

Land use, environmental change, and sustainable development: the role of institutional diagnostics

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Abstract: Although the “tragedy of the commons” is common currency in popular accounts of problems arising in human–environment relations, empirical research has shown that common-property systems do not always lead to tragic outcomes. Moreover, systems of private property or public property, often proposed as solutions to the tragedy of the commons, can generate tragedies of their own that are equally severe. The challenge we face is to develop strategies for avoiding these tragedies featuring structures of property rights that are most likely to lead to sustainable outcomes in specific situations ranging from local communities reliant on the harvest of renewable resources to the global system facing the prospect of climate change. Successful governance systems typically involve regulatory, top-down strategies, normative, bottom-up strategies, or some combination of the two. What is needed to achieve sustainable results is a diagnostic approach that matches institutions to specific biophysical and socioeconomic conditions in contrast to an ideological approach that advocates the application of one system of property rights to all situations.

Keywords: Bottom-up strategies, common property, governance, institutional diagnostics, normative, private property, public property, regulatory, the “tragedy of the commons”, institutions, top-down strategies

Acknowledgement: My thinking about the issues discussed in this article has benefited from a long-running dialogue involving those like Elinor Ostrom who analyze human–environment interactions in micro-level or local settings and those like myself who explore such matters in macro-level or global settings.

I. Introduction

Elinor Ostrom's seminal book entitled *Governing the Commons* (Ostrom 1990) together with the remarkable stream of research on this topic that has ensued over the last 20 years constitutes a major landmark in the study of human–environment relations. Anchoring assessments in empirical research on small-scale societies, the scholarly community has been able to demonstrate convincingly that what we know as the “tragedy of the commons” (Hardin 1968) is not an inevitable outgrowth of the existence of common property arrangements, even in situations involving common pool resources (McCay and Acheson 1987; Berkes 1989; Ostrom et al. 2002; Ostrom 2005). Ostrom has been an active participant as well in a lively discussion of the issue of scale in this realm or, in other words, the extent to which findings derived from the study of common property arrangements in smallscale societies also apply to larger systems all the way up to the global level and vice versa (Young 1994; Keohane and Ostrom 1995; Ostrom et al. 1999; Dietz et al. 2003; Young 2005; Ostrom 2007). Taken together, these contributions add up to one of the richest and most sophisticated streams of analysis that those interested in governance have produced in the postwar era.

At an even deeper level, Ostrom's contributions address the role of systems of property rights and more generally social institutions as determinants of the course of human–environment relations. Here, interest focuses not only on the problem of avoiding the tragedy of the commons in situations involving common property arrangements but also on the effects of alternative systems of property rights (e.g. private property, public property) in efforts to steer human societies toward socially desirable outcomes (e.g. sustainability) and away from undesirable outcomes (North 1990). This opens up the prospect of comparing and contrasting the effectiveness of several distinct families of property rights in addressing the great issues of our times in the realm of human–environment relations (e.g. climate change, loss of biodiversity, overfishing, desertification). In the process, Ostrom and others working in this field have made profound contributions to the way we think about the nature of governance – in contrast to government – and its role in guiding human affairs (Ostrom 1990; Rosenau and Czempiel 1992; Young 1997; Delmas and Young 2009).

In this article, I seek to contribute to this stream of analysis through a comparative analysis of the consequences of common property, private property, and public property as institutional arrangements governing human–environment relations. The literature spawned by the work of Hardin and those who have followed in his footsteps conveys the impression that common property systems typically generate tragic outcomes but that the prospect of tragedies occurring in situations featuring private property or public property is a lesser concern. In this article, I argue that we need to consider the gap between the ideal and the actual more generally and to recognize two additional tragedies – the tragedy of private property and the tragedy of the public domain – that parallel the tragedy of the commons, though each has its own logic (McCay and Jentoft 1998). There is no

a priori way to determine which of these tragedies is most severe as measured in terms of social welfare or various other conceptions of the common good and, for that matter, which of the tragedies is the easiest to avoid in specific situations. Nonetheless, there is a compelling case to be made for the proposition that the tragedies of private property and the public domain are every bit as worrisome from the perspective of social welfare as the tragedy of the commons, especially as we endeavor to achieve sustainability in an era of globalization and global environmental change.

If this argument is correct, how should we respond to the triple threat of these tragedies both in general terms and with particular reference to patterns of land use, an area that Ostrom has chosen frequently as a domain of concern in her applied work (Moran and Ostrom 2005)? Is there a way out of each of these tragedies that is compatible with the pursuit of sustainability in today's world? I argue that two main types or families of solutions merit particular attention as we strive to navigate safely in this realm and to avoid ending up on the horns of a dilemma that leaves us paralyzed. One family of solutions is regulatory and top-down in character. Societies can devise systems of rules that impose prohibitions or requirements on the actions of users of natural resources and ecosystem services and proceed to promulgate the regulations needed to move these rules from paper to practice. The other family is more normative and bottom-up in character. It directs attention to normative constraints that emerge in the form of social practices.

Is one of these families of solutions preferable to the other? I argue that there is no general answer to this question. The advantages and disadvantages of emphasizing regulatory, top-down strategies and normative, bottom-up strategies will vary from one situation to another. In the typical case, we are likely to find that it makes sense to employ some mix of the two. The interesting challenge, then, is to identify and explore conditions prevailing in specific situations that determine what combinations of strategies are likely to be most effective, most efficient, and most equitable from the perspective of society as a whole as well as in terms of the welfare of the individual members of society. The result is what both Ostrom and I have described as a diagnostic approach to the governance of human–environment interactions (Young 2002: Ch. 7, 2008; Ostrom 2007).

2. Three tragedies

Merriam-Webster's *Collegiate Dictionary* (Mish 1993, 1251) defines a tragedy as "... a serious drama typically describing a conflict between the protagonist and a superior force (as destiny) and having a sorrowful or disastrous conclusion that excites pity or terror." Though human–environment relations are not often framed in these terms, there is something apt in this definition. It suggests the occurrence of processes that are beyond the control of individual participants and that somehow move inexorably toward unhappy outcomes. As I argue in this section, the tragedies of private property and of the public domain share this

unfortunate dynamic with the tragedy of the commons. But the exact mechanisms leading to the unhappy outcomes with respect to sustainability differ from one type of tragedy to another.

2.1. The tragedy of the commons

Almost everyone has heard about the tragedy of the commons. Understood intuitively for centuries by users of natural resources, this collective-action problem was formalized in the 1950s in seminal papers by Gordon (1954) and Scott (1955) drawing on examples pertaining to open-to-entry fisheries and popularized by Hardin in his *Science* article introducing the phrase “The Tragedy of the Commons” (1968) and highlighting examples relating to cattle grazing on common pasture land. In its simplest terms, the tragedy occurs because rational users thinking in individualistic terms lack incentives to contribute to the common good and, as a consequence, act in ways that lead to the depletion of fish stocks, the degradation of grazing lands, the destruction of forests, the onset of climate change, and so forth leaving all members of the user group with outcomes that are inferior to what they could have obtained by acting in a cooperative manner. According to Hardin and many others, avoiding the tragedy requires restructuring the commons either through privatization or through the incorporation of the resources in question into the public domain (Baden and Noonan 1998).

Two different stories about the behavior of individuals involved in such situations provide insights into the dynamics of the tragedy. One follows Hardin’s grazing example in which the problem arises from the fact that each user receives the full benefit of adding one more cow to the common grazing area but incurs only a fraction of the resultant costs to the group as a whole. If each member of the group reasons this way, free riding becomes the norm and the tragedy occurs. The other story features the individual appropriator of the next fish or the next tree who assumes that any he leaves will be taken by other members of the group and who therefore has no incentive to leave units of the good to ensure regeneration or the sustainability of the good over time. These stories help us to understand the motivations and the reasoning of individual members of the group. But it is also worth noting that both situations can be represented in a fairly straightforward way as instances of the game-theoretic model known as prisoner’s dilemma (Hardin 1982). The critical insight arising from this observation is that the players engaged in such interactions have what are known in game theory as dominant strategies or strategies that are preferable regardless of the choices of others. On this account, they will always select the “defect” option in contrast to the “cooperate” option, despite the fact that collective outcomes under these conditions will be Pareto inferior or, in other words, worse for all parties concerned than at least one other feasible outcome.

This is what leads analysts like Hardin to call for privatization or the enlargement of the public domain as a means of avoiding the tragedy. But it is now well-established that these are not the only options available to members

of a group seeking to avoid the tragedy of the commons. Empirical work in this field has turned up numerous cases in which the existence of common property arrangements does not lead to the tragedy, as well as other cases in which the tragedy does occur in the presence of common property. This obviously leads to questions about conditions that are either necessary or sufficient to prevent the occurrence of the tragedy and about conditions that encourage or discourage the occurrence of the tragedy. Those who think about this subject in collective-action terms tend to emphasize factors like the articulation of well-understood rules, transparency regarding the behavior of users, the development of inspection procedures, and the availability of graduated sanctions to impose on violators as keys to success.¹ Those who think in social-practice terms, by contrast, emphasize factors like cultural norms, belief systems, socialization, and what are known as habits of obedience (Young 2002). For their part, those who look at the world through a lens in which the individual is the product of the collectivity rather than vice versa are apt to take the view that the mechanism alleged to give rise to the tragedy is suspect (Wendt 1987; Young 1999; Agrawal 2005).

2.2. The tragedy of private property

Many practitioners and analysts have sought to solve the tragedy of the commons by means of privatization. Once we substitute the rights of owners of private property for the preexisting rights of common property ownership, on this account, incentive structures will change, and users will take steps to conserve living resources and to harvest them in a sustainable manner rather than depleting or degrading them. The logic of this argument is clear and quite simple (Dales 1968). Following privatization, owners/users will take an interest in regulating their harvesting practices to maximize returns over time, since they can now assume that whatever they leave in the current time period will not be scooped up by others. To be concrete, they will have incentives to limit their take of fish or to restrict their harvest of trees in the interest of achieving sustainable yields over time. Since they will pay the full costs arising from adding another cow to a finite pasture, they will not only have to confront declining marginal returns but also to think about how to maximize their own income streams over time, taking into account expectations about future harvests as well as their personal discount rates regarding time. Proponents of this line of thinking take the view that all we need is action on the part of some public authority or government to restructure property rights to expand the scope of private ownership, after which the force of individual rationality will take over and move the system toward sustainable outcomes. Once the shift in property rights is institutionalized, the solution to the problem will follow.

¹ Ostrom herself has identified eight “design principles” or conditions that can be regarded as necessary to ensure that common property arrangements do not give rise to the tragedy of the commons (Ostrom 1990, 90).

Yet, as the literature on market failures makes clear, things are not quite so simple with regard to the benefits of privatization (Wolf 1988; Buchanan and Musgrave 1999; Stone 2002). Among the forms of market failure most relevant to understanding human–environment relations, three stand out: (i) killing the goose that lays the golden egg, (ii) failing to consider non-market values, and (iii) ignoring the impacts of unintended side effects. Together, these problems can lead to tragedies of private property that are just as worrisome from a societal perspective as the tragedy of the commons.

The mechanism known as killing the goose is simple (Fife 1971). In those cases in which it is profitable for owners to use up a resource completely and then to invest the proceeds in some other goods or services, it makes sense from the point of view of the utility-maximizing owner to consume the resource in its entirety. Clear cutting of trees, especially in cases where the denuded land can still be sold to developers at a profit, often conforms to this logic. The owner cuts all the trees, markets the timber, invests the proceeds in some alternative sector featuring a higher rate of return, sells the land itself for some purpose like farming or residential development, and is happy with the outcome. This strategy will be particularly appealing in cases where the resources in question grow or develop slowly, the owner has a high rate of discount with respect to time, there are investment options that seem likely to produce higher rates of return, and there are few if any public regulations regarding the destruction of the resource itself. The most malleable of these conditions will often be the one involving regulations, so it is understandable that non-owners in such situations often lobby vigorously for the development of such behavioral restraints as a means of avoiding the destruction of natural resources or the degradation of ecosystem services. But recognizing the need to pursue this option is to acknowledge that privatization by itself is far from being a solution to all our problems.

Privatization also favors those values that can be commodified or made marketable relatively easily and inexpensively. Consider a forest in this light. Forests produce a variety of wood products that are typically easy to sell in well-developed markets. But forests also produce a range of other goods and services, including subsistence resources, habitat for wildlife, protection against soil erosion, recreational opportunities, spiritual experiences, storage for carbon dioxide, tourist attractions, and other ecosystem services (MEA 2005). However, many of these values will be harder to commodify and therefore more difficult to subject to the forces of supply and demand in market interactions than conventional wood products. Private property arrangements, in such settings, provide owners with incentives to favor some uses of forests (e.g. the production of timber or pulp) at the expense of others (e.g. ecosystem services). The result, again, is a practice that is costly to society, even though it makes sense from the perspective of the rational owner. It is possible to alter the behavior of owners either by demonstrating ways to make a profit from non-consumptive uses of forests or by developing regulations or social practices that impose restrictions on consumptive

uses. But the costs of doing so are often high – especially in areas where illegal logging is a major source of revenue to individual players in the system – and it is not easy to see how individual citizens can muster the influence needed to make this happen. The way to achieve such changes in many cases will be through the development and implementation of public policies, a fact that brings us back to the observation that privatization by itself does not provide a straightforward solution to the concerns of those worried about the tragedy of the commons.

Equally important are the unintended side effects of using private property for any number of purposes. Whereas commodification is about the choices that owners make regarding alternative uses of their own resources, unintended side effects or externalities have to do with impacts on the welfare of others flowing from choices about the use of resources. Sometimes, the consequences occur on a small or local scale. The owner who clear cuts a stand of trees may leave a mess that the neighbors find unsightly or that triggers erosion engendering negative consequences for owners of adjacent lands. Increasingly, externalities are contributing to largescale environmental effects that are already costly to society and that are destined to become even more costly. The destruction of forests, for example, accounts for some 15–20% of carbon dioxide emissions and therefore constitutes an important force in the dynamic of climate change. The destruction of wetlands can have the unintended effect of driving species extinct. The clearing of coastal mangrove forests leaves nearby communities more vulnerable to storm surges and the impacts of tsunamis. What was once a relatively smallscale matter largely affecting the well-being of neighbors or those in close proximity has become a global concern, and there is no way to come to terms with the problem without imposing restrictions on the behavior of owners or users of private property. No one likes regulations that are introduced specifically to constrain or limit their activities. But so long as private property remains a widespread system of rights governing human–environment relations, rising interdependencies among the members of society will dictate the need to find ways to impose increasingly restrictive rules limiting the freedom of owners of private property to do as they please regarding the use of their property.

2.3. The tragedy of the public domain

This leaves public ownership supplemented perhaps with the use of the idea of the public trust as an option for managing human–environment relations in a sustainable manner. Public ownership of land and natural resources is surprisingly widespread, even in America where the ideal of private property is accepted as a social principle. The US federal government alone owns almost a third of the nation’s land, including over 80% of Nevada and about 60% of Alaska (Dombeck et al. 2003). Historically, the federal government adopted and implemented policies predicated on the desirability of transferring the public domain into private hands through a variety of measures, such as the Homestead Act of 1862 and the General Mining Act of 1872, that established straightforward procedures for privatizing

land and natural resources belonging to the government. Today, a sizable fraction of the remaining public lands are designated for specific purposes (e.g. parks, fish and wildlife refuges, national forests), and some of these lands are subject to a wilderness overlay that imposes sharp restrictions on the activities of human users.² Even so, several hundred million acres of federally-owned lands remain in the general public domain and are managed on the basis of what is known as the principle of multiple-use.

The idea of the public trust grew up to provide governments – initially state governments in the American system – with the authority to manage human uses of areas or resources not subject to ownership in the usual sense of the term but affected by the activities of a variety of users (Sax 1970; Osherenko 2006). The most prominent examples include coastal waters – managed by coastal states out to a three mile limit – as well as navigable waterways, such as the Mississippi River or the Great Lakes. These areas are not part of the public domain; they are not considered property in any ordinary sense of the term; the government is not authorized to transfer them into the hands of private owners. But they are of interest to many users, and they are subject to various kinds of degradation in the absence of some system of rules designed to govern the activities of users.

One of the most important changes in management authority during the last century was the formalization of Exclusive Economic Zones (EEZs) under the terms of the 1982 UN Convention on the Law of the Sea granting coastal states jurisdiction over human activities out to a limit of 200 nautical miles from the coast and encompassing some 10–12% of the world's oceans (Ebbin et al. 2005). Coastal states do not own their EEZs in the same sense that they own the public domain. The rationale for public management of these resources stresses the need to develop systems of rules and decisionmaking procedures to govern their use by humans and to protect them from the destructive consequences of unregulated human actions. Many now wonder whether it would be sensible to extend the reach of this way of thinking to cover other biophysical systems that are important to human welfare, such as the Earth's climate system.

This leads to a range of questions concerning the extent to which public property (or public stewardship) is less likely to be affected by disruptive or destructive practices than common property or private property. Lumping these questions together leads to the following general query: Is there a tragedy of the public domain that parallels the tragedy of the commons and the tragedy of private property? Those who have thought about what we now often characterize as government failures have identified a number of major concerns in this area (Wolf 1988; Mitchell and Simmons 1994; Winston 2006). Among those most relevant to the tragedy of the public domain, three stand out: (i) the occurrence of gridlock resulting from a breakdown of policymaking processes and eventuating

² Designating public lands as wilderness is an overlay in the sense that it adds restrictions on their use over and above the restrictions already in place.

either in paralysis or unhelpful compromises, (ii) corruption in the form of the activities of special interests, iron triangles and lobbyists leading to subsidies, tax breaks, and a host of other outcomes favoring the interests of certain user groups, and (iii) the onset of institutional arthritis that eventuates in an inability to respond to emerging problems in a nimble fashion, to engage in adaptive management, and to address longer-term issues in a timely manner.

Although it occurs in all political systems, gridlock is particularly pervasive in policymaking processes – like those prevailing in the US – that feature more or less elaborate systems of checks and balances (Klyza and Sousa 2008). A common result both at the legislative level and at the administrative level is paralysis attributable to the fact that many players or coalitions of players are able to form blocking coalitions but few are in a position to form winning coalitions (Tsebelis 2002). Perhaps the most common outcome in such situations is a strong preference for the status quo, whether or not this is conducive to the pursuit of sustainability. A dramatic example is the inability of the US Senate to ratify the 1982 UN Convention on the Law of the Sea, despite the fact that it has had the backing of both Republican and Democratic presidents and is favored by a sizable majority of senators. The alternative, in many cases, is the development of complicated compromises that work in political terms but are problematic in terms of their consequences for human–environment relations. A particularly prominent case in the US is the regime for marine fisheries which phased out and eventually eliminated foreign fishing in American waters as a necessary condition for avoiding overfishing, but then turned around and provided financial incentives for a rapid growth in fishing power on the part of American fishers (Young 1982).

Policies that have the effect of subsidizing interest groups desiring to use the public domain are common at both the legislative level and the administrative level. In the American case, for instance, farmers in the West benefit from subsidized water; ranchers grazing cattle on the public domain are allowed to pay below market prices; loggers enjoy the fruits of below cost timber sales in the national forests; producers of oil on public lands are granted a depletion allowance, and many consumers around the country receive relatively cheap electricity resulting from federally funded and administered projects like the Tennessee Valley Authority. There are even federal agencies, such as the Bureau of Reclamation, whose existence is predicated on the argument that the federal government should both develop and pay for largescale infrastructure (e.g. large dams) for the benefit of various user groups. There are a number of explanations for this phenomenon, including the character of the American system of campaign financing, the effects of the committee system in the US Congress, the emergence of so-called iron triangles in which those in charge of congressional committees and administrative agencies and representatives of the interests of influential stakeholder groups form lasting and mutually supportive relationships that make it difficult to change course regarding policies that are outdated and inappropriate from the perspective of sustainability (Wilkinson 1992).

Institutional arthritis is largely a function of age. Unlike gridlock, which results from the inability to create winning coalitions, arthritis results from the entrenchment of defenders of the status quo in legislative settings and the ossification of bureaucracies responsible for the implementation of policies (Olson 1982). The result is a form of path dependency leading to the perpetuation of the status quo regardless of the consequences for sustainability. Although there is always an element of politics in such matters as well, the inability of both Congress and the relevant administrative agencies (e.g. the Environmental Protection Agency) to make progress in addressing emissions of greenhouse gases, for example, owes a good deal to the resultant sluggishness of the system. This problem is particularly acute when it affects matters, like climate change, in which the occurrence of tipping points can precipitate abrupt changes that require nimbleness and a capacity to engage in adaptive management on the part of those responsible for making and implementing policies affecting human–environment relations. Under the circumstances, we face a dilemma in which a rising need for governance for sustainability is paired with a declining capacity to address such challenges resulting from institutional arthritis as well as policy gridlock and the ability of a variety of groups to protect their interests (Delmas and Young 2009).

2.4. The tragedies compared

Is one of these tragedies more common, more severe, or more difficult to cope with than the others? There is no straightforward metric available for use in comparing and contrasting the consequences of the three tragedies. Still, three observations may help to put this issue in perspective and to organize our thinking about the subject.

The first is that none of the tragedies is purely dichotomous in the sense that it occurs in its pure or most severe form or does not occur at all. Users of common property may experience partial success in their efforts to devise rules to limit or govern the use of the resources in question. Regulatory systems created to limit unintended side effects arising from the actions of owners of private property may be more or less effective. The severity of the problems of gridlock and institutional arthritis affecting efforts to manage uses of the public domain will vary from one political setting to another and from one time to another. To make judgments regarding the relative severity of the three tragedies, therefore, requires a focus on the extent or intensity of each tragedy under real-world conditions rather than limiting ourselves to all-or-nothing projections. There is nothing surprising about this. Ideal types (e.g. the game-theoretic construct known as prisoner's dilemma or the Coasean world of zero transaction costs) that are useful in exposing the fundamental character of problems like the tragedy of the commons typically do not map onto real-world situations perfectly. This does not eliminate the value of these ideal types. But it does mean there is a need to proceed with caution in moving from the analytic world of the ideal types to the empirical world of concrete conditions.

A second observation is that the impact of each of the tragedies in real situations is a function of the nature of the problems involved. When common property arrangements lead to the extinction of harvested species or the disruption of large marine or terrestrial ecosystems, for instance, the consequences are particularly severe from the perspective of sustainability. Much the same can be said about situations in which greenhouse gas emissions occur as unintended byproducts of the use of private property for legitimate purposes. Similar remarks apply to the destruction of large terrestrial ecosystems that are part of the public domain or large marine ecosystems subject to public management. Conversely, there are situations in which the consequences of each of the tragedies are modest or limited in both space and time. It follows that it is pointless to argue about the relative severity of the three tragedies in generic terms. Each tragedy can generate impacts that are severe under a variety of conditions. What is needed, in this connection, is a consideration of solutions to all three tragedies rather than more arguments about reasons to favor private property over common property, the public domain over private property, and so forth.

The third observation has to do with framing. In many cases, there is scope for choice in the framing of real-world problems involving human-environment interactions. It is perfectly plausible to treat the Earth's climate system, for example, as a largescale commons that humans use as a repository for wastes, such as carbon dioxide and other greenhouse gases, in a manner that gives rise to the dynamic of the tragedy of the commons. An alternative view is that the emission of greenhouse gases into the Earth's atmosphere is, for the most part, a matter of unintended side effects that are byproducts of activities (e.g. heating buildings, driving cars) that constitute legitimate uses of private property. Yet another view starts from the premise that the Earth's climate system is or should be subject to the public trust doctrine, a way of thinking that leads to the conclusion that the buildup of greenhouse gases in the atmosphere is for all practical purposes a tragedy of the public domain. Is one of these formulations correct or preferable in some way to the others? The answer to this question may be more a matter of the character of the prevailing social and political setting than a question of the objective characteristics of the relevant biophysical systems. Societies differ substantially with regard to their ability to devise effective rules governing the use of common property, to compel private actors to internalize externalities, or to promulgate effective regulations justified as exercises of the public trust doctrine. It follows that the appropriate framing of problems involving human-environment interactions can and often will be at least as much a function of prevailing sociopolitical conditions as it is a matter of the characteristics of the biophysical systems involved.

3. Avoiding the tragedies

How can we manage human-environment relations to avoid these tragedies or at least to catch them at an early stage and take steps to head off their worst effects?

The first thing to notice in responding to this question is that each of the tragedies is a direct outgrowth of human behavior and especially human behavior occurring in settings featuring interactive decisionmaking or, in other words, choices in which the outcomes or payoffs for each member of the relevant group are determined in part by the choices that others make (Schelling 1978).

Two additional remarks will help to clarify both the growing importance of governing behavior that produces these tragedies and our limited expertise in dealing with such matters, especially on a large scale. So long as human actions were relatively small factors in the dynamics of ecosystems, the tragedies under consideration here could be treated as somewhat marginal concerns. Subsistence users might exhaust a local fish stock or deplete the supply of game in a limited area, but they could not disrupt biophysical systems on a large scale. Now that human actions have burgeoned into a pervasive force leading to the emergence of human-dominated ecosystems on a global scale and triggering the onset of a new era often called the Anthropocene (to differentiate it from the Holocene), however, the potential consequences of the tragedies are enormous, raising concerns for the future of the planet's life support systems like the Earth's climate system (Vitousek et al. 1997; Crutzen 2002; Steffen et al. 2004). In addition, the rapid growth in the population of humans inhabiting a finite Earth has increased interdependencies among humans on a global scale. Whereas the effects of human actions were once largely local, they are now global. Emissions of greenhouse gases anywhere on the planet, for instance, contribute to the systemic problem of climate change and variability. The speed with which these developments have occurred has limited opportunities for societal learning regarding the options for governing human-environment interactions. In effect, the capacity of humans to generate the tragedies under consideration here has outrun knowledge of effective ways to head them off or to catch them at an early stage before they become costly and even irreversible.

What can we do to prevent these tragedies from occurring or to alleviate their impacts once they do occur? Many responses to this question are possible; they have been acted on with varying degrees of success in a wide range of real-world situations. As Ostrom has emphasized in her recent work, there are no panaceas in the sense of simple prescriptions that will allow us to avoid the tragedies of common, private, and public property (Ostrom 2007). The success or effectiveness of specific solutions is normally determined by a combination of conditions occurring in real-world situations.

Just as it is useful to draw analytic distinctions among the three tragedies, however, it is helpful to draw distinctions among broad categories of responses to these tragedies. In this section, I draw attention to two families of strategies for avoiding tragedies in human-environment relations. One family, encompassing what I will call regulatory, top-down strategies, features rule-making on the part of those authorized to make decisions for the collectivity coupled with implementing regulations applicable to all members of the community. The second strategy,

including what I will describe as normative, bottom-up strategies, features norms governing behavior that arise as social practices and spread to encompass all members of the community. Let me observe at once that these families of strategies are not mutually exclusive. Complex combinations can and do flourish in many real-world settings. Still, the two sets of strategies point to distinct mechanisms for influencing human behavior, and it seems helpful to explore the differences and to comment on their efficacy in the context of human–environment interactions.

3.1. Regulatory, top-down strategies

A major insight flowing from the work of those who study common property arrangements in smallscale social settings is that groups of users are often able to make explicit and sophisticated rules governing the actions of individual users/appropriators that prove effective as mechanisms for avoiding the tragedy of the commons. These analysts have produced a large body of research exploring the formulation and implementation of such rules in a variety of biophysical and socio-cultural settings. The general message is clear. Many, but by no means all, human groups have demonstrated an ability to adopt rules of use, to articulate them in operational terms, to induce their members to comply with these rules most of the time, and to adjust the rules in the light of biophysical changes and technological innovations occurring over time. There are no grounds for complacency here. Even communities that have succeeded in these endeavors over long periods of time can experience spectacular failures, especially when biophysical and demographic circumstances change. Biophysical variations (e.g. prolonged droughts) and anthropogenic developments (e.g. population shifts, changes in lifestyles, technological advances) can disrupt regulatory, top-down solutions in short order. Still, the evidence collected from many settings provides some grounds for optimism regarding this strategy for avoiding the tragedy of the commons.

Regulatory, top-down strategies have achieved particular prominence in efforts to avoid the tragedy of private property. Rules and regulations applicable to the behavior of owners of private property have grown at a rapid pace in modern societies. The resultant restrictions place limits on most activities of interest to owners of private property ranging from agricultural uses to commercial and residential uses. Many now find these restrictions so burdensome or onerous that they engage in organized efforts to roll back a variety of applicable restrictions through political action. Their battle cry is: “get government off our backs”. A particularly important movement of this sort in the United States centers on the idea of “regulatory takings” and pushes for measures to cut back sharply on regulations imposed on property owners or alternatively to force governments at various levels to compensate owners for resultant losses of value under the terms of the takings clause of the 5th amendment to the Constitution (Epstein 1986). Battles over such issues seesaw back and forth in both legislative and judicial settings. There is little reason to believe that any dramatic reduction in rules and regulations applicable to the activities of owners of private property will

occur during the foreseeable future. Yet these battles do serve to make clear that regulatory, top-down solutions do not constitute a panacea with regard to efforts to avoid the tragedy of private property.

Many analysts have identified the establishment of public property as a possible solution to both the tragedy of the commons and the tragedy of private property. And there certainly are cases (e.g. the establishment of the Great Barrier Reef National Marine Park in Australia or the creation of the system of wilderness areas in the US) in which public action has made a real difference (Nash 1982; Day 2002). There is no shortage of rules and regulations developed to govern various uses of the public domain. But overall, it is clear that inclusion in the public domain in the case of terrestrial systems or coverage under the public trust doctrine in the case of aquatic, marine, or atmospheric systems offers no guarantee that tragedies will not occur. Even in the US, which has a highly developed system of public land law, publicly owned grazing lands are degraded, forests are mismanaged, mineral deposits are exploited in a destructive manner, and wetlands are damaged or destroyed. When it comes to societies (e.g. the former Soviet Union) in which most of the country is included in the public domain, environmental catastrophes on a vast scale (e.g. the destruction of the Aral Sea) occur with some frequency (Kasperson et al. 1995). The point is not to argue that regulatory, top-down strategies are bound to fail as mechanisms for avoiding or limiting destructive uses of the public domain. There are many examples of successful regulatory systems designed to protect the public domain or areas subject to the public trust doctrine. Still, the tragedy of the public domain is just as resistant to regulatory, top-down strategies as the tragedy of the commons and the tragedy of private property in many settings.

3.2. Normative, bottom-up strategies

Assertions of rights are a prominent feature of modern societies. Social movements dedicated to securing human rights, civil rights, workers' rights, women's rights, children's rights, indigenous peoples' rights, patients' rights, and even the rights of animals and trees are influential features of the contemporary landscape. Much less is heard in these debates about the role of duties and obligations. Yet duties and obligations constitute the flip side of rights. Just as rights create entitlements for the occupants of various roles (e.g. citizen, worker, woman, and so forth), duties and obligations impose social responsibilities on the occupants of these roles (e.g. parent, student, employer, pet owner) (Hohfeld 1913, 1917).

Applying this logic to systems of property rights can help in identifying solutions to the tragedies. Bundles of private property rights, for instance, usually include rights to use property as the owner sees fit, to exclude others from using the property, and to transfer title to the property under a variety of circumstances. The duties or obligations associated with the ownership of private property, on the other hand, may include a range of normatively grounded responsibilities, including the duty to avoid actions that are unduly harmful to the neighbors or

the obligation to contribute to the common good through the payment of property taxes. In some societies, property duties are absorbed into common law through the articulation of ideas like the nuisance doctrine, giving rise to top-down strategies much like those considered in the preceding subsection. Fundamentally, however, the idea of a duty is normative in character. Whereas one complies with a rule as a result of some calculus concerning the prospect of public sanctions, one fulfills a duty because it is the right and proper thing to do under the terms of social norms prevailing in the relevant socio-cultural setting. Those who refuse to comply with rules are violators who are subject to a variety of sanctions at the disposal of public agencies or other authorized actors. Those who shirk their duties or obligations, by contrast, become outcasts or pariahs who are subject to various forms of opprobrium (e.g. guilt, shame, or, in extreme cases, ostracism) embedded in social or cultural systems. Of course, this distinction is analytic in character. Duties may be absorbed and codified in legal systems. Rules may become matters of custom backed by social norms. In thinking about solutions to the tragedies discussed in this article, however, it seems helpful to make use of this analytic distinction in order to pose questions about the extent to which normative, bottom-up solutions in contrast to regulatory, top-down solutions can make a difference in avoiding or ameliorating the various tragedies.

The evidence suggests that normative, bottom-up solutions are an important part of the story, especially in smallscale traditional societies in which common property arrangements are prominent. Users of common property in such settings are apt to be able to interact with one another on a face-to-face basis, a condition that facilitates the development of guilt and shame as mechanisms for ensuring compliance with norms regarding the use of common property. The actions of individual users are often transparent in such settings, and cultural mechanisms like taboos, respect for animal spirits, and long-standing cultural norms about harvesting practices can play prominent roles in guiding the behavior of individual users. Of course, changing circumstances can erode the effectiveness of social norms that act to restrict the behavior of actors in normal times. Prominent examples are occurring today in areas like the Arctic where subsistence harvesters find longstanding practices relating to human interactions with animals falling prey to the impacts of climate change. Even so, it is evident that normative, bottom-up solutions are important factors in the ability of smallscale societies to regulate human-environment interactions in a sustainable manner.

Is there a role for normative, bottom-up solutions in efforts to avoid the tragedy of private property? As a broad generalization, it seems fair to conclude that the flood of recent literature on the advantages and disadvantages of various forms of private property has drawn our attention more to rights treated as entitlements of ownership than to the duties or obligations of owners. This may have something to do with the facts that modern societies, especially those operating in North America, have spawned myriad groups held together by a common interest in claiming and exercising rights and that, at the same time, the steady growth of

restrictions on the freedom of rights holders to do as they please in exercising their rights has triggered increasingly vociferous complaints among various groups of rights holders. Nowhere is this more evident than in the case of owners of private property. Holders of private property rights also have more or less well-developed incentives to ignore the unintended consequences of their actions. Farmers whose agricultural practices are linked causally to the dead zone in the Gulf of Mexico, ranchers whose activities cause land degradation, and ordinary citizens whose consumptive habits contribute to the mining of reservoirs of ground water are all reluctant to acknowledge the consequences of their actions.

Still, it would be a mistake to dismiss the effects of normative, bottom-up strategies in efforts to alleviate the tragedy of private property. With all due respect to the roles that conventional command-and-control systems or newly emerging incentive systems can play in dealing with problems like habitat destruction, acid rain, or climate change, it is hard to see how to solve many of these problems without relying on the growth of informal social practices that guide the behavior of rights holders. Evidence of this phenomenon is visible in many settings. Ellickson's case study regarding the informal practices governing interactions between ranchers and residential property owners in California's Shasta County, for example, provides a limited but particularly striking example (Ellickson 1991). Although the nature of the setting is vastly different, some such mechanism is also reflected in Principle 2 of the 1992 Rio Declaration which not only asserts that states have a right to exploit their natural resources according to their own preferences but also imposes a duty on them to avoid doing so in a manner that causes undue harm to their neighbors in the process.

Is there a role for normative, bottom-up solutions in avoiding or ameliorating the tragedy of the public domain? Such mechanisms may lack credibility, at least in modern societies that have made a point of replacing informal practices in the public sector with formal rules that are thought to be more advanced and more subject to deliberate design on the part of policymakers than traditional systems relying on customs, taboos, and so forth. In the US, for instance, public land law is formalized to a high degree and, at least according to its proponents, based on sophisticated and up-to-date science. Still, it is evident that such systems for managing human-environment relations lead repeatedly to subsidies for inefficient uses of water, below market value sales of timber, habitat destruction resulting from clear cutting, severe depletions of fish stocks, and so forth. At the same time, administrative agencies responsible for managing various parts of the public domain regularly develop informal practices or cultures that have far-reaching consequences for the practice of stewardship regarding the public domain, though they are not prescribed in formal policies. The resultant norms, often embedded in standard operating procedures or SOPs, can lead to biases in practices regarding the claims of user groups, and they are apt to be difficult to adjust easily or quickly to changing circumstances. But it would be cavalier to dismiss the option of turning to normative, bottom-up strategies reflected in agency cultures as a means

Table 1: Solution strategies to tragedies of common, private, and public property

		Solution strategies	
		Regulatory, top-down	Normative, bottom-up
Types of tragedies	Common property	Communal rules	Social practices
	Private property	Public regulations	Private governance
	Public property	Legislative oversight	Agency cultures

of circumventing the tragedy of the public domain, even in modern societies that take pride in relying on rational regulatory systems.

Adding up the options discussed in this section produces a toolkit available to those seeking to avoid the tragedies of common, private, and public property (see Table 1). The take-home message is that just as no system of property rights is uniformly superior to the others in the realm of human–environment interactions, no single family of strategies can provide surefire recipes for avoiding all three tragedies. What is needed in this context is a diagnostic approach that endeavors to match strategies to the circumstances at hand in specific situations (Young 2002: Ch. 7, 2008; Ostrom 2007).

4. Conclusion

Two propositions stand out as take home messages from this analysis. It is essential to draw a clear distinction between the ideal and the actual, thereby avoiding comparisons between an ideal version of one system of property rights and real-world versions of other systems of rights governing human–environment relations. It is easy to show that ideal systems of private property and the market mechanisms they engender produce better results than those arising from the efforts of corrupt or arthritic governments. Similar observations are in order regarding comparisons between ideal common property systems and private property arrangements that ignore many values and generate severe side effects. But such arguments get us nowhere. The relevant comparisons are among the ideal versions of all three systems on the one hand and among actual outcomes arising from the different systems operating under real-world conditions on the other.

The second proposition centers on recognizing the importance of institutional diagnostics and focusing on the creation of governance systems that are designed with the major features of specific situations in mind. Just as an engineer will design a bridge to fit the needs of a specific situation and an architect will design a building to fit the needs of specific users, those interested in designing governance systems applicable to human–environment relations need to pay attention to what has become known as the problem of fit (Young et al. 1999;

Galaz et al. 2008). From this perspective it pays to have a range of options in one's toolkit. For those who think only of the virtues of private property, for instance, every situation seems like a candidate for privatization. And the same applies to those who propound the virtues of common property or public property. In the end, sustainability will emerge from the efforts of those who follow Elinor Ostrom's advice to use a diagnostic approach that allows us to go beyond panaceas (Ostrom 2007).

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