

## Ostrom for anthropologists

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**Abstract:** Elinor Ostrom has devoted much of her career to understanding the conditions under which people have incentives to conserve or over-exploit common-pool resources (e.g. oceans, air, irrigation, unowned forests and grassland). While a growing number of anthropologists have taken an interest in this critically important topic, her work is not well known to many anthropologists. This paper describes three different aspects of Ostrom's work which should be of interest to anthropologists. First is her analysis of collective action problems and the conditions under which people in local communities have devised rules and institutions to solve those dilemmas to conserve resources. Second is Ostrom's discussion and classification of the complex rules used to manage resources. Third is her analysis of four kinds of goods (i.e. public goods, common-pool resources, toll goods and private goods) and the property regimes that produce them in different combinations. Last, I outline several directions in which her work seems to be going.

**Keywords:** ADICO, anthropology, collective action, Ostrom, resource management

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### I. Introduction

*Governing the Commons: The Evolution of Institutions for Collective Action*, in the opinion of many, is the most important book published in the past few decades on the social-science aspects of resource management. Although it appeared 20

years ago, it is worthwhile reviewing because the book contains case studies, concepts, analytic methods, and conclusions that have strongly influenced social scientists interested in the social-science aspects of resource management ever since. First, I will review the analysis and conclusions of *Governing the Commons*. Second, I will discuss the ways in which the conceptual apparatus has changed in the past 20 years. Throughout the discussion, I will point out the contributions of anthropologists to the debate and what anthropologists can and have gained from Ostrom's work.

Ostrom was trained as a political scientist, but she is really a general social scientist whose work is highly interdisciplinary. She shows a refreshing willingness to use case studies, concepts, models, and methodologies from many social sciences and from history. Her work has been influenced greatly by political science and economics, but anthropological case studies and concepts from sociology and psychology are present also. Her work is of primary value to the large number of academics, government officials and legislators, and policy makers concerned with managing natural resources. She has produced an incredible amount of work, which goes in so many directions that it is difficult to summarize. But there are certain themes, commitments, and concerns that run through her work. In this paper I will focus on those seminal ideas, stressing those that I believe should be of particular interest to anthropologists.

Ostrom's work should resonate with anthropologists. Although she is a political scientist, she does not focus on governments or states in the First World, or on international relations or political philosophy. Rather she is concerned with managing the natural resources of the world, including the forests, water systems, fisheries, and stocks of wildlife found in Third World countries. Many of the systems devised to control these resources are informal and are managed by people at the local level. Ostrom shows that many of these systems can work quite well. She and her students have studied irrigation systems in places such as Nepal, the Philippines, and the Los Angeles basin (Tang 1992); forests in India, Asia, Africa, Latin America, and North America (Moran and Ostrom 2005); and fisheries from India to Canada and Maine (Schlager and Ostrom 1993; Ostrom 2008).

## 2. The management of the commons

Much of Ostrom's career is devoted to answering two questions: (1) Why are natural resources over-exploited? (2) Under what conditions are resource users and communities able to generate effective rules to manage them? Much of her work focuses on the management of common-pool resources because so many over-exploited and threatened resources fall in this category, including fish, oceans, rivers, air, and rangeland.<sup>1</sup>

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<sup>1</sup> Recently her interest has expanded to include other kinds of commons, such as intellectual resources (Hess and Ostrom 2003).

Common-pool resources are shared by groups of people. They are defined by two traits: (1) subtractability, which means that one person's use of the resource subtracts from the amount available to others; (2) difficulties excluding others from using the resource (Ostrom et al. 1994).

Managing common-pool resources poses several different problems. First, successful management must involve rules to control both entry and effort on the resource. Without rules to control entry, a common-pool resource becomes an "open access" resource, which is subjected to unrestrained exploitation that halts only when the resource is destroyed. After all, groups who appropriate resources cannot be expected to constrain themselves if the benefits of conservation go to new entrants who do not make a sacrifice to conserve the resource. Moreover, rules to control exploitation are also necessary. Those using an open access resource do not have to pay for the goods they extract. Since users of open access resources are not paying all of the costs of production, there is a tendency to overinvest (i.e. overcapitalization) in equipment to harvest the resource (Acheson 1989). This makes it possible for user groups to deplete the resource faster than otherwise would be the case.

Second, there are many different combinations of rules and strategies that can be used to govern common-pool resources. The only real constraint is that the rules devised must be congruent with the "physical environment and characteristics of the community" (McGinnis 1999: 8). This means that there are no general solutions to common-pool resource problems.

Third, it is difficult to use market solutions to govern common-pool resources (Ostrom et al. 1994: 7). The primary reason is that the subtractability of such resources means that users foist externalities on other users. As Bates (1994) points out, externalities are the primary cause of market failure. All of these factors make it difficult to devise rules to manage common-pool resources.

Ostrom's primary goal in *Governing the Commons* was to specify the conditions or circumstances leading to effective and ineffective rules to manage common-pool resources at the local level. To this end, she analyzed a number of cases where robust, long-lasting resource-management systems existed (1990), including common-pasture management in Switzerland and Japan and irrigation systems in Spain and the Philippines, along with systems that have failed (e.g. fisheries in Turkey, Sri Lanka, and Nova Scotia; and irrigation systems in Sri Lanka). She could not find specific rules that worked in a large number of cases. This prompted her to move to a higher level of generality and specify "the broader institutional regularities among systems that were sustained over a period of time" (Poteete et al. 2010: 99). The result was the design principles, which are probably the best-known ideas stemming from *Governing the Commons*. She argues that successful common-pool resource management systems of all kinds (i.e. irrigation, fisheries, forests) are characterized by eight traits: (1) well-defined boundaries, (2) proportional equivalence between benefits and costs, (3) collective-choice arrangements, (4) monitoring, (5) graduated sanctions, (6) conflict-resolution mechanisms, (7) minimal recognition by governments of the rights of local people

to organize, (8) nested enterprises (i.e. common-pool resource management units arranged in a nested hierarchy) (Ostrom 1990). This list appears in a number of other works (1999a, 2000b, 2005). The design principles have been used by anthropologists seeking to understand local management regimes (e.g. Tucker 1999). The same concern with cases of success and failure of common-pool governance shows strongly in a number of other publications (Ostrom 1992, 2003, 2008; Ostrom et al. 1999; Gibson et al. 2000).

### 3. Generating institutions to conserve resources: the problem of collective action

A concern with the generation of norms has taken Ostrom into one of the most basic issues in the social sciences – namely, how are rules generated? While the generation of rules, norms, and institutions has never been the primary focus of attention for any social-science discipline, the problem has been approached by people from virtually every social science over the course of several decades. In the 1960s and 1970s, anthropologists were making key contributions to this field with the work of Barth (1959, 1981), Bailey (1969), Heath (1976), Kapferer (1976), and Netting (1976). Since the 1970s, mainstream cultural anthropology turned to symbolic anthropology and the problem of generating norms was left to political scientists, economists, and sociologists interested in what is known as rational-choice theory and the closely related fields of institutional economics and institutional analysis and development (Cook and Levi 1990). While the “new institutionalists” have made notable progress, only a small number of anthropologists have taken an interest in the new literature on institutions (e.g. Ensminger 1992; Acheson 1994, 2003; Lesorogol 2008).

Ostrom’s contributions to this field have been summarized by the Institutional Analysis and Development framework. This model is concerned with decision making under constraints (Ostrom 2005, 2010). She is primarily interested in decisions concerning natural resources, which, she argues, are constrained by a number of factors including physical attributes of the resource and traits of human communities.

In *Governing the Commons*, Ostrom begins her analysis of the problem of how institutions are devised to conserve resources by noting that several famous analysts have different explanations for the problem and different solutions. One is Garrett Hardin, whose famous “tragedy of the commons” ultimately traces the source of resource problems to the common-property nature of the resource regime which gives a resource user an incentive “to increase his use without limit – in a world that is limited” (1968: 1244). Hardin saw the solution to tragedies of the commons as top down, autocratic management by the government.

Although the idea that open-access resources are subject to escalating abuse gained notoriety with Hardin, several economists years before had pointed out that the absence of private property rights gave people an incentive to over-exploit (Gordon 1954; Scott 1955). These economists believed that since the problem

was the absence of property rights, the solution was to establish property rights through the use of licensing, limited entry, or individual transferable quotas (National Research Council 1986).

Another conception of the problem was Mancur Olson's idea of free riders. Prior to Olson's publication of *The Logic of Collective Action* (1965), there was a consensus among social scientists that rules make it possible for human beings to coordinate their activities and achieve goals they could not achieve alone. But Olson pointed out that simply because rules bring about collective benefits is no guarantee that they will be provided. The essential problem, as he saw it, was that there is no incentive for individuals to help to produce a rule or public good since they are going to have the benefit of it regardless of whether they contributed to producing it. Since it is rational for every individual to "free ride" on the efforts of others, the public good is not produced. Everyone has acted rationally, and yet all are worse off than if they had cooperated (Ostrom 1990). For Olson the solution is to do away with free riders by imposing punishments or rewards to encourage cooperation.

Ostrom's explanation is the collective-action dilemma (1990). This is a more recent conceptualization of the problem (see Elster 1989; Taylor 1990). Collective-action problems occur when there is a divergence between the interests of the individual and those of the society. In these cases, it is not rational for individuals to cooperate, even though cooperation would bring positive results for all (Taylor 1990). In such dilemmas, rational action by the individual will bring suboptimal results or even disaster for the collectivity. One solution is to establish rules constraining the behaviour of individuals, but this can be difficult to do.

### 3.1. Collective-action problems and the prisoner's dilemma

Collective-action problems can be modeled as different kinds of games, and each game poses a different set of problems that must be overcome if the dilemma is to be solved. Elinor Ostrom generally discusses the problems posed by collective-action problems by assuming that the interaction can be modeled as a prisoner's dilemma, a game with which most social scientists have some familiarity. The reasons that prisoner's dilemmas pose such problems for those seeking to cooperate to develop rules can be seen by analyzing a hypothetical game. Ostrom uses the classical example of two criminals who have been caught by the police who separate them so they cannot talk with each other. If both cooperate with each other and remain silent, the police will not have evidence to convict them and they will both go free or get a light sentence. If they both confess (i.e. do not cooperate with each other) they both get a heavy sentence. If one confesses to the police (i.e. defects on his partner in crime) while the other remains silent, the snitch gets a very light sentence and the one who remains silent gets a very heavy sentence. Both figure that if they confess, they will get a light sentence which means the other is heavily punished. As a result, both confess with the worst of all results – heavy sentence for both – rather than the light sentences they would have received

had they cooperated with each other and remained silent. It is difficult to solve prisoner's dilemmas since both players have an incentive to defect in the short run. In the parlance of game theorists, the dominant strategy is to defect, even though all players would get higher payoffs if they cooperated. Many collective action dilemmas can be modeled as prisoner's dilemma games (Taylor 1990).

There are three different ways to solve a prisoner's dilemma. The most common solution is called repetition of play. In an infinitely played game, cooperation can emerge if players use the right strategy such as tit-for-tat or the grim trigger strategy. Another solution, fairly rare, occurs when a large or dominant player provides the rule or public good even though others are defecting. It may be rational for him or her to do this when the losses from defecting outweigh the benefits to be gained from cooperation. A third way to solve the problem is the one most analyzed by Ostrom – namely, to get rules dictating that players will not play their dominant strategy (Dixit and Skeath 2004).

Common-pool resources, including marine fisheries, present a classic collective-action dilemma. In the case of fisheries, it is in the self-interest of individual skippers to get as many fish as possible, even though a rule constraining exploitive effort would result in a healthier breeding stock, increased catches, lower prices for consumers, and a sustainable industry. In most fisheries, the conditions necessary for the generation of norms have been largely absent, with the result that large numbers of fish stocks are dangerously over-exploited. Such failures to solve the collective action problem have been documented in great detail in the literature on fisheries and common-pool resources (McGoodwin 1990).

Collective-action dilemmas have received an enormous amount of attention from social scientists, primarily because they describe so many of the most vexing problems plaguing humanity. Taylor (1990: 224) goes so far as to say that “politics is the study of ways of solving collective action problems.”

Game theorists and analysts like Olson, who Ostrom says is the primary author of the zero-contribution hypothesis (2000b), led us to believe that people will rarely cooperate to produce rules to manage resources or anything else unless very special incentives are used (Olson 1965). As Mary Douglas (1986: 29) points out, Olson assumes that people are “easily deterred from contributing to the collective good.” In fact, however, people do cooperate to manage resources all the time. Anthropologists and other social scientists have described a variety of systems that have been managed by local-level communities or groups of private citizens (Ruddle and Akimichi 1984; National Research Council 1986; McCay and Acheson 1987; Berkes 1989; Ostrom 1990, 1999a, 2000; Anderson and Simmons 1993; Dyer and McGoodwin 1994; Baland and Platteau 1996). Others are engaged in co-management, where rules to manage and enforce resource-management rules are shared between government agencies and local-level groups (Pinkerton 1989; Pinkerton and Weinstein 1995). This means that these groups have overcome a collective-action dilemma. Elinor Ostrom has made good use of these cases in analyzing the conditions under which successful and unsuccessful resource

management regimes are produced (Ostrom 1990, 1992, 1999a,b, 2000a,b, 2008; Ostrom et al. 1994, 2007; Dolsak and Ostrom 2003).

### **3.2. Solving collective-action problems: the nature of the community and the resources**

Among rational-choice theorists there is a consensus that rules to constrain individuals will improve outcomes in collective-action dilemmas. However, there is little consensus on the conditions under which such rules are generated (Taylor 1990). It is clear that people will not cooperate to produce rules or other kinds of public goods if those who do not sacrifice to produce them get most of the benefits. Curbing free riding is essential. Among earlier analysts of the problem there was a consensus that people will be able to provide themselves rules and institutions if the group is small, if people know a good deal about each other's past performances, if the game is played repeatedly, and if the rules can be enforced (Elster 1989; North 1990; Ostrom 1990; Taylor 1990; Knight 1992; Wade 1994). In such circumstances, people know who is likely to cooperate and can monitor behaviour and sanction shirkers.

Ostrom, who has done a good deal of work on cooperation to solve collective-action problems, argues that the list is much larger. She has stressed a large number of variables facilitating the production of norms and rules, including traits of the community contemplating cooperation and the nature of the resource. According to Ostrom (1999a, 2000a), communities or groups will have a higher probability of succeeding in getting norms if they are small, homogenous, have a lot of social capital, a strong sense of community, mutual trust, can change the rules, are dependent on the resource and have a low discount rate (i.e. willingness to sacrifice current payoffs for higher payoffs in the future). Ostrom is one of the social scientists who stress the importance of the discount rate (Ostrom 1990), which arguably is one of the most important variables (Kortenkamp and Moore 2006). Leadership or political entrepreneurship, which offers resources and changes people's minds about the value of the rule or public good, is also essential (Ostrom 1990, 2000b).

The nature of the resources themselves make a difference. Ostrom (1990) mentions this factor, but a more complete analysis has been done by her students who have pointed out that those using common-pool resources face different problems depending on the degree of mobility and storability of the resource. Users of storable resources that are stationary (e.g. groundwater basins) face a different set of problems in generating rules from those dealing with fugitive resources that cannot be stored (e.g. fisheries and some irrigation systems). Grazing areas (stationary and storable) pose still other problems (see Ostrom 1990; Schlager et al. 1994).

In addition to ethnography produced by field studies, Ostrom extensively uses experimental games to buttress her findings concerning collective action (see Ostrom et al. 1994). Several interesting conclusions came from this work. First,

in the baseline experiment where people could not communicate or sanction each other, there was “substantial overuse of a common-pool resource” (Ostrom et al. 1994, 283). Second, changing the rules changes the structure of the game and the outcomes (Ostrom et al. 1994). Specifically, allowing players to first have face-to-face communication, second to sanction each other, and last to make agreements concerning future allocations (i.e. covenants) increased cooperation at every stage (Ostrom 1999a). Third, it is critical to monitor to ensure compliance with rules (Ostrom et al. 1994). Fourth, sometimes behaviour and decisions are congruent with equilibria, sometimes not (Ostrom et al. 1994). Fifth, there is a lot more cooperation than would be expected based on non-cooperative game theory.

### **3.3. A revised theory of collective action: Experimental games and social evolution**

A good deal of Ostrom’s work in the late 1980s and 1990s was devoted to pinpointing the conditions under which rules arise. Her analysis at this time focused on the traits of communities and groups that had developed long-lasting governance structures to manage common-pool resources. But analysis that points to the fact that small, homogenous communities with much social capital and stationary resources are likely to develop effective resource management rules, while undoubtedly true, does not suggest how norms arise in the first place. In the past 20 years Ostrom has worked on this problem with marked success.

A number of different theories have been developed concerning the process by which norms or rules are produced, including those of Knight (1992), Lewis (1969), North (1990), and Sugden (1986). These have been put to good use by a few anthropologists interested in how norms and rules are developed (see, for example, Ensminger 1992; Acheson 2003; Lesorogol 2008).

Ostrom virtually ignores all of these explanations and has devoted considerable attention to the social-evolutionary theories that have received a good deal of attention in recent years. Such theories are based on an adaptational approach that posits that successful strategies are copied and spread, while less successful strategies are abandoned after many iterations of the game (Axelrod 1984). The result is what Ostrom terms a “Revised Theory of Collective Action” (2000b, 141).

Ostrom posits, along with many evolutionary anthropologists and psychologists interested in social evolution, that survival in the Pleistocene depended on maximizing payoffs and solving collective-action problems inherent in hunting, seeking food, and defense. Those who could recognize who was trustworthy and solved problems most effectively “had a selective advantage over those who did not” (Ostrom 1999a, 143). She accepts the idea that human beings have developed a propensity to learn norms.

Ostrom uses a couple of evolutionary approaches to understand the development of norms. One of those is the indirect evolutionary approach, which



posits that there are two types in a population: conditional cooperators (norm users) and rational egoists.<sup>2</sup> If a conditional cooperator interacts with a rational egoist, the rational egoist will win. If people have information on each others' reputation, "conditional cooperators playing a trustworthy strategy will more frequently receive higher payoff, while rational egoists will consistently receive a lower payoff, since others will not trust them" (Ostrom 2000b, 145). As a result, conditional cooperators will survive as a substantial proportion of the population. New entrants to the population will most likely adopt the strategies and values of those who obtained the best payoffs, which would bolster the proportion of norm users in the population (Boyd and Richerson 1985). Henrich and Henrich (2007) have argued that human beings use kinship, ethnicity, and reputation to distinguish people who are likely to cooperate from others who are not. Ostrom agrees (1998: 1) that "reciprocity, reputation and trust can help to overcome short-term self interest."

Second are tipping models, which are quite congruent with the indirect evolutionary approach. Players in tipping models do not have perfect information. Their decision to cooperate or not depends on the actions of other players, particularly in the first iterations of the game. If large numbers do not cooperate, they will not cooperate because they believe that cooperation under these conditions leads to a sucker payoff. However, if the level of cooperation is above the tipping point, then ever-increasing numbers of players will cooperate. In time this can lead to cooperation by all players (Poteete et al. 2010).

Another problem is the evolution of costly punishment. Why should players punish others when that will cost them? No rational player would bother to punish defectors. A number of analysts including Ostrom et al. (1994) and Boyd et al. (2003) have shown that subjects in experimental games are willing to punish non-cooperators and that punishment in combination with communication can increase levels of cooperation substantially. This is especially important in situations where the defection of a few people disrupts the efforts to manage common-pool resources.

#### 4. The nature of rules

Anthropologists and other social scientists have long shared an interest in rules or norms. Norms are a basic idea that underlies all of the concepts connected to social structure, including status, role, and institution. Norms, after all, are expectations and social structure is a structure of expectations. However, the classifications and analyses of anthropologists concerning rules are quite rudimentary. Ostrom has compiled a huge collection of rules pertaining to resource use. She points out that rules structure games and interactions by affecting risk, changing payoffs, opening or closing access to resources, allocating resources, and specifying how resources will be harvested, captured, or used. We have much to learn from Elinor

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<sup>2</sup> The article by Nowak and Sigmund (2005) contains a good explanation of indirect reciprocity.

Ostrom who has done more to analyze and categorize rules pertaining to natural resources than anyone else.

The syntax used to analyze rules has five components: (1) attribute – distinguishes to whom the rule applies; (2) deontic – specifies what is permitted, obliged, or forbidden; (3) aim – describes the actions or outcomes to which the deontic is assigned; (4) conditions – defines when and where an action is permitted, obligatory, or forbidden; (5) or else – specifies a range of punishments if the rule is broken. Only if there is an explicit or else statement with standards detailing monitoring and sanctioning should we call it a rule (Crawford and Ostrom 2000; Ostrom 2005).

The “**aim**” of a rule can be used as a means of classifying rules. There are position rules, boundary rules, along with choice, aggregation, information, payoff, and scope rules, each of which has a number of traits (Ostrom 2005). Boundary rules, for example define (1) who is eligible to enter a position; (2) the process that determines which eligible participants may enter (or must enter) positions; and (3) how an individual may leave (or must leave) a position. Ascribed and achieved characteristics are frequently used to define qualifications for entry (e.g. age, gender, height, weight, experience, kin tie, previous employment, citizenship and a number of other traits have all been used). Another set of boundary rules define succession and exit from that position.

There are also default rules specifying actions to be taken if no rules apply. Adding to the complexity, Ostrom says that all rules can exist at three different hierarchical levels: operational, collective choice, and constitutional (2005).

Rules of these different types and levels can be combined with each other in complex ways. A hypothetical example is a rule specifying that only adult men from a certain clan may take the resource (boundary and position); when the elders give permission, by using fish traps in certain months (choice and scope); and that the fish must be shared by all clan members (payoff rules). Another is that all boat owners who have a license may take all kinds of fish throughout the year on every fishing ground in the Exclusive Economic Zone of the nation.

The combinations of rules used to manage forests, fisheries, and grazing land in different cultures can and do vary widely. Moreover, Ostrom (2005) points out that the rules in use, traits of the biophysical material world, and the characteristics of the communities involved combine in complicated ways to ensure that every resource management situation is unique in some respect. Several different aspects of Ostrom’s analyses of rules need to be stressed. First, changing the rules can change the outcome of an interaction dramatically. Ostrom (2005) uses the snatch game to provide an example. In the base game, the preferred strategy is to take as much of the resource as possible since there are no property rights and people do not have any strong rules prohibiting snatching. With the imposition of rules giving property rights to all players, an exchange between the players will make both better off. Second, some types of norms can foster collective-action. Third, generating rules to solve collective

action problems is incredibly complex. She goes on to say that they cannot be solved analytically, but require extensive field study to become familiar with the specific case in question. Fourth, a simple policy reform “requires multiple rule changes” (Ostrom 2005, 215).

One of the most important sets of rules influencing resource management is property rights, and Ostrom has devoted a good deal of time to analyzing such rights and the kinds of goods produced by various property rights regimes.

## 5. Property rights, types of goods and the management of natural resources

Anthropologists’ interest in property rights goes back to the time of Lewis Henry Morgan, and a great deal has been written on the subject. For decades, textbooks in anthropology had chapters on property rights. The relationship between property and power has been a mainstay of political anthropology. Economic anthropologists have written extensively on land tenure and exchange of goods and services, while kinship specialists such as Goody (1998) have focused attention on inheritance. In recent years there has been a spate of interest in reprivatization of land after the fall of communism, and a number of anthropologists have studied common-property arrangements of various kinds (Hann 1998). For all this interest, anthropologists have not developed a widely accepted classification of types of property rights. Hunt (1998, 21) points out that the distinctions we make between various kinds of property “are vague.”

Social anthropologists and other social scientists have long recognized that property consists of a bundle of rights to land, goods or services, which can be combined in many ways to make a wide variety of property arrangements (Davis 1949; Mair 1965). Beattie (1964) points out that the term “ownership” means little. “The right question to ask in such contexts is rather: who are the people who have rights in this piece of land and what rights do they have? ... All rights are conditional and limited” (Beattie 1964, 193–194). This point is echoed by Goody (1998).

Ostrom, however, has made a substantial contribution to the discussion of property rights by classifying types of ownership rights and analyzing the way rights of various types influence decisions of how to use resources. According to Ostrom there are five different types of property rights: (1) access – right to enter a defined physical area and enjoy non-subtractive benefits (e.g. hiking, skiing); (2) extraction – right to take products of a resource system (e.g. to fish, divert water); (3) management – the right to regulate use patterns and make improvements on the resource; (4) exclusion – the right to determine who will have access and withdrawal rights; (5) alienation – right to sell or transfer management and exclusion rights. Varying combinations of these rights are associated with statuses. Owners have all of these rights; authorized users can only access a property and withdraw resources.

These combinations of property rights, Schlager and Ostrom (1993) argue, have important implications for resource management. Owners and proprietors have an incentive to invest in a resource and conserve it. Claimants and authorized users can use the resource, but have no incentive to invest since they cannot exclude others from harvesting or using the resource.

More importantly, Ostrom has made a major contribution by categorizing types of goods. Four different kinds of goods exist: private goods, toll goods, public goods, and common-pool resources. These are defined by combinations of excludability and subtractability. *Excludability* refers to the ease with which others can be kept from using the resource. *Subtractability* refers to the degree to which use by one person subtracts from someone else's ability to use the resource. The classification of types of goods is shown in Figure 1.

Each of these types of goods is a universe. *Privately-owned goods* are subtractable, which means that they can be depleted. However, such goods have a private owner who can exclude others from using these resources, usually at a reasonable cost. Since it is not in the rational best interest of an owner to damage his or her property, most common-pool resources owned privately are used efficiently and conserved (Acheson 1989; McCay 1992).

*Toll goods or club goods* are characterized by excludability and non-subtractability. A country club, for example, can only be used by those who pay for the privilege, but the use by one person does not prevent another from enjoying the club and its amenities.

		Subtractability	
		<i>Low</i>	<i>High</i>
Excludability	<i>Difficult</i>	Public goods	Common-pool resources
	<i>Easy</i>	Toll goods	Private goods

Source: Ostrom et al. (1994, 7).

Figure 1: Types of goods.

*Public goods* are characterized by difficulties of exclusion, but are not subtractable. Police protection and military defense are classic examples. One person's enjoyment of police protection does not subtract from the protection afforded other citizens. However, once such goods are provided, they benefit everyone in the society whether they have paid for them or not. As a result, the provision of public goods poses a collective-action dilemma. Such goods might benefit the community as a whole, but there is little incentive for an individual to invest in them. Where public goods are concerned, the incentive to free ride is

irresistible. Thus, if public goods are to be provided, there must be some means of forcing users to pay their fair share of the costs of producing and maintaining such goods. For this reason, most public goods are produced by the government, an organization capable of using force to end free riding.

*Common-pool resources* have been described in some detail earlier in this paper. They can be managed, but only with difficulty because they pose a substantial collective-action dilemma. It is all too rational for individuals to over-exploit such resources, even though this is detrimental to interests of the larger society. As is the case in all collective-action problems, the solution is to get rules to constrain people's behaviour. In the case of fisheries, for example, the rules would control exploitive effort to produce a sustainable output of the resource.

Until recently there has been a tendency to associate one type of good with one type of property. That is, it was assumed that private goods are held under private-property regimes whose owners have all of the rights to the goods produced. Common-pool resources are produced in situations in which group rights are specified or insecure property rights exist, while public goods are produced by the government since they cannot be produced through the market.

Elinor Ostrom and a number of social scientists have come to the conclusion that the situation is more complicated: a single property-rights regime can produce several kinds of goods (Hann 1998; Berge 2002; Benda-Beckman et al. 2006). In this regard, Ostrom points out, "thus common-property resources are not automatically associated with common-property regimes – or with any other particular type of property regime" (Ostrom 2003, 249). In many societies different combinations of goods have been produced by the same type of property regime. In Western Europe, private property produces private goods for landowners, but also a common-property resource for members of the public who are allowed to roam on that land (Kaltenborn et al. 2001). In some European countries, private estate owners have rights to timber and agricultural goods (a private good), while peasants have the *de facto* right to treat the land as a commons where they can graze their animals and gather nuts, mushrooms, and firewood (Blok 1974). In other societies the same parcel of land is held privately at some times and is a commons at others (Bauer 1987; Vondal 1987). Lesorogol describes a case in which African land is being privatized but still retains some of the traits of a common-property regime. The types of goods produced under these alternating property regimes differ. In the Indonesian case described by Vondal (1987), land is divided into private plots in the dry season when agricultural goods are produced. In the wet season, the same land is held as a commons, flooded, and used to grow ducks.

In Maine, forest land, which is privately owned, produces all four kinds of goods, and the right to withdraw those goods is held by different groups of people. Privately-owned forest land produces timber and pulp and agricultural goods that only the landowner has a right to take. However, hunters and sportsmen have traditionally used that same land for recreation, making it a recreational commons.

State policy and the Great Ponds Law support the hunting rights of the public. These same landowners are also producing public goods in the form of erosion control, carbon sequestering, and aesthetics. When these landowners sell some of the right to the land to hunting clubs or for conservation easements, they are producing toll goods (Acheson and Acheson 2010).

To complicate matters further, McKean (2000) points out that common-pool resources can be held under several different types of governance structures. A forest, for example can be held by a single private owner; it can be held as a common-property resource if it is owned by a municipality; or it can be a toll good if it is rented out. Ostrom (2003) would agree with this analysis.

I suspect the future will see Ostrom's analysis being used to create far crisper analyses of property rights and the goods associated with property regimes than we have had in the past.

## 6. What of the future?

There are a number of important commitments that run through Ostrom's past work and which will undoubtedly be found in her future work.

First, she is committed to using a variety of methods to achieve her goals. In *Governing the Commons* (1990), she used case studies, historical data and statistical analyses. In *Rules, Games and Common-pool Resources* (Ostrom et al. 1994), she and her colleagues explored the use of game theory as it pertained to solving collective-action problems. In *Working Together* (Poteete et al. 2010), she and her colleagues add agent-based models, qualitative methods, and meta-analyses. All of these methods cannot only add new data, but can support or contest conclusions stemming from studies employing other methods. An important conclusion of Ostrom's analysis of experimental games is that the results of games are consistent with analyses coming from case studies and from theories of human behaviour (Ostrom 1999a). But at times, data gathered by one means undermines the conclusions reached by using other methods. Both are equally valuable. In short, Ostrom believes social-science researchers should buttress their findings by using as many methods as possible. Anthropologists might take a page from Ostrom's book and consider making extensive use of more research methods, including game theory and formal models, than we do at present.

Second, the number of variables involved in collective-action problems to manage natural resources is large and complicated. We need to identify combinations of variables in different resource settings that affect the incentives and actions of actors in diverse governance settings. We need to view systems as decomposable and composed of levels, with lower levels being sub-units of higher-level units (Ostrom 2007). If Ostrom is correct, virtually every resource involves a unique set of variables that must be considered when trying to understand that resource and the management problems it faces. Elegant formal models are not likely to capture all that needs to be considered in formulating

policy in management. What is needed is the kind of detailed case studies which anthropologists have long provided.

Third, among those interested in conserving natural resources, there is a strong tendency to advocate a single solution for all resource problems. For Garrett Hardin it was government control. The common-property economists advocated privatization. Olson believed that the key was to do away with free riders. A number of anthropologists saw another possibility – control at the local level or co-management. Throughout most of her career, Ostrom has argued that common-pool resources could be well managed by local-level units. She has advocated polycentric governance, where much control rests in the hands of local communities, which nest inside of larger government entities. She and her students argued that governments often failed in attempts to manage resources (Wunsch 1999; Ostrom 2005). However, she does not believe that local-level management is appropriate in all situations. There are no panaceas, she says (Ostrom 2007). No single governance system or type of system is a solution for all resource management problems (see Acheson 2006). What is needed are solutions tailored to incredibly complicated ranges of circumstances on the ground. I have no doubt that the future will see Ostrom describing a series of cases and recommending different solutions for each.

Fourth, in Ostrom's later work is a commitment to the study of socio-ecological systems. Human beings have changed the environment, and these altered environments in turn limit what human beings can produce and the decisions they make. Understanding these systems poses tremendous problems and opportunities. Ostrom and her colleagues have already begun to document the various ways in which stable socio-economic systems have adapted to new types of human-created disturbances (Janssen et al. 2007). Van Laerhoven and Ostrom (2007) outline some of the new contributions to this field and point the way for further development.

## 7. Conclusion

A number of anthropologists have taken an interest in environmental problems plaguing the world. More of them would be well-advised to use Elinor Ostrom's work on decision-making under institutional constraints as a template for their own research. This would lead anthropology back to a paradigm that thrived in the 1960s and 1970s when there was much work on these topics by those interested in action theory, exchange, and social process (see Whitten and Whitten 1972). It would focus attention on extending the work of the "new institutionalists" on the generation of rules, social change, and social evolution. With the exception of the work of people such as Acheson and Gardner (2010); Boyd and Richerson (1985); Henrich and Henrich (2007); and McCay (2002), this perspective has received less attention than it deserves from anthropologists. This would forge an important link to economics,

political science, and sociology from which mainstream anthropology has been separated for too long.

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