addressing environmental and natural resource objectives.

5.2 Regulation, property rights, and markets

Command and control regulation

The initial response to open access generally has been state regulation of entry and production to include: a) restrictions on access or time of use; b) equipment and other input controls; and c) extraction or production regulations. State regulation is the initial resort for a number of reasons. One is that it avoids the complex, costly, and controversial allocation of more definite property rights, which could directly address the problem of externalities. Second, state regulation may involve lower costs of measurement, bounding, and enforcement, and, if the resource is of relatively low value, more definite property rights may be too costly to be an option.[7] Another reason is that state regulation is consistent with the notion that many natural resources are rightly 'public' with ownership reserved in the state rather than in private parties. Similarly, if there are important public goods associated with the resource, then state ownership and regulation of access may be optimal. Finally, state regulation can advantage certain influential political constituencies who mould regulatory policy in their behalf. While market processes

[7] See Alston, L.J., Libecap, G.D. and Schneider, R. 1996, 'The determinants and impact of property rights on the frontier: Land titles on the Brazilian frontier', *Journal of Law, Economics, and Organization*, vol. 12, no. 1, pp. 25–61, for discussion of the emergence of property rights as resource values change.

are relatively transparent, political and bureaucratic processes are less so, facilitating preferential treatment to certain parties.[8] This situation underlies the notion of regulatory capture.

One of the constituencies in regulation is the bureaucracy itself, which develops a stake in the maintenance and expansion of state authority and resistance to property regimes where more decision making responsibility is granted to actual resource users. Agencies often are relatively insulated, especially when resource management requires scientific knowledge that may not be generally available to citizens. Hence, agency officials can manage the resource to maximise budgets and regulatory discretion, to advantage particular favoured constituencies, and/or to advance certain political, scientific, and professional views of resource access and use. Since neither politicians nor bureaucrats are direct residual claimants to the resource rents that are saved by mitigating the losses of open access, their regulatory decisions may or may not increase the social or economic value of the resource.

For all of these reasons, when the costs of central regulation become large and its effectiveness in stemming open-access losses questioned, other options come to be considered. If the resource is of high enough value to warrant more definite property rights, then they can be adopted. But property rights arrangements are costly and often controversial, and how they are implemented affects their efficacy in addressing the losses of the commons.

Advantages of property rights and markets

Property rights are directly relevant in confronting open access because, if fully assigned, they close the externality directly and thereby link individual incentives with social objectives for resource use. With a single owner or a limited number of them, decisions about resource investment and use can be made quickly. When the rights structure includes the right to transfer the asset and transaction costs are low, adjustments to changes in price and cost can occur rapidly and flexibly. Optimal production sizes can be achieved.

The sale or other exchange of property rights also generates valuable information regarding alternative uses and opportunity costs that promote efficiency in resource allocation and application. The asset flows to high-valued uses and thereby maximizes social benefits. Indeed, one of the most critical contributions of property

[8] For discussion of the problem of oversight when information is limited, see: Johnson, R.N. and Libecap, G.D. 2001, 'Information distortion and competitive remedies in government transfer programs: The case of Ethanol', *Economics of Governance*, vol. 2, no. 2, pp. 1001–34.

rights is that they provide the basis for exchange or bargaining among parties to tackle open-access problems. The critical agents are identified as owners, the ones who bear the benefits and losses of taking action or not doing so.

Allocation of property rights

The allocation of property rights is contentious because of the associated assignment of wealth and political influence that comes with ownership. Property rights are political institutions and, as such, political negotiations influence the nature of the rights arrangements that are implemented and change their adoption times and effectiveness.

Property rights allocation is also affected by other factors, including the physical nature of the resource, the number and heterogeneity of the parties involved, equity norms and precedents, and the legal environment.

There are several allocation mechanisms:

First-possession rules

First possession is the dominant method of establishing property rights.[9] It assigns ownership on a first-come, first-served basis or first-in-time, first-in-right. First-possession rules are attractive because they recognise incumbent parties, who have experience in exploiting the resource and hence may be the low-cost, high-valued users. Incumbents also have a direct stake in access to the resource and will be important constituents in any property rights distribution. They are concerned about past investment in specific assets, which otherwise would not be deployable to other uses. Since first-possession rules recognize these investments, this security may encourage future outlays. Allocations that do not consider the position of incumbents will face opposition, raising the costs of rights assignment and enforcement. Accordingly, grandfathering in the initial allocation has been a necessary ingredient in building the political support necessary to implement the approach.

First possession is criticised for possibly encouraging rent dissipation as parties rush to 'capture' the resource by establishing excessive use patterns. If the competing parties are homogeneous and ownership is short-term, then full dissipation is

9 See Libecap, G.D. 2007, 'The assignment of property rights on the western frontier: Lessons for contemporary environmental and resource policy', *Journal of Economic History*, vol. 67, no. 2, pp. 257–91.

possible. If, on the other hand, the parties are heterogeneous and use rights are long-term, then first-possession assignments to a flow can mitigate rent dissipation.[10]

First possession is also criticised for its equity implications. Its use can provide windfalls to past users instead of providing funds to the state that might be used under some circumstances to compensate losers from privatisation, and it discriminates against new entrants.[11]

Uniform allocation rules

Equal sharing rules avoid the distributional concerns associated with first possession and better reflect egalitarian goals. If there are no restrictions on subsequent exchange of property rights and transaction costs are low, there are few efficiency implications. The resource still migrates to high-valued users. Uniform allocations also avoid the measurement costs of verifying claims of past production or use or of documenting precedence claims that are part of first-possession assignments. They can also avoid the costly pursuit of property rights when first possession is known to be the allocation rule.

Lotteries are examples of uniform allocations because each claimant is given an equal, random draw in the assignment of rights to the resource, and the allocation granted is generally partitioned equally among lottery winners. Uniform allocations via lotteries are most effective when applied to new resources where there are no incumbent claims and all parties are relatively homogeneous. They can also be used when the access and use rights granted are short-term and no long-term ownership is implied, such as with lotteries for annual hunting licences.

Auction allocation

A third allocation mechanism, often favored by economists, is auction. It can directly place assets into the hands of those who have the highest value for the asset. It thereby avoids the transaction costs of reallocation. Auctions also generate resources for the state and avoid the windfalls that might be considered unearned and divisive. Auction returns can be used to cover the costs of defining and enforcing property rights and other costs of resource management. As with lotteries,

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10 Johnson, R.N. and Libecap, G.D. 1982, 'Contracting problems and regulation: The case of the fishery', *American Economic Review*, vol. 72, pp. 1005–22, show that heterogeneity among fishers limits rent dissipation even under open access and the rule of capture.

11 Stavins, R.N. 1995, 'Transaction costs and tradable permits', *Journal of Environmental Economics and Management*, vol. 29, pp. 133–48, refers to grandfathering as a give-away. Inefficiencies would come through a race between homogeneous parties.

auctions work best for new, unallocated resources where there are no incumbent claimants and where resource values are very high. By granting more of the rents to the state, auctions reduce the distributional implications of first-possession or uniform allocation.

As with other allocation arrangements, there are costs to auctions. The state must be able to measure and enforce resource boundaries and individual allocations secured by auction. The terms of the auction may also be influenced by competing claimants who lobby for rules that provide them with specific advantages.

Collective action issues and delay in the assignment of property rights

The brief discussion of allocation mechanisms suggests that there is often an underlying collective action problem associated with the definition and assignment of property rights and, hence, why they generally are adopted late in resource use. For example, Scott Gordon wrote his classic article on waste in open-access fisheries in 1954.[12] Individual Transferable Quotas (ITQs) were suggested by fishery economist Francis Christy in 1973, but it was not until 1986 (32 years after Gordon wrote his article) that New Zealand adopted the first rights-based approaches.[13] Similarly, in air pollution control, the notion of tradable emission permits was put forward by Thomas Crocker in 1966 and by J.H. Dales in 1968 when air pollution was becoming a growing problem in the United States, but adoption of such permits took another 30 years.[14]

The main reason why formal property rights are adopted late in resource use (even after extensive periods of open-access losses) is that they involve high resource and political costs relative to their expected gains. These issues become even more problematic when there are multiple parties claiming a stake in the resource, a point that is addressed in more detail below.

Property rights have formidable information and input requirements in allocation, measurement, bounding, and enforcement, and they can have substantial distributive effects when there is too much uncertainty as to the impact on key constituencies. These resource and political costs hamper the assignment of

12 Gordon, H.S. 1954, 'The economic theory of a common-property resource: The fishery', *Journal of Political Economy*, vol. 62, no. 2, pp. 124–42.

13 Hannesson, R. 2004, *The Privatization of the Oceans*, MIT Press, Cambridge; Newell, R.G., Sanchirico, J.N. and Kerr, S. 2005, 'Fishing quota markets', *Journal of Environmental Economics and Management*, vol. 49, pp. 437–62.

14 Crocker, T.D. 1966, 'The structuring of atmospheric pollution control systems', in Wolozin, H. (ed), *The Economics of Air Pollution*, W.W. Norton, New York, pp 61–8; Dales, J.H. 1968, *Property and Prices*, University of Toronto Press, Toronto.

property rights to address open access. As argued above, when the value of the resource or the cost of the externality is relatively low, prescriptive regulation to limit exploitation through uniform restrictions can be cost-effective and politically acceptable. Information demands are limited to the setting and administering of general rules and standards; it does not involve obvious redistribution; and reliance upon standardized regulations reduces uncertainty regarding the impact on constituencies. The various parties involved can generally predict how they might be affected, and their current political and wealth standings are unlikely to be significantly altered. At the same time, however, these policies incompletely address the externality, leaving many margins for rent dissipation unconstrained.

Property rights are relevant because they address the externality directly and link individual incentives with social objectives for resource use. But they are typically adopted only when their costs are offset by the aggregate rents that are saved from overexploitation. Because these transaction costs can be quite considerable, the value of the resource and the nature of uncertainty determine the optimal time for introducing formal property rights. Crises that suddenly and sharply raise benefits and lower uncertainty accelerate this process.[15] Crises here are events or spikes that dramatically raise the wastes associated with open access and at the same time lower the transaction costs of collective action by providing new information about the benefits of institutional change to combat the problem.

Collective action, which may not be possible early, can become more practical after delay, as transaction costs fall. Additional information emerges regarding the severity of the problem, reducing uncertainty and measurement costs and eliminating information asymmetries; the resource becomes more valuable (perhaps due to greater depletion, raising the benefits of action); new technology or techniques are developed to lower the costs of closing the externality; and the number of parties declines as the private returns to exploitation fall. At this point, distributional concerns can become subordinate to the overall need to respond to open access, and successful group efforts become more likely.

These problems are compounded, however, when the externality is larger, spreading across multiple groups or constituencies, so that its resolution requires broader government involvement and the associated efforts of politicians. When there are numerous constituencies affected differently by the problem and the costs of mitigation, politicians must balance constituent interests to maximise political support for taking action.

15 Libecap, G.D. 2008, 'Open-access losses and delay in the assignment of property rights', *University of Arizona Law Review*, vol. 50, no. 2, pp. 379–408.

When constituencies are heterogeneous in the net gains of collective action, politicians must devise side payments from high gainers to those who expect to do less well in order to build a political consensus. Transfers that seem too obvious and as unfairly rewarding particular groups can bring a reaction from general taxpayers. Accordingly, camouflaging transfers, linking them to popular public goods, and tying them to broad distributional norms can reduce their political costs. Their design, however, may lower the overall effectiveness of the government regulation of the externality.

Uncertainty in predicting aggregate costs and benefits of addressing externalities and their distribution across constituencies complicates the crafting of side payments by encouraging disputes over the size, nature, and direction of compensation. These disputes increase political risk and reduce the expected politicians' benefits from deal-making to address the externality.

As a result, politicians select policies that lower uncertainty and raise expected net gains for key constituents. These policies include postponing any action; encouraging research in information about the externality; promoting new technology that lowers costs; investing in resource-stock enhancement, including restricting access by non-citizens or other politically-weak groups; and adopting standardised regulations that reduce the externality while appearing to remain neutral and not changing the existing distribution of wealth and political power.

Politicians will support property rights only if it is politically beneficial to do so — when command and control regulation has not worked, when they have the support of key constituencies, and when it is possible to construct side payments to influential groups that might be harmed. Accordingly, to build political support, politicians shape the assignment of property rights in a manner that achieves other distributional objectives or meets the demands of those who claim to be harmed. These adjustments, which, however, attenuate the property rights that are granted, also weaken the ability of the rights regime to reduce the losses of open access.

Common-property regimes

When private property rights seem to be too controversial to be adopted, more inclusive common-property options may be considered. Such institutions seem to be especially attractive when there are many divergent claimants or interests associated with a resource, as can be the case with ocean fisheries and related aquatic habitats as well as with fresh water. Both resources have public good aspects; are seen as inherently public by some; have many distributional implications from single ownership; and their fluid physical nature raises the bounding costs of assigning private rights.

In these cases, common-property regimes are often presented as a viable option that avoids the political conflicts associated with private property. While this may be the case, an extensive body of theory and empirical evidence regarding common property exists to illustrate when such institutions are likely to be effective in addressing open access and when they are not. If common property is to be considered as an alternative to private rights and markets for the reasons described above, the tradeoffs should be considered explicitly in public policy decisions.

A number of points are worth making. First, any common resource must still be bounded in some manner, so that group members (perhaps citizens or other designated stakeholders) have access and set use rules so as to protect the resource and avoid rent dissipation. Non-group members are denied access. Hence, bounding and enforcement costs remain to be addressed by policy makers. Second, there is the critical issue of internal decision making and responsibility for resource use.[16] If this process is impaired, common property can be costly, with misalignment of member incentives for maximising the social value of the resource. Cooperation within the group depends upon resource, group, and management characteristics.

Resource characteristics

1. The smaller, the more observable, and the less mobile the resource, the lower the transaction costs of bargaining within a group to address commons problems. These conditions allow appropriators to observe the waste of open access, to define accurate external boundaries for the resource, to evaluate the response to management efforts, and to police entry and use. All of these are issues of information. Changes in the technology of transportation, observation, and communication generate more information, allowing the resource size to be larger and less observable. A policy role for the state can be to provide credible scientific information about the resource, its character, and its boundaries to encourage collective action.
2. Clearly-defined resource boundaries allow the group to police entry, allocate access among its members, monitor their compliance, and invest in the stock (conservation). Changes in bounding and enforcement technology, also possibly promoted by policy, can lower the costs of marking resource perimeters and thereby can promote group action.
3. A well-defined commons problem or, alternatively, good information about the resource and the losses of open access, allows the group to agree on the significance of the problem and the benefits of addressing it. If the losses are

16 Baland, J.M. and Platteau, J.P. 1996, *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?*, FAO and Clarendon Press, Oxford, p. 187 discuss these two problems in the use of common property to address resource issues.

controversial (as assessments vary) or small, then there is less pressure to take action.

4. Similarly, the less uncertainty about the commons problem and the resource reaction to it, the greater will be the identification of the returns to cooperation and less disagreement among the parties. Accordingly, policies aimed at providing information about the commons problem and methods of addressing it can make common property (indeed, all property arrangements) more feasible and effective.

5. Finally, all else being equal, more valuable resources will have more costly externalities and greater losses from open access. The gains from group action to address the problem rise. At the same time, rights and other management arrangements for more valuable resources have greater enforcement costs. The benefits of defection are greater. Indeed, high value and cheating are argued as reasons for adoption of private rights.[17] Value may rise from exogenous price increases, changes in social values (greater appreciation of biodiversity, ecology) or new extraction technology. These factors could invite outside entry and raise the costs of cohesive group action.

Group characteristics

1. Clearly-defined membership in the group is important so that members can be identified for bargaining and enforcement and for avoiding open access through unlimited entry.

2. Smaller groups are more effective. Olson (1965) emphasised the costs of bargaining, allocation, and enforcement as group size increases. It is more difficult to bring parties into agreement and to observe cheating as group size rises. Incentives to free-ride rise with group size, because enforcement is more difficult and the cost borne by each party from violating agreements on average falls.[18]

3. More homogeneous groups are better able to address commons problems collectively.[19] They are more likely to have similar consumption or use patterns and, accordingly, common objectives. They are apt to have comparable time horizons for resource management and, if relevant, similar extraction costs. Members of such groups also are more likely to have similar information about

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17 Demsetz, H. 1967, 'Toward a theory of property rights', *American Economic Review: Papers and Proceedings*, vol. 57, no. 2, pp. 347–59.

18 Olson, M. 1965, *The Logic of Collective Action,* Harvard University Press, Cambridge, MA; and Baland, J.M. and Platteau, J.P., *op.cit*. pp. 77, 298, 'Small is beautiful'.

19 Ostrom, E. 1990, *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press, New York; Baland, J.M. and Platteau, J.P., *op.cit*., p. 75.

the resource and the problem of over-extraction. These conditions lower the transaction costs of bargaining because they facilitate agreement on the problem and the allocation of benefits and costs that are inherent in any management solution.[20] On the other hand, less homogeneous groups may face problems due to differences in the expected net gains of cooperation.

4. A common understanding about the resource and the potential for open-access losses and how the resource system operates promotes action. This condition includes an appreciation of the link between harvest and depletion. Outside claims of potential losses that appear inconsistent with local experiences, or are difficult to verify, are unlikely to be considered credible. This is a key aspect of homogeneity. As such, government policies that limit entry into a common-property regime to similar groups may be worthwhile to make it more effective. At the same time, however, these policies reduce the ability of common property to be more inclusive. Even so, absent a common understanding or objective, the transaction costs of agreement will be higher. Asymmetric information about the problem and the costs and returns of various management options raise bargaining costs because the parties will have different views of how they will benefit from action relative to the *status quo*. It may not be possible to devise side payments to bridge these disagreements. Neutral, objective information provided by outside sources or government agencies, however, may promote agreement.

5. Group dependence upon the resource and a history of past depletion raise the expected gains of addressing the commons problem. Crises provide information about the seriousness of open access, lowering transaction costs.[21]

6. Effective communication within the group is another important characteristic of successful common property. This attribute is closely linked to group size and homogeneity. Greater communication makes agreement on a management plan more likely, and lowers the cost of monitoring. Repeated interaction builds trust, lowers the transaction costs of bargaining, and raises compliance. Communication can make contributions self-enforcing.

7. Close proximity of group members and frequent interaction lower the transaction costs of bargaining and communication, increase information, and reduce enforcement outlays.

8. Leadership also is important for group success. Although economists are not well equipped to model leadership, there is considerable empirical evidence that in cases where group members are not homogeneous and where some

[20] Wiggins, S.N. and Libecap, G.D. 1985, 'Oil field unitization: Contractual failure in the presence of imperfect information', *American Economic Review*, vol. 75, no. 3, pp. 368–85.

[21] Libecap, G.D. 2008, *op.cit.*

disproportionately benefit from taking action, those parties are often leaders in implementing a management plan.[22] They can make credible commitments, and have incentives to achieve effective action.

9. Shared moral norms within groups promote cooperation.[23] These norms are internalised rules of conduct that promote coordination though clear group identity, trust, and reduced free-riding. When moral norms are present, formal extraction rules are less necessary. Such customs are more likely to be found in small groups and less so in large ones where formal rules are more important. In small groups there can be continuous interaction which is observed and memorised. For larger, more heterogeneous groups, there may be no internal mechanism for lowering bargaining and enforcement costs. In this case, central regulation or private property rights are apt to be more effective solutions to open access.
10. Group stability and tradition also matter. Stable groups have limited size and are more homogeneous. Further, they can rely on past customs to address commons problems.

Management characteristics

1. Observable indicators of management performance that are predictable are necessary to assess the results of group action.
2. The distribution of the benefits and costs of resource management across the group should be proportionate. If this is not the case, then the net returns from management will vary among members, changing incentives. Those who benefit more from some actions and share less in the associated cost will naturally support those efforts, even if they are not optimal in the aggregate.[24]
3. Appropriation or allocation rules that are consistent with local conditions are important. They blend with available knowledge, can be observed, and are consistent with group notions of equity.
4. Local resource-use rules should dominate, so that affected group members participate in allocation and investment decisions.[25] The alternative of

[22] Baland, J.M. and Platteau, J.P. *op.cit.*, pp. 79, 114, 337.

[23] Baland, J.M. and Platteau, J.P. *op.cit.*, pp. 116, 119, 176.

[24] This is illustrated by experiences in oil field unit contracts when participants do not share proportionately in unit revenues and costs from certain investment and production decisions. These units are not successful. Prudhoe Bay is a prime example. See: Libecap, G.D. and Smith, J.L. 1999, 'The self-enforcing provisions of oil and gas unit operating agreements: Theory and evidence', *Journal of Law, Economics, and Organization*, vol. 15, no. 2, pp. 526–48.

[25] See summary by Libecap, G.D. 2007, *op.cit.*

centralised regulation by bureaucracies involves problems of limited information as well as of incentives. Neither politicians nor bureaucrats are typically residual claimants in the benefits of cooperation, and they may have short time-horizons.

5. Local monitoring and sanctioning of member compliance are generally more effective than are external regulations.
6. Graduated sanctions that are deemed fair promote agreement.
7. Low-cost local arenas for resolution of conflicts should exist to encourage group action.
8. Group rules should be recognised by governmental authorities and not undercut by them.
9. Economic incentives for conservation are provided by the state to the group.
10. Nested enterprises are in place for rules regarding appropriation, provision, monitoring, enforcement, conflict resolution, and governance.

Given all of these requirements, common property can be a helpful intermediary between regulation and private property rights, but the conditions under which it is effective must be kept in mind.

Generally, collective action to address open access is promoted if: (1) the number of parties is small; (2) they are similar in the expected net gains of agreement; (3) there is little uncertainty regarding the size and distribution of costs and benefits (information, measurement, bounding, and compliance costs are small); and (4) the aggregate gains of taking action are large relative to the costs.

Important deviations from these criteria, however, hinder group efforts. If aggregate net gains are limited — that is, the common resource is of low value and/or the transaction costs of addressing the problem are high — there are few incentives for action until values increase or costs fall. As group size grows, bargaining and compliance costs rise. If the aggregate benefit is a public good (having high bounding costs), while the costs of taking action are private, free-riding and defection are encouraged.

With this background discussion of delay in the assignment of property rights, the allocation issues involved, and the conditions for successful common property, we now turn to two empirical examples in ocean fisheries and fresh water.

5.3 Fisheries

Property rights: delay, potential benefits, restrictions

The first government reaction to open access in fisheries has involved implementation of uniform restrictions on access and fishing effort. These regulations have minimised information requirements and avoided significant deliberate changes in *status quo* economic and political rankings among the parties involved. Uniform regulations, however, are unlikely to be fully effective because they do not align the incentives of the parties with the objectives of reduced harvest and conservation of the stock.

Accordingly, if the fishery is sufficiently valuable, at some point there has been a turn to property rights of some type. But these have come late, generally only after the stock has collapsed and declining returns have made existing practices untenable. Even then, conflict over the nature of the rights to be granted and their allocation has slowed adoption of a rights regime, constrained the privileges assigned, and limited the overall benefits obtained.

To illustrate these points, Rögnvaldur Hannesson, Ragnar Arnason, and Ross Shotton, among others, outline a common process of open-access losses, delayed regulation, and finally, a limited adoption of ITQs or Individual Vessel Quotas (IVQs).[26]

Under ITQs and IVQs, regulators set the total annual allowable catch based on assembled biological information, anticipated environmental conditions, and expected harvest impacts. Each authorised fisher or vessel is granted a share in the annual catch based on the allocation rule, and the quotas generally can be traded, although with varying restrictions. The most common allocation rule is based on first possession or historical catch. Past investment in vessels and equipment is also often taken into account. The advantage of ITQs over regulation is that they better align the harvest practices of fishers with practices that protect or enhance the stock. The value of their quotas, which often can be major sources of wealth, depends upon the long-term health of the fishery. Hence, there are incentives for self- and

26 ITQs are the most widely applied form of property right in fisheries (Hannesson, R. *op.cit.* p. 56). See also Arnason, R. 2002, 'A review of international experiences with ITQ', Annex to *Future Options for UK Fishing Management*, Report to the Department for the Environment, Food and Rural Affairs, CEMARE, University of Portsmouth, UK; and Shotton, R. 2000, 'Current property rights systems in fisheries management', in Shotton, R. (ed), *Use of Property Rights in Fisheries Management*, Proceedings of the FishRights99 Conference, Fremantle Western Australia, FAO, Rome, Fisheries Technical Paper 404/1, pp. 45–50.

group-monitoring of compliance; and importantly, ITQs, as a property right, are the basis for further contracting among fishers to reduce fishing pressure.

The beneficial effects of ITQs are impressive. Many studies — among others, Grafton, Squires, and Fox (2002); Shotton (2000); Arnason (2002); Newell, Sanchirico, and Kerr (2005); and Wilen (2006) — report increases in fishery product value, improved efficiency, and enhanced stock conditions.[27]

The adoption of ITQs in the United States, however, has been slow and contentious.

ITQs are more limited and are a weaker property right in the United States than in many other major fishing countries.[28] As late as 2002, after years of open-access losses and ineffective regulation, only four US marine fisheries operated under ITQ regimes: the Mid-Atlantic surf clam and ocean quahog fishery, the Alaskan halibut and sablefish fishery, and the South Atlantic wreckfish fishery, all adopted in the early 1990s. This situation compares with at least 20 ITQ-managed fisheries in Australia, covering about 34 per cent of the volume and 22 per cent of the value of the country's fisheries and 40 fisheries in Canada, accounting for over 50 per cent of the value and volume of landings as of 2002.[29] Two extensions of ITQs were under consideration in 1995 for the Gulf of Mexico red snapper and Pacific sablefish fisheries, but tabled in 1996.

In these discussions, there has been an effort to preserve the relative position of regions, communities, fleets, capital, and crew by limiting the assignment and trading of ITQs. Some US ITQs are reserved for community development and not granted to individuals. There also are formal limits on the size of individual quota holdings and their transferability.

In the Alaska halibut fishery, for example, only transfers from larger to smaller vessel classes are permitted, and no individual is allowed to own more than 0.5 per cent of the total quota.[30] Other controls over share concentration are designed to

27 Grafton, Q.R., Squires, D. and Fox, K.J. 2000, 'Private property and economic efficiency: A study of a common-pool resource', *Journal of Law and Economics*, vol. 43, no. 2, pp. 679–713; Arnason, R. 2002, *op.cit.*; Shotton, R. 2000 *op.cit.*, pp. 45–50; Wilen, J.E. 2006, 'Why fisheries management fails: Treating symptoms rather than the cause', *Bulletin of Marine Science*, vol. 78, no. 3, pp. 529–46; Newell, R.G., Sanchirico, J.N. and Kerr, S. 2005, 'Fishing quota markets', *Journal of Environmental Economics and Management*, vol. 49, pp. 437–62.

28 Arnason, R. 2002 *op.cit.*, pp. 52–7.

29 *Ibid.*, pp. 3–17.

30 *Ibid.*, pp. 54–5.

limit holdings and maintain a targeted number of vessels in the halibut fleet.[31] Further, in 1996, the Magnuson–Stevens Fishery Conservation Act (*Sustainable Fisheries Act, 16 USC 1801*) placed a four-year moratorium on the adoption of further ITQs in US fisheries.

Common property: Regional Fishery Management Councils

The political push for adoption of the Magnuson-Stevens Act not only illustrates the distributional conflicts over assignment of ITQs, but also the pressures to broaden the number of stakeholders and interests to be included in any management plan. For the reasons described above, the increased scope of issues to be considered (multiple species stock conservation, provision of biodiversity, and ecosystem services) as well as the expansion of parties involved (commercial vessel-owners, crew, community leaders, processors, environmental groups), suggest that any institutional response to open access in fisheries is likely to be cumbersome at best and ineffective at worst. These actions include adoption of Territorial Use Rights to Fisheries (TURFs) and Regional Fishery Management Councils (RFMCs) as common-property regimes.[32]

In the debate leading to enactment of the Magnuson-Stevens Act, vessel-owners and larger distributors generally backed ITQs, whereas representatives of fishing communities, part-time fishers, crew, and processors, typically were resistant. The provisions of the law also reflect the many issues at stake (reducing by-catch, conserving habitat, preventing overfishing) as well as opposition to further extension of private property rights to the stock: the Act 'shall not create, or be construed to create, any right, title, or interest in or to any fish before the fish is harvested'.[33]

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31 Singh, R., Weninger, Q. and Doyle, M. 2006, 'Fisheries management with stock growth uncertainty and costly capital adjustment', *Journal of Environmental Economics and Management*, vol. 52, pp. 582–99, 594–95.

32 For discussion of the RFMCs see Hanna, S. 2006, 'Will structural reform fix fishery management? Commission policy recommendations and the US Regional Fishery Management Council system', *Bulletin of Marine Science*, vol. 78, no. 3, pp. 547–62.

33 Some key provisions of the Sustainable Fisheries Act include:

- Preventing overfishing, and ending overfishing of currently depressed stocks
- Rebuilding depleted stocks
- Reducing by-catch and minimizing the mortality of unavoidable by-catch
- Designating and conserving essential fish habitat
- Reforming the approval process for Fishery Management Plans (FMP) and regulations
- Reducing conflict of interest on Regional Councils
- Establishing user fees.

As argued above, as the number of stakeholders rises and as they become more heterogeneous in their objectives, the more difficult it is to reach agreements on fishing rights and collective action regarding habitat. Some RFMCs already are well known for being mired in debate.[34]

The RFMC system was established by the Magnuson-Stevens Fishery Conservation and Management Act of 1976 for the purpose of managing fisheries in the newly-recognised exclusive economic zone between three and 200 miles offshore of the United States. The eight RFMCs are decision-making bodies and develop and recommend specific management measures in the form of fishery management plans. Unfortunately, the RFMCs generally are not viewed as successfully meeting conservation objectives, of providing for the long-term economic productivity of fisheries, or of protecting ecosystems.[35] They face many divergent interests and ambiguous goals, and no single entity is responsible for ensuring that management objectives are met.[36] It is likely that they are too large and too complicated for effective coordination.[37] Even so, there are pressures to make them even more inclusive, for example through extension of the public trust doctrine that asserts the 'inherent' common nature of the marine resource.[38]

A key problem is that generally no party has property rights within the RFMC to internalise the benefits and costs of decision making. Indeed, the absence of property rights means that there is no basis for exchange among the parties regarding different fishery values.

Where ITQs are implemented and other public good issues exist (by-catch, biodiversity), restrictions on certain actions, such as through use of marine easements in a manner similar to those applied to land–owners, could be considered

http://www.nmfs.noaa.gov/sfa/SFA-Report-FINAL7_1.pdf; NOAA 'SFA Update', 1997; http://www.nmfs.noaa.gov/sfa/juneup.pdf; Opposition to property rights: Source: STAT 3576-3577;http://www.nmfs.noaa.gov/sfa/sustainable_fishereries_act.pdf.

34 See Fluharty, D. 2000, 'Habitat protection, ecological issues, and implementation of the Sustainable Fisheries Act', *Ecological Applications*, vol. 10, no. 2, pp. 325–37.

35 Engle, J., Newkirk, S. and Thompson, B.H. Jr. 2003, *Taking Stock of the Regional Fishery Management Councils*, Pew Charitable Trust, Washington D.C., pp. 1–2.

36 Hanna, S.S. 2006, 'Implementing effective regional ocean governance: Perspectives from economics', *Duke Environmental Law and Policy Forum*, vol. 16, pp. 205–16, 211. See also the other articles in this issue.

37 *Ibid.*, p. 215.

38 Fletcher, K.M. 2006, 'Regional ocean governance: The role of the public trust doctrine', *Duke Environmental Law and Policy Forum*, vol. 16, pp. 187–204, 200.

as an alternative to common property.[39] Regulated private rights may be more effective than use of common property where all parties have a say in the provision of the many fishery services but no associated bearing of the opportunity and direct resource costs involved.

5.4 Western US fresh water

Water rights: delay, potential, limits

In the face of rapid urban population growth, greater demands for recreational and environmental uses, and possibly more limited and/or variable precipitation with climate change, there are pressures to move water from historical uses in agriculture to meet urban and environmental demand. Currently, agriculture uses approximately 80 per cent of the water and, on the margin, water values are much higher in urban and agricultural uses. For example, some farmers in southern California's Imperial Irrigation District pay $20 per acre-foot of water while the City of San Diego has offered ten times that amount — $225 — per acre-foot for the same water.[40] Even so, water markets have been slow to develop.[41]

In the US west, the appropriative rights structure potentially allows for water markets to address some of these reallocation pressures. Under the appropriative doctrine, the first claimant can divert a certain amount of water from its natural course for private beneficial purposes on land remote from the point of diversion. Subsequent claimants can also divert water with lower priority rights. Because appropriative rights can be separated from the land, and sold or leased, they can be the basis for private water transfers in response to changing economic conditions and water values. But trades that change the location of water diversion, nature of use, and timing, especially if they are large relative to stream flow, are restricted by State law and regulated by State agencies. Some States have more restrictive regulations regarding transfers than do others.

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39 Deacon, R.T. and Parker, D. forthcoming, 'Encumbering harvest rights to protect marine environments: A model of marine conservation easements', *Australian Journal of Agricultural and Resource Economics*.

40 See Donohew, Z. forthcoming, 'Property rights and western US water markets', *Australian Journal of Agricultural and Resource Economics*; Brewer, J., Glennon, R., Ker, A. and Libecap, G.D. 2008, 'Water markets in the west: Prices, trading and contractual forms', *Economic Inquiry*, vol. 46, pp. 91–112.

41 Young, R.A. 1986, 'Why are there so few transactions among water users?', *American Journal of Agricultural Economics*, vol. 68, no. 5, pp. 1143–51.

In a recent study, Brewer et al. (2008) detail the nature of water transactions over 19 years across 12 western States. There is considerable variation in the extent of water trading and, of reported data, only about 2 per cent of water consumed is annually traded.[42] Much of this activity is among farmers through one-year leases or between agricultural and urban users. Trades to environmental uses are rarer and usually due to court rulings and government mandates.

There are a number of reasons for the comparatively limited movement of water through market processes.[43] One is that surface water is difficult to bound, so that multiple parties might be affected from any privately-negotiated transfer. For instance, out-of-basin transfers may reduce recharge and stream flows and, hence, the amount of water available to lower-priority water claimants.

A second, and more critical, factor is that water-rights owners have only usufruct rights and many parties (farmers, members of environmental and wildlife groups, urban users) claim an interest in water allocation and use. In this way, water is similar to ocean fisheries where the number of constituencies and objectives of management have grown, as noted above. Accordingly, there is resistance to recognising existing water rights and paying for them as part of any reallocation effort. Such payments are controversial because they appear to recognise an ownership right that does not formally exist. Further, such payments might drain the budgets of advocacy groups or State agencies. Third, monopoly conditions might be encountered where key water rights owners were in a position to hold out or extract most of the social surplus of the movement of water to environmental and recreational uses.

Nevertheless, market transactions have values of their own. First, they generate information about relative water values and hence, the nature of opportunity costs. Since owners have the option of selling, they have incentive to determine just how much water they require and how much might be sold. Buyers have incentive to determine how much water is actually required to meet urban or environmental demands in the face of alternative uses. Second, water transactions and market values encourage investment in the stock of water by current owners. Third, market transactions can take place routinely and quickly to meet new social demands as they do for many other resources. Because owners are compensated, they have less incentive to block socially-valuable water movement. Accordingly, such transactions can be smooth and uncontroversial.

42 Brewer, J., Glennon, R., Ker, A. and Libecap, G.D. 2008, *op.cit.* There are undocumented, routine exchanges among farmers within irrigation districts.

43 There are issues of quality and conveyance, but given rapidly rising water values, these factors are not likely to be binding on markets.

Despite these advantages, water transfers to meet environmental demands are often very contentious and lengthy. They occur through arbitrary reallocation, typically without compensation and implementation of common property-like regimes. The delay and wastes involved in these conflicts dissipate resource values. The Mono Lake case illustrates these issues and how they affect the response to environmental concerns. The alternative of greater reliance on water rights and trading is presented with discussion of the actions of the Oregon Water Trust.

Common property: the public trust doctrine and Mono Lake

The famous Mono Lake controversy, involving Los Angeles' water, illustrates the use of common property through the public trust doctrine instead of private property rights. Between 1930 and 1940, the Los Angeles Department of Water and Power acquired riparian water rights to the four tributaries that feed Mono Lake, an alkaline and hypersaline lake situated in the eastern side of the Sierra Nevada mountains, roughly 300 miles northeast of the city.[44] The agency applied to the State Water Resources Control Board (SWRCB) in 1940 for permits to appropriate the water and, in 1941, finished constructing an aqueduct and began diverting the water for urban use. In 1963, to further augment urban supplies, construction began on a second aqueduct, which was completed in 1970.[45] While between 1940 and 1970 an average of 57 067 acre-feet was exported to Los Angeles, with new aqueduct capacity exports increased to 100 000 acre-feet or more through 1975.[46] At the time, water for urban consumption was viewed as the highest and best use of the water. Indeed, the Mono Basin alone accounted for about 15 per cent of the city's water.[47]

Over time, however, these water exports had substantial adverse effects on Mono Lake and its surrounding environment. The tributaries dried up below the diversion points and the level of Mono Lake began to decline by about 1.6 feet a year. Between 1941 and 1981, the lake's level fell about 46 feet, with one-third of that decline occurring after 1970. The surface area of Mono Lake diminished from 90 to

44 For discussion, see: Libecap, G.D. 2007, *Owens Valley Revisited: A Reassessment of the West's First Great Water Transfer*, Stanford University Press, Palo Alto, pp. 132–7.

45 http://wsoweb.ladwp.com/Aqueduct/historyoflaa/aqueductfacts.htm.

46 *National Audubon Society v. Superior Court* (33 Cal. 3d 429). See also Libecap, G.D. 2007, *op.cit.*, p. 138.

47 Libecap, G.D. 2007, *op.cit.*, pp. 132–7.

60 square miles, and its salinity increased from 50 grams per litre to 90 grams per litre.[48]

As Mono Lake levels declined, the National Audubon Society, Friends of the Earth, the Sierra Club and a new coalition of environmental activists, the Mono Lake Committee, that had formed in 1978, brought suit under the public trust doctrine in May 1979 to curtail Los Angeles' export of water. The plaintiffs charged that the public trust doctrine applied not only to navigable waterways, but to streams used for recreation, wildlife habitat, and ecological study; that Mono Lake was being harmed by Los Angeles; and that the city's diversion was not a reasonable and beneficial use, as required by the State's appropriative water rights system. This public trust argument posed a clear challenge to Los Angeles' water rights.

The 'public trust' is a common-law principle creating the legal right of the public to utilise certain lands and waters, such as tidewaters or navigable rivers, and other waters and natural resources with high amenity or public good values. Under the doctrine, the rights of the public are vested in the State as owner of the resource and trustee of its proper use. As a result, public trust resources are effectively common property with stakeholder membership very broadly defined.

On 17 February 1983, in *National Audubon Society v. Superior Court* (33 Cal 3d 419) the California Supreme Court held that exercise of appropriative water rights is subject to limitation by the State in order to protect public-trust values, including those of wildlife habitat: 'Thus, the public trust is more than an affirmation of state power to use public property for public purposes. It is an affirmation of the duty of the state to protect the people's common heritage of streams, lakes, marshlands and tidelands…' (33 Cal 3d 441). According to the court, public-trust regulatory responsibilities applied *ex post* to existing water rights, and these rights were use rights only that could be reconsidered in light of changing perceptions of the trust. Regulatory agencies were required to monitor water use and reallocate it in a manner consistent with shifting notions of the public trust.

Under this common property arrangement, constituencies with standing as part of the 'public' could lobby for changes in water use whenever they believed that current practices were inconsistent with the public trust. State agencies and courts would be responsive to these demands whenever they were politically salient and within the guidelines of past judicial rulings. No costs, however, are directly assigned from these actions, except for those borne by current water users, who are not compensated.

48 For discussion see Brewer, J. and Libecap, G.D. forthcoming, 'Property rights and the public trust doctrine in environmental protection and natural resource conservation', *Australian Journal of Agricultural and Resource Economics*.

In the case at hand, Los Angeles' water rights were rejected and — facing the loss of valuable water rights as well as the value of past fixed investments in aqueducts, dams, reservoirs, and hydroelectric facilities — the city fought the reallocation of its water. It took over a decade of a complex series of subsequent court rulings and appeals before the California regulatory agency, the SWRCB, halted virtually all water exports until Mono Lake's level reached 6377 feet above sea level.

In the end, it took nearly 20 years from the initial effort to reduce diversions from the Mono Basin until the agency handed down its final decision. Millions of dollars were spent in the litigation. All the while, Mono Lake's environment continued to worsen, streams remained dry, and riparian and aquatic habitats remained unrestored.

Following the Mono case, other public-trust efforts have been launched to shift water from current uses, generally in agriculture, to environmental and recreational applications. These too typically have been very divisive, costly, and long-lasting.[49]

A market-related response is an alternative approach for addressing conflicting public and private values as occurred in the Mono Lake case. In such a situation, rather than rejecting Los Angeles' water rights under public-trust claims, State and Federal agencies might have purchased water to restore Mono Lake's level to address public concerns. Where narrower private interests were involved, such as with individual stream fisheries, private fishing groups could have bought or leased water from Los Angeles. Organisations, such as the Oregon and Montana Water Trusts, regularly secure water from farmers in those States to maintain riparian habitats for fish and other species.

Reliance on market transactions would have the advantages of producing more information about the relative values of water for current and proposed uses, and of reducing the conflict associated with uncompensated reallocations. Extreme demands encouraged by open standing under the public trust would have been tempered by the requirement to purchase. Where no voluntary agreements on water transfers for public environmental or recreational uses were forthcoming due to bilateral monopoly conditions, eminent domain with compensation could be used for government acquisition of water. The Oregon Water Trust is an example of an organisation that relies on markets for reallocation of water.

[49] See, for example, the controversy over Friant Dam water releases: Friant Water Users Authority (FWUA) 2006, *Settlement Press Release*, http://www.fwua.org/settlment/supplemental/docs/SJRS_ final_News_Release.pdf

Actions of the Oregon Water Trust as an example of water market processes for environmental benefits

Under State laws in Oregon and some other western States, private organisations may acquire water rights by purchasing, leasing, or accepting donations for environmental applications, such as maintaining streamflow to protect fish stocks during dry periods. Once those rights are transferred from the previous water-rights owners (often irrigators) and converted to in-stream use, they must be assigned to the State and held in trust for in-stream public uses.

In Oregon, such organisations include the Oregon Water Trust, the Deschutes River Conservancy, and the Klamath Basin Rangeland Trust. All three are not-for-profit groups formed to acquire water rights to enhance river flows for ecosystem restoration. Oregon's laws permit several methods for converting existing water rights to in-stream use: standard leases, split-season leases, permanent transfers, and time-limited transfers. Split-season leases allow a water-right holder to use the water for an existing purpose, such as irrigation, for part of a year and leave the water in-stream for another part of the year.

Split-season leases were developed so that irrigators could use their water in agriculture in the spring and early summer when instream flows are high and the additional value of putting more water in-stream is low. In late summer, the second half of the irrigation season, the water right is leased for in-stream use when flows are low and the value of in-stream water to protect environmental amenities is higher. Time-limited transfers allow for the water to be reallocated for short periods, such as for short-term drought, and then reverting to its original use.[50] Funding for the organisations comes from donations from private individuals, foundations, and the State and Federal governments.[51]

The overall magnitude of these water market activities to provide environmental benefits is small, but growing. In Oregon, where there is the most activity, there were approximately 140 transactions in 2005, involving approximately 70 000 acre-feet of water annually. One-year and five-year water leases were most common.[52] The advantage of these activities is that they occur routinely, rapidly, and without contention. Further, they underscore existing property rights to water

[50] King, M.A. 2004, 'Getting our feet wet: An introduction to water trusts', *Harvard Law Review,* vol. 28, no. 2, pp. 495–534; Landry, C.J. 1998, *Saving Our Streams Through Water Markets: A Practical Guide*, pamphlet, Political Economy Research Center, Bozeman.

[51] For example, see the 2006 Annual Report for the Deschutes River Conservancy. Substantial support comes from Bonneville power administration from the Columbia River basin. The Texas Water Trust is a State agency.

[52] Oregon Water Resources Department. In 2005, there were 868 leases and 34 sales.

and thereby maintain any beneficial incentives for investment in water quantity and quality. Finally, these exchanges generate information about the value of water in environmental uses and, hence, guide water allocation and use among both irrigators and those concerned about aquatic habitats.

5.5 Concluding remarks and policy implications

There is increased interest in the assignment and enforcement of property rights and the associated use of market mechanisms to provide environmental quality. Property rights and markets are attractive because they better align the incentives of the parties directly involved for reducing environmentally-damaging externalities.

With command and control regulation, the setting is often one of extractors, harvesters, and emitters versus the state in the implementation and enforcement of regulatory policies. There are major incentives for free-riding. Little information is generated in this process to know exactly how much environmental quality to provide and at what cost. Once in place, regulations generate constituencies, creating inflexibility and, often, inefficiencies.

With markets, on the other hand, the setting becomes more collaborative because with ownership there is potential for the parties involved to capture both costs and benefits.

Self-enforcement becomes more prevalent. Ownership also identifies parties for bargaining over resource use and protection, creating the basis for trade to achieve environmental benefits. These trades provide valuable information to guide policy on the cost and value of environmental quality. And there are private incentives to invest in the resource.

Two points have been made in this paper. One is that despite the advantages of property rights and markets, they typically are not the first response to the losses of open access. Rather, they are adopted late after considerable waste has occurred. There are important resource costs of bounding and enforcement, as well as important political costs due to allocation disputes. How these conflicts are addressed by public policy can influence just how effective the property-right structure might be.

The second point is that broadening the scope of 'ownership' to include multiple and very different stakeholders can undermine the effectiveness of property regimes in providing environmental benefits. The pressure to be inclusive with common property is understandable, especially in light of the potential for public goods, such as biodiversity and other ecological services. Common property works best when

the number of parties is small, and they are in agreement on resource management objectives. Movement from these conditions, however, can lead to paralysis and ineffective measures to advance the environment. For these reasons, it may be preferable, when feasible, to define private property rights as the primary mechanism for governing resource use, but to regulate them to constrain behaviour and thereby reduce any externalities.

Two US examples are used to demonstrate these arguments: fisheries and surface fresh water. In both cases, greater reliance on property rights and markets has come slowly, with delay. Crises have been instrumental in pushing privatisation. Even so, the process has been contentious. Inclusive common property, such as creation of regional fishery management organisations in fisheries and emphasis on the public trust doctrine in water either have or are likely to have limited effectiveness. Costs and benefits are not internalised individually in either case and there are no bases for private negotiations to provide environmental benefits. There may be cases where common property is optimal, but the tradeoffs between greater inclusion and higher decision-making and enforcement costs must be considered in policy debates.

To conclude, there are growing institutional options to meet the increased demand for improved environmental outcomes. Property rights and markets are a key part of that menu. By sharpening incentives, reducing externalities, establishing trading opportunities, where they are feasible, private property rights and markets can promote the provision of environmental and natural resource benefits more smoothly, rapidly, and at lower cost than command and control regulation. And they may be superior to common-property regimes where the number of parties is large and heterogeneous. These insights are likely to be helpful in the design of policies as worldwide environmental and natural resource values rise.