SCARCITY, EQUITY, AND TRANSPARENCY: GENERAL PRINCIPLES FOR SUCCESSFULLY GOVERNING THE WATER COMMONS*

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Abstract: A comparative cross-cultural study of several successful farmer-operated irrigation systems in two different parts of the world—the Andes of South America and the Mediterranean coast of Spain—reveals that the same set of institutions (or rules and operating principles) produces sustainable positive outcomes in each case. Several successful irrigation systems, well-documented in the literature, are thought to be of fundamentally distinct types and known to be of widely different scales: Valencia, Alicante, and Murcia in Spain. This success can only be explained in terms of basic similarities underlying the more obvious but superficial differences noted previously by other researchers. Similarities include operating principles the author first identified in his ethnographic research on successful irrigation communities in Peru. A brief overview of the comparative literature on successful systems in other semi-arid regions—India, Nepal, the Philippines—shows that the same basic system for sharing water under conditions of scarcity has emerged independently in a great many communities throughout the world, suggesting that this system is an optimal one, and constitutes a clear and unprecedented case of parallel or convergent social evolution. The author concludes with some implications of such a general model—or "universal" schema—for both the theory and practice of sustainable local irrigation.

Keywords: water management, irrigation, common-property resources, policy, markets, Peru, Spain, Chile

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E. Wiegandt (ed.), Mountains: Sources of Water, Sources of Knowledge, 43–61.

1. INTRODUCTION

Few works in social science have influenced policy as much as Hardin's (1968) attempt, in "The Tragedy of the Commons" to explain the tendency of people to overexploit any resources that they hold in common in terms of an irresolvable conflict between the inherently selfish interests of the individual and the cooperative needs of the group. The results of such a tragedy are of course evident today throughout much of the world in the use of common-property resources: irrigation water, pasturelands, forests, and fisheries. Yet Hardin's theory has been criticized and even refuted convincingly by many authors, based on their studies of hundreds of cases where local people have managed such resources cooperatively, and done so very effectively, over a very long period of time. This rebuttal has turned attention toward the task of devising an alternative theory to explain how people have been able to overcome their conflict of interest, escape the "commons dilemma", and pursue the common good (e.g., N.R.C. 1986; McCay and Acheson 1987; Bromley 1992).

Recent research on the management of water for irrigation, some of which will be reviewed briefly here (Trawick 2001a,b; 2002a,b; 2003a,b; 2005), lends significant new support to this effort and promises to allow a decisive revision of the conventional theory. It shows that people in a great many communities throughout the world long ago arrived, quite independently, at the same sustainable solution to the "commons dilemma", creating a set of principles for sharing scarce water in an equitable and transparent manner that minimizes social conflict. This comparative research strongly suggests that, in cases where irrigation communities have managed a scarce resource autonomously and effectively over a long period of time, the principles of distribution and use appear to be highly similar if not exactly the same, and this seems to be true regardless of whether the water is communally or privately owned.

The programs of the World Bank and the regional development banks with which it is affiliated continue to be strongly shaped by the conventional theory, and they have long advocated water privatization, one of Hardin's proposed solutions to the commons dilemma, on a massive scale (World Bank 1995). My research indicates that the creation of water markets will not solve the problems afflicting irrigation in many regions of the world today, and that such markets do not actually work in the manner that they are widely thought to work, at least not in the small-scale canal

systems that typify most arid and mountainous regions. This work has revealed the existence of heretofore unrecognized but highly significant commonalities in the dynamics of successful communal and "market" systems.

Scholars and scientists have made steady and important progress in critiquing and revising Hardin's theory, most notably Ostrom (1986, 1990, 1992, 1998; also Ostrom et al. 1999, 2002) and Tang (1992), who, through comparison of a large number of case studies in different countries, have led the way in identifying basic design principles that all effective locally run irrigation systems seem to share. Their focus has tended to be on canal systems of 1,000 ha or less, the kind of "indigenous" or peasant community system found in most mountain regions (Mabry and Cleveland 1996). Such small scale, and the kind of intensive face-to-face interaction among water-users that this makes possible, seems to be a common denominator that can contribute significantly to local success (Ostrom 1987). However, most of the principles identified thus far remain rather abstract, and more suitable for predicting the general conditions under which people will be able to come up with a solution of their own than for showing them how to manage water effectively when they have failed or lost the ability to do so on their own.

The effort to revise theory and make new policy has been hindered by the limitations of the primary data in these studies, which are always highly objective and descriptive at the system level, typically presented from the point of view of a resource administrator or a water distributor, but without incorporating the more subjective and culture-bound perspective of the individual farmer and water-user. Analysts have also tended to emphasize the diversity that seems to exist among local systems while not giving enough attention to the one important feature that nearly all of them have in common, at least at certain times of the year, and that is water scarcity. All of this has obscured the fact that the keys to local success in dealing with scarcity appear to be highly similar everywhere if not exactly the same: operating principles that together instill a strong positive incentive in people to obey the rules and conserve the resource, rather than merely a negative incentive that rests entirely on punishing people for "free-riding" infractions. Once the principles are identified in a particular ethnographic case, and the way that they work together from the water-users' point of view is understood, as I will try to explain below, the parallels in other countries become evident and are striking indeed.

2. HUAYNACOTAS: AN "AUTONOMOUS" INDIGENOUS COMMUNITY

The community of Huaynacotas in the Peruvian Andes, which I studied over a period of more than two years, is located in the Cotahuasi valley of the Department of Arequipa, in the southern part of the country. It is a village of Quechua-speaking peasants (population roughly 1,080), one of only a few villages in the valley that were never directly colonized by outsiders. That is to say, the Spanish landlords who became dominant almost everywhere else in the valley never succeeded in acquiring any land there and actually residing. Although extremely remote, Huaynacotas is not a pristine community, but rather one that managed to contract its boundaries very early after losing all of its low-altitude land to these local colonial elites. The villagers thereby managed to prevent further loss of land and water to the landlords and their haciendas (private agricultural estates) and to maintain a significant kind of autonomy, having full control over their water supplies and the rules governing resource use.

The hydraulic tradition described below is also found in two other villages in this same valley, and it has been shown to exist in other indigenous communities in southern Peru (see, e.g., Treacy 1994 a,b). The scarcity of water in Huaynacotas is acute even under "normal" conditions, and this constrains the sequence and timing of distribution.[1] As in most communities, the main flows of water within the system are so small that one or two landowners at a time must take turns in using it—an arrangement known as a *mita* or *turno*. The cycle of turns is so slow that it takes two to three months to water the entire 410 ha expanse of irrigated land, even after a year of good rains. During the maize planting in September and other crop plantings thereafter (e.g., beans, potatoes), the watering frequency gradually declines, and this continues until the rains begin in early January, at which time irrigation normally ceases. This means that staple crops are watered at most three times during the agricultural year.

[1] The hydraulic system is a dual one with two major water sources, both of them alpine springs, a pattern that is typical of the Cotahuasi valley and the Andes as a whole. The flows are stored at night in two tanks and distributed during the daytime through two separate networks of canals. The canal system as a whole spans elevations from 3,100 to 4,100 m and encompasses roughly 410 ha of territory that is divided into named sectors of land. The sequence in which the sectors are watered is determined by micro-climatic variation making some sectors colder than others, which extends the germination time for maize, the main staple crop. This initial planting and watering sequence is then repeated for each irrigation cycle throughout the agriculture year.

The function of irrigation here is to distribute the supply equitably, efficiently, transparently and with minimal conflict, so that local people are able to make the best of a bad situation. The arrangement of landholdings directly promotes this outcome: the highly fragmented pattern, or *minifundia*, that is characteristic of Latin America and typical of peasant villages throughout most of the world. Regardless of how much land people own, they tend to have numerous small parcels scattered in different sectors at various elevations and located along different canals. They also tend to have land in both halves of the irrigation system, which has two main water sources and two largely independent networks of canals. The pattern is so highly fragmented here that one cannot speak of the usual population of "head-enders" and "tail-enders" along each canal, since most people seem to have land in both kinds of situations.

3. THE RULES OF WATER MANAGEMENT

The canal system is operated through a system of rotating authority in which customary procedures are always followed. This is done by two elected water officials called *Kampus*, who oversee the two halves of the system. During each distribution cycle, the *Kampus* divide the flow of each main canal in half, into two standard and roughly equivalent portions (*rakis*), in the act of diverting it into the secondary canals. They then allow the water to flow down to the fields, where each share is used by a landowning family or household. This happens in both halves of the canal system at the same time according to rules that are essentially equivalent.

3.1. The Rules of Distribution

Certain procedures ensure that all parcels of land served by a given source, and all households, receive water with the same frequency, which varies with seasonal and long-term fluctuations in the supply. First, the land sectors that make up the village territory are given water consecutively in a fixed sequence based on altitude and microclimatic variation. During each cycle of the system, water passes through all the sectors currently in production, reaching every parcel before beginning again.

Second, the plots within each sector are given water in a rigid contiguous order, starting at the bottom and moving upward, in such a way that the time at which they are serviced depends only on their location, rather than on who owns them or the crops in which they are planted. Alfalfa, for example, an irrigated pasture is grown here in tiny plots; but,

unlike the situation that one finds in most other local villages, here it is watered in the same way and on the same schedule as any other crop.

Third, a standard method of adjusting to drought ensures that the impact of periodic shortages is absorbed equally by all households. After a year of poor rains, as the water flows subside during the planting season, some of the sectors at the upper end of both halves of the system are taken out of production in order to prevent a further decline. This was done about thirty years ago, in response to a sustained and still ongoing drought, and the abandoned sectors have remained out of use ever since. Since everyone had land in these sectors, most people were affected by the contraction. But everyone benefited equally from it, since the goal was to keep the watering cycle from stretching out so far as to seriously jeopardize the harvest. A result of this kind of cooperative arrangement is that, even though the springs here are the most vulnerable in the entire province to droughts, conflict over water is far less prevalent in Huaynacotas than in other local villages, which are less vulnerable to drought but which in nearly all cases have far less equitable arrangements (see Trawick 2001a, 2003b, Chapters 4 and 7).

3.3. The Rules of Utilization

The entire landscape of the village is terraced into level surfaces that are designed and carefully maintained to promote the absorption and retention of water. These make it possible for the watering to be carried out through a uniform technique that ensures that the duration of irrigation, and the amount of water consumed by people in their allotments, is strictly proportional to the extent of their land. Standard water containment features (*atus*)—earthen structures of uniform height—are used by everyone. Because liquid is pooled on the surface to the same depth, irrigation time and water consumption are regulated by the technology itself. Once the pools are full, irrigation is finished and the water distributors allow no departures from this arrangement—such as returns to top up the pooling structures, or the destruction of terracing and the irrigation of slopes, practices that are common in other local villages. For the purposes of this comparative analysis, the important point here is that control over irrigation time and the amount of water consumed in each household allotment are inherent features of the local technology—control that, it should be pointed out, can be and is achieved in other kinds of irrigation systems by other means.

4. THE OPERATING PRINCIPLES

From an analysis of the rules of water management in Huaynacotasone we can derive a set of operating principles on which successful irrigation seems to depend.

BASIC PRINCIPLES OF IRRIGATION IN HUAYNACOTAS

1) *Autonomy*: The community has and controls its own flows of water.

2) *Contiguity*: Water is distributed to fields in a fixed contiguous order based only on their location along successive canals, starting at one end of the system and moving steadily across it.

3) *Uniformity*:
- Among water rights: Everyone receives water with the same frequency.
- In technique: Everyone irrigates in the same way.

4) *Proportionality* (equity):
- Among rights: No one can use more water than the amount to which the extent of their land entitles them, nor can they legally get it more often than everyone else.
- Among duties: People's contributions to maintenance must be proportional to the amount of irrigated land that they have.

5) *Transparency*: Everyone knows the rules and has the ability to confirm, with their own eyes, whether those rules are generally being obeyed, as well as to detect and denounce any violations that occur.

6) *Regularity*: Things are always done in the same way under conditions of scarcity; no exceptions are allowed, and any unauthorized expansion of irrigation is prohibited.

The control of water here is unified or centrally directed (see Hunt 1988), but the system is not directly articulated with any outside agency and is, at the present time, autonomous. Although the State theoretically owns all of Peru's irrigation water according to existing law, the government water bureaucracy has never had any presence here, as in probably

the majority of highland communities. This has left the local people free to maintain their own customs. As Ostrom (1990, 1992) has noted, people are much more likely to respect the rules when it is they who set them.

The principle of proportionality, among people's rights and between their rights and duties, has been noted and discussed in many other case studies. However, without uniformity, especially in the watering frequency, no such proportionality among people's rights can exist. In Huaynacotas, uniformity is a major concern and a central theme in village social life. The right to one's proportional share of water during each distribution cycle is the basic egalitarian principle upon which life in this community has long been based. However, people do not have to worry a great deal about this uniformity or be constantly on the lookout for theft and other forms of cheating and "free-riding" that would threaten it. This is because such infractions are easily detected and therefore are, and reportedly "always" have been, extremely rare. Because of the contiguous order in which it is carried out, irrigation is a highly visible activity, so that people have the capacity to monitor the system systematically, and can easily investigate matters in this way if they have reason to. The result is a tangible and widely recognized power of families and households to protect their own water rights, which results in a very strong positive incentive to obey the rules and respect local tradition.

People's rights—de facto claimant rights (see Schlager and Ostrom 1992), otherwise known as "communal" rights—are qualitatively equal, in that everyone is subject to the same rules and procedures, which they know well. Indeed, every man in the village knows how to operate the entire system, since the male heads of household serve in the post of *Kampus* in rotation, also sponsoring and directing the yearly Water Festival, the ritual cleaning of the irrigation canals. Ostrom (1987) has observed that this kind of arrangement ensures that knowledge of the rules is evenly distributed throughout the community, rather than being concentrated in the hands of a water official.

Water rights in Huaynacotas are also quantitatively proportional to each other, varying only with the extent of a person's land. This means that no one is allowed to deprive other people of water by using more than the amount to which the extent of their land entitles them, or, as commonly happens in other places, by getting it more often than everyone else. Just as in any other stratified community, some families have more land and use more water than others, but a fundamental symmetry prevails, both in the

size and frequency of household allotments, and in the corresponding duties that people must fulfill in order to preserve their rights. Because large landowners have more land and use more water, their contributions to the Water Festival, and generally to the upkeep of tanks and canals, are required to be greater, in terms of labor and other inputs, than those of the smallholder majority. Largely because of this, the infrastructure is very well maintained.

The principle of contiguity is vital for several reasons. In addition to providing a uniform frequency of irrigation, a contiguous distribution pattern limits waste due to evaporation and filtration by minimizing the total surface area of canals in use on any given day. The canals are unlined and allow a great amount of water loss. The loss decreases dramatically once a canal surface and the soil beneath it have become saturated or waterlogged. By watering the entire surrounding area before moving on, the loss is minimized.

The contiguous pattern also makes irrigation a thoroughly public affair. Since everyone knows the rules that govern distribution, and the exact order in which they are supposed to receive water, and, because the owners of adjoining parcels tend to irrigate on the same day, people are normally putting their fields in order, or simply waiting and watching, while their neighbors finish their turns. This means that monitoring is pervasive and routine, spread out among users throughout the system, rather than a specialized role that is entirely in the hands of the water distributor. The visibility, and the passive vigilance provided by neighboring landowners, helps the distributors in ensuring that traditional procedures are followed, and they have the vital effect of providing controls over theft, favoritism on the part of water officials, and other forms of corruption. The rules and the work involved, together, thus create a situation of transparency. People have a strong sense of security regarding their water rights as a result, and have a strong tendency to obey the rules and respect tradition.

Infractions and other causes of conflict are rare in Huaynacotas, but, due to the extreme scarcity of the resource, they do occur. This will happen to some extent in any irrigation system, no matter what the rule. However, such corruption cannot happen repeatedly here without soon being discovered by the other water users. When infractions are detected the penalty is severe, but graded according to the gravity of the offense. It varies from the loss of one allotment during a given cycle to the loss of one's water rights on a given field for the remainder of the year.

5. THE INCENTIVE TO COOPERATE

All of the above principles play their part in creating a transparent and equitable system, and all contribute to its effectiveness. They include regularity: the rules must be consistent at all times, in all places, for everyone involved. As I learned through my work in other valley communities, exceptions to the principle of regularity that allow some crops to be watered more often than others and special provisions that temporarily modify the watering order only promote mistrust by introducing a degree of opacity, and they open the door wide for favoritism and abuse. Allowing irrigation to expand, for example, for some people would allow them to benefit specially and disproportionately from the cooperation and frugal water use of others.

The most central principle in terms of the incentive to cooperate, however, is the uniformity of the watering frequency. When everyone irrigates their land on a single schedule, and when expansion is prohibited, the water saved through conservation and self-restraint causes the distribution cycle to run faster. Thus, by limiting watering to a fixed period of time and obeying the rules, people are able to irrigate more often, as often as possible from the long-term point of view. And, in a situation of uniformity, any "free riders"—people who ignore the rules and steal water, or who irrigate excessively—interfere with the efforts of others to keep the cycle short and cause it notably to slow down.

The feedback on such behavior is thus immediate, negative, and easily perceptible: the number of days it takes to water a given area of land. The incentive to comply is consequently remarkably strong and the tragedy of the commons, far from being inevitable, is actually rather difficult to bring about. People enjoy an extraordinarily high degree of security about their water rights because, in a transparent system, a person can maintain and protect them quite effectively him or herself.

The incentive to cooperate is thus primarily a positive one that rests on this pervasive sense of security and on the lack of any persistent threat, rather than a negative one that rests on people's constant vigilance against an ever-present danger of theft and on the resultant frequent sanctions. Cheating is truly irrational and is widely perceived in that way; and this, according to the local people, explains why such behavior is so rare. This general situation is created by the scarcity of the resource, which in this community is especially grave, and by the institutional arrangements that people have worked out for dealing with a situation that is far from ideal. That is the "commons dilemma" that the people of Huaynacotas face, but it is not one they have brought upon themselves.

6. SUCCESSFUL SYSTEMS IN OTHER PARTS OF THE WORLD

There is now a large and growing literature critiquing Hardin's explanation for the commons tragedy in examining the local use of a wide array of common-property resources. (e.g., Bromley 1992; McCay and Acheson 1987; N.R.C. 1986; Ostrom 1990, 1992, 1998; Ostrom et al. 1999, 2002; Dolsak and Ostrom 2003), and irrigation communities provide some of the most impressive examples discovered thus far of successful management. Their implications for theory and policy have never been fully appreciated, however, because these analyses have focused mainly on institutions, rather than people, on structure at the expense of agency, and they have generally not explained things clearly from the "native point of view" of the water user.

A close reading of these studies—by Coward (1979) and Siy (1982) in the Philippines, Wade (1986, 1988, 1992) in southern India, Ostrom and Gardner (1993) in Nepal, Maass and Anderson (1978), and later Ostrom (1990, 1992, 1998) in various parts of Spain—strongly suggests that the same basic principles identified above are apparently at work in many of the systems described. Where the resource is scarce relative to the area of land and the crops involved—which may be the case all of the time, as in most of the Andes, or only seasonally, as in the moister regions of Asia—these principles seem to be crucial to the success of local management traditions. Moreover, this generalization seems to include rather large-scale systems composed of many communities, such as some of the ones in Spain, and to apply to both communal and "market" systems of the peasant type. Thus neither the size of the irrigation system nor the property regime seems to matter.

Autonomous control over the resource, or over each group's collective share of it, is recognized to be present in each of the communities studied. Beyond that, the principle that has been most clearly defined in the literature is proportionality, among rights (i.e., there is a single land/water ratio for each user of each major source) and between people's rights and duties, a principle first identified by Coward (1979, p. 31) in a zanjera system in the Philippines. More recently, Ostrom and Gardner (1993, p. 100) have found this to be the basic principle governing both rights and duties in many irrigation systems in Nepal, although the exact number of examples, though large, is unclear (also see Guillet 1992, pp. 204–206). Proportionality is also shown to be present in the various systems, totaling roughly 60 communities, that Ostrom (1990, pp. 69–82) has analyzed in Valencia and Murcia-Orihuela in southern Spain, based on the earlier work

of Glick (1970) and Maass and Anderson (1978, 1986). What has not been realized, however, is that proportionality among water shares can in part be a by-product of irrigation technique.

Wherever the irrigation technique is highly uniform and involves pooling water on the surface of terraced fields to a standard depth—as with the pond-field terraces used all over Southeast Asia for growing rice (Conklin 1980)—proportionality among rights exists, provided that the frequency of irrigation is the same for every user of a given water source. Taking this into account, proportionality seems to be a feature of several of the systems described in southern India by Wade—again, the exact number of cases that Wade is describing is unclear—as well as the ten zanjera communities analyzed by Siy (1982) and Ostrom (1990, pp. 82–88) in the Philippines. Although he pays little attention to this question, Wade (1986, p. 75) does note in passing that people's contributions to canal maintenance must be proportional to the land area irrigated in each case. All of this strongly suggests that equity (Hunt 1992) or proportionality among both rights and duties, the central defining principle of the Andean tradition previously described, is a key feature of self-governing irrigation communities that work well and that have lasted for a long time in other mountainous parts of the world.

Uniformity is perhaps the most crucial concept, as stated previously, since without this basic commonality—a fairly uniform technique and a frequency of irrigation that is the same for everyone—no real proportionality among people's rights can exist. One can therefore infer that this principle is present in each of the systems studied. A uniform frequency necessarily must exist in all systems where water rights are tied to the land—true in the vast majority of the cases mentioned—and where there is a comprehensive, fixed order of rotation within each community or for each major water flow, as in the seven turno systems that make up the huerta of Valencia (Ostrom 1990, pp. 71–76; Maass and Anderson 1978, p. 39), as I was able to confirm in the ethnographic research of 2003–2004. Even in situations where certain crops and certain fields are given priority during a drought emergency, so that some crops then get water in lieu of others, it nevertheless appears true that all landowners and farms receive water on the same schedule.

By the same logic, uniformity must also exist in rotation systems where the actual time of irrigation is fixed by the day and hour for each parcel of land and each landowner, as in most of the 42 canal communities[2] (employing a tanda system) that make up neighboring Murcia

[2] Four of Murcia's forty-two branch canals are always open, so that water flows into them whenever it is available. These canal communities have never had an organized tanda,

(Maass and Anderson 1978, pp. 74–79; Ostrom 1990, pp. 76–78). There, the same kind of priority system was formerly implemented in times of severe drought, so that uniformity was preserved in both of these well-known Spanish systems. Today, however, such adjustments are left up to the individual in both cases; the frequency of irrigation (in Valencia), or the amount of water that actually arrives when watering takes place (in Murcia), are cut back naturally by dwindling flows and perhaps also by administrative action, and the farmer must then decide how to adjust the mixture of crops planted and the pattern of watering according to the amount of the resource that is available.

Contiguity is somewhat easier to confirm, like the feature of transparency that derives directly from it. The importance of a fixed, contiguous order of distribution is fundamental to conservation in situations where water is in short supply, and this is recognized implicitly by most of the authors whose work is being reviewed here. Wade (1988, pp. 77–78; 1992, p. 218) implies the existence of such a fixed order for numerous villages in South India (again, the exact number is unclear). Coward (1979, pp. 32–33) describes a similar system in the Philippines, but one where water is delivered simultaneously to all parcels within a given block of land whenever there is enough available to do so, as is the case much of the time. He also speaks at length of a system for rationing water during the yearly dry season, the season of scarcity, but without ever saying explicitly what the order of rotation among adjacent fields is. Nevertheless, his account does seem to imply that the rationing order in these zanjera systems is canal-by-canal, block-by-block, and field-by-field, as does the work of Siy (1982) on nine other nearby communities. Ostrom (1990, p. 73) does not clarify this in reference to the zanjera systems, but, citing Maass and Anderson (1986, p. 28), she does explicitly note that contiguity is the rule among the turno systems of Valencia. She is less specific about Murcia and Orihuela but does speaks of those systems as being "quite rigid" and involving a regular rotation during low-water periods (Ostrom 1990, p. 76), implying a contiguous order that was conclusively confirmed in the fieldwork of 2003−2004.

Contiguity is crucial in water-rationing systems for two reasons. First, the rule is the simplest one possible and is therefore easy to understand, so that knowledge of it is evenly distributed throughout the community.

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having instead practiced a kind of free or first-come-first-served access among the members. Not surprisingly, in these days of a prevailing chronic shortage, mitigated only by the use of local wells belonging to each user-group, these communities clearly have the highest level of water conflict, as manifested in formal complaints between neighbors about violations of the rules.

Second, we have already seen that applying it has the effect of concentrating irrigation in one area at a time and thereby making it a highly visible public activity. The result, as Ostrom (1990, pp. 73–75) points out in her analysis of Valencia—though not explicitly in the other cases—is that farmers routinely have the opportunity to observe each other irrigate and to monitor, not only each others' activity, but also that of the water distributor. Even if it is not often actually used, the availability of such potential assistance is crucial because, in the steep and convoluted terrain of the Andes and other mountainous regions, it is ultimately beyond the capacity of any distributor—even the most physically fit individual—to divert the water from the main canals, guard against theft higher upslope, and monitor the circumstances and duration of water use in the fields down below.

These observations relate to the last of the six principles as well, regularity, which also seems to be present in each of the cases at times when the resource is scarce. There are a few exceptions, as in the case of the priority that used to be given to certain crops in situations of real drought emergency in Valencia and Murcia,[3] or of occasional expansions of the system—putting new properties under irrigation—which are sometimes allowed by the communities in these two districts. But those are unusual events that require special permission by the community, and they do not alter the fact that, without them, things are always done in the same orderly way. As explained, some changes are also made in Huaynacotas during severe droughts without altering the basic equity and proportionality of the arrangement.

The realization that the same basic principles are apparently at work in at least seventy to one hundred communities worldwide and that this solution was probably arrived at independently in the many countries where it exists today has important implications. First, it is one of the most striking examples yet found of parallel or convergent cultural evolution—the emergence of similar adaptations to environmental conditions—that, despite significant differences, have in common the necessity for the social groups to solve problems of serious water scarcity. The convergence itself requires an explanation which is ultimately beyond the scope of this discussion, but it suggests the existence of a widespread, or "universal," culture of irrigation and sustainability in water-sharing, which is readily

[3] Fieldwork in 2003–2004 revealed that this is no longer done either in Murcia or Valencia. In the former, wells have been drilled in large numbers to attempt to compensate for the growing scarcity of water, which has been greatly exacerbated by the Tajo–Segura Pipeline, the largest hydraulic project ever carried out in Europe. Supposedly built to benefit local farmers of Murcia and the upper and lower *vegas* (plains) of the Segura, the project turned out to be a massive swindle that actually deprived them of most of the water of their own Segura river.

activated when a prevailing scarcity emerges locally among groups of farmers. Second, these revelations about successful farmer-managed irrigation systems come at a critical moment in a debate about water policy. People not only can work out effective rules and principles for governing the commons; they have done so in a great many places all over the world and arrived at the same basic rules in each case. What are the implications of this general, or universal, model during a time of crisis in thinking about water management?

7. RETHINKING POLICY

Despite the arguments of many knowledgeable people against it, and even serious disagreement within the Banks over whether the policy is advisable, "privatization", otherwise known as tradable concessionary rights in water, has until very recently been strongly promoted by the World Bank and the InterAmerican Development Bank throughout Latin America as a solution to the problems that now afflict management of the resource, particularly in mountain regions. Beginning in Peru a few years ago, but then progressively in Ecuador, Bolivia, Brazil and now in other countries too, the Banks have sponsored and overseen the drafting of essentially the same privatization law, one that is based on the 1981 Water code of Chile (see Trawick 1995, 2002a).

The results of the fieldwork of 2003–2004 strongly suggested that privatization and the buying and selling of the resource will not solve the problems that are so widespread and symptomatic of the tragedy of the commons in water management. There are several reasons for this, but the main one is quite simple. In a region where the average household irrigates less than a hectare of land—one where subsistence agriculture predominates—the amount of water that can be saved by people through more conservative use, although quite significant in the aggregate, will rarely be large enough that it could feasibly be sold to someone else, even if the infrastructure existed to make this possible (it does not in most communities in the Andes today). The transaction costs, or the amount of trouble people have to go to in order to do it reliably on a long-term basis, are too high. In the rugged terrain of the Andes, the motive for conservation can only be found in the link between the efficiency of water use—in terms of both avoiding waste and respecting the rules—and the duration of the irrigation cycle.

This is well illustrated by the situation in rural Chile, a country where private tradable water rights have existed for many years, but where no

such markets have apparently emerged within the peasant communities, i.e., those with small-scale, locally run canal systems. Although there are few published studies of such cases, all indications are that little or no buying and selling of water has occurred in the communities, and many of them have sought legal recognition and protection of their communal water supplies so that these kinds of transfers between individuals have not been allowed to take place (Dourojeanni and Jouravlev 1999; Bauer 1995, 1997; Solanes 1996; Hendriks 1998; Bjornlund and McKay 2002). For the most part peasants have not wanted to be part of the national water market and they have actively prevented themselves from being incorporated into it, as regards their daily use of water for irrigation (see Castro-Lucic 2002).

There is in fact only one thorough study now available of a long-standing and fairly autonomous water market, one composed largely of peasant farmers who cultivate rather small units of land, and that study focuses on the community of Alicante in Spain, one of the three systems in that country examined by Maass and Anderson (1978, 1986) and Ostrom (1990). Alicante formerly covered about 3,700 ha and included roughly 2,400 households; yet these people together form a single user community (Maass and Anderson 1978, pp. 100–145). Alicante may have been the oldest water market in the world, dating back to the sixteenth century, and was said to be remarkably efficient, with an extremely low incidence of rule infractions and resulting social conflict. Although the water market no longer exists,[4] having been disbanded in the early 1980s, this example

[4] Although it is not widely known, the Alicante market was abolished several decades ago, precisely because it did not work nearly as well as was widely thought. The Huerta went into bankruptcy due to decades of corruption and other problems back in 1983, and was officially abolished and turned into a fully communal *tanda* system in 1987. This was one of the first facts revealed in my fieldwork there during 2003–2004, which confirmed my hypotheses about the "moral economy" model for Alicante as well as for Murcia and Valencia. Space does not permit a thorough discussion of the results here, except to say that I was able to confirm, through extensive interviews with a large number of local informants (30 in Valencia, 20 in Murcia, and 10 in Alicante [combined with a substantial amount of documentary research]), that the "moral economy" model based on the principles discussed above does indeed apply to all three of the Spanish systems (or formerly did in the case of Alicante). I was able to confirm these intuited hypotheses about how the Alicante system worked during my fieldwork with local informants (Ten farmers and former water distributors) and my documentary research in the huerta's Sindicate archives. My sincere thanks again go to the Sindicate, especially to Manuel Jose, the Secretary, without whose help and collaboration I could not have completed the research.

The Alicante "market" was basically a communal *tanda* system where a priviledged minority of wealthy feudal water owners was able to exploit the prevailing scarcity (of "new" water among peasants, by selling or renting portions of the "old" water) to peasants at auctions (the shares of which had been gradually accumulated by these elites because they were no longer attached to the land). Any water bought, however, was delivered at the

from the literature has always seemed, on the face of it, to justify and endorse the World Bank's enthusiasm for water markets, as Bank economists have long been quick to point out. A close reading of Maass and Anderson's initial description of the rules operating to distribute community-owned water (both the so-called "old water" and the "new"[5]) during times of scarcity (which is the normal situation) shows that, even though these individual shares—the core rights of the system—were available for rent or purchase by other people, both of them were still held to some extent in common. The two kinds of water were delivered together in a strict contiguous order determined by the landscape, and used on a single schedule according to a fixed set of rules. Moreover, receiving them was contingent upon the completion of certain duties, duties that in each case were proportional to rights in a basic way.

In the case of the "new" water, which dated back to the sixteenth century, these allotments were merely claimed, not purchased, because the rights were directly tied to the land and determined by, and proportional to, the amount of land a farmer owned (Maass and Anderson 1978, p. 112). But even in the case of the "old" water shares, which was by far the predominant kind of water sold (amounting to roughly half of the total local supply), and which were "private" and no longer directly tied to the land, a person had to be a huerta landowner in order to use this water, and it could not be sold to anyone outside the community.

From a practical point of view, this means that nearly everyone in the community received some of the water during each rotation. They could transfer all or part of their right to someone else—particularly the "old" or feudal water, which was essentially the only kind of water sold in the local market—but that family would, in the same way, receive the additional water during their normal turn on the same schedule as everyone else, according to the location of their farm along its canal. Thus the main distribution cycle was governed, not by the "law" of supply and demand, but by a clearly defined and fixed set of rules decided upon by the

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same time as the buyer's regular share of new water, in the same fixed order and on the same uniform schedule. The system worked well, with very few infractions, because of the institutional foundation upon which the market rested, the set of principles discussed in this article. Contrary to the impression given in the earlier published accounts, peasants almost never rented or sold their "new" water; such trafficking could only be engaged in by the wealthy nobles and owners of "old" water. The system did not in fact work very well in the view of the vast majority of the *huerta* members (water theft was rare because the system was quite transparent and because people lived in fear of the landlords), and that is the main reason why it was ultimately abolished and made a fully communal *tanda* system.

[5] Some of Alicante's water is external, supplied separately and sold by outside utilities and delivered through pipelines.

community—institutions determining the uniform frequency with which the water was available to everyone. And people only received this water if they had paid their taxes and made the other proportional contributions to maintenance upon which their rights depended. Only direct proportionality with land was lacking, and this was the case with only about half of the community's supply (the old, essentially feudal water). Once the description is clarified in this way, it becomes apparent that this was really at heart a turno system much like any other one in Spain, a community with a fixed order of rotation and a single cycle for the two kinds of water.

What all of this means, however, is that people's motives for rule compliance and water conservation have in this case been seriously misunderstood. Even though very small quantities of water were constantly traded in this community over a period of centuries (shares of the "old water" belonging to the big landlords), what was being "maximized" by people in this community by obeying the rules was not anyone's cash income, but rather how often they had the opportunity to irrigate their fields. The fact that people could sell any extra water that they did not use, or buy more if they needed it—which the small landowners normally did because of the supply of "new water" was chronically insufficient—or that a few people had rights to water which they usually sold because they no longer had much land, did not mean that such sales or such income was their main reason for being conservative and cooperative. This was clearly revealed in the fieldwork in interviews with the few people remaining in Alicante today who are old enough and knowledgeable enough to remember in detail how the "market" system worked (a system they generally refer to simply as a "tanda"). Some monetary income was a benefit, to be sure, but this was clearly recognized as secondary to the main benefit and logic of making the irrigation round as short and rapid as possible.

The primary benefit here—a maximal frequency of availability of very scarce water and a maximal frequency or intensity of its use—was, unlike any resulting income from water sales, shared equally by everyone. Thus in Alicante, just as in all the other cases mentioned here, we can speak of a close correspondence or compatibility, even a congruity, between private self-interest and the public good, in this limited sense. Given the prevailing scarcity, it was necessary for people (at least the peasants) to cooperate, and all of them experienced the benefits of doing so, directly and immediately, as well as the negative consequences of greed, of any failure of the common good to prevail. Such behavior had little to do with money, according to people who formerly participated in the "market," and everything to do with the circumstances of water use, the simple principles upon which people had agreed for centuries that water utilization would take place.

8. CONCLUSIONS

Envy, resentment, and conflict are inevitable in any human community, mainly because people are never really equal and all communities are stratified. And of course there will probably always be some free riders in any group of people. The important question is how many, and how pervasive their antisocial attitude can become under a given set of institutions and customary rules. But all of the communities described here show that "human nature" can be, in the right institutional setting, predominately social, communal and cooperative rather than selfish. And, indeed, these two supposedly contradictory motives can under certain circumstances become entirely consistent with each other and even appear to be congruent, or essentially equivalent, in the eyes of rational people. The system of rules and principles I have described here, which I call "the moral economy of water," accomplishes this. The tradition exists in south-east Asia, where water is scarce during only a fairly short season of the year, and also in places like Valencia, Murcia, Alicante, and Huaynacotas, where the resource is scarce under all but the very best of conditions. It is based on a consensus and a spirit of cooperation that, while not perfect, are nevertheless pervasive and have clearly prevailed for a very long time.

This, I would suggest, is where we should be getting our models of, and for, human behavior, and our images of "human nature." As for policy, these irrigation systems are clearly the places from which our models for building stronger institutions and better irrigation communities should come, especially for rebuilding communities that have long been rife with water conflict. With regard to irrigation water, I think that we can begin to speak now of a universal model that emerged independently in hundreds of places and reflects a worldview that was once pervasive among the world's peasant societies. Based on the central moral concept of equity, this general type of society, I think, provides us with an unprecedented case of parallel or convergent social evolution. It could clearly serve us well as a model for the greater human community of which we are a part, far better than any story of greed and tragedy, and far better than any abstract "market." For it is a clear expression of one side of our nature, as the eminently social and cooperative species we have always been whenever circumstances required us to choose which of our innate potentials was the more valuable one in the long run, and which one should come to the fore and be activated and reinforced. The model emerged independently in a great many places throughout the world, and it has endured for hundreds, perhaps even thousands, of years.