Comedy and Tragedy in the Andean Commons

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Few themes in social science have generated as much commentary or had as much impact on policy as the "tragedy of the commons", the widespread tendency of people to overexploit and abuse the resources that they hold in common. G. Hardin (1968), of course, took up the problem years ago and explained it in terms of an irresolvable conflict between the interests of the individual, said to be inherently selfish, and the cooperative needs of the group. His theory continues to have its appeal, especially to policy-makers, because of the ongoing crisis in the use of common-property resources--irrigation water, pasture lands, forests and fisheries--in many parts of the world, which Hardin thought to be inevitable. Yet it has also drawn a lot of criticism, especially within anthropology, based on studies of local communities that have managed such resources cooperatively, and done so quite effectively, over a long period of time, of which there are now many examples (N.R.C. 1986; B. McCay and J. Acheson 1987; D. Bromley 1992; E. Ostrom 1990, 1998; E. Ostrom 2002). This rebuttal has turned attention toward the related task of devising an alternative theory to explain how--according to what kinds of rules and principles--people have been able to overcome their conflict of interest, escape the 'commons dilemma', and pursue the common good (E. Ostrom 1990, 1992; E. Ostrom, R. Gardner, and J. Walker 1994).

An equally important task has been the documentation of situations where the tragedy has in fact occurred and the careful study of those local histories. Of particular interest here have been cases where access to the resource in question is not free and open, as in Hardin's model, but limited in some way by a community of users, a situation far more common than his hypothetical frontier. That effort has led to the realization that the two solutions he proposed--privatization of the resource, on the one hand, or control by a coercive State, on the other--can, if not carefully designed and implemented, create serious problems and lead to the failure of programs of reform. Some authors have even argued (B. McKay and J. Acheson 1987), as I will do here, that the tragedy is the direct result of those policies, that privatization and state control have often simply been imposed, and that they have helped to weaken or destroy effective local institutions for resource management, which were once widespread. They have created 'perverse' incentives for people, becoming causes of rather than solutions to the commons dilemma.

New laws governing the ownership and use of the commons are usually tied to major changes in a country's political economy, which the laws are designed to encourage, so that the State and dominant commercial interests have always in some way played major roles. That has long been the case in my own region of study, the Andes of Peru, where a tragic story has unfolded in many places around a conflict over water, the most vital natural resource and one of the most troublesome from a policy point of view. Although there are probably many local variants to the story, the major players and their various roles have, I think, been much the same over a large part of the region, and the general outline or plot—which I will follow here in one highland valley, based on my ethnographic research--has often been repeated: 'comedy' (as defined below) giving way slowly to tragedy. The good news, however, which I will also try to reveal, is that this has not always been the outcome, and that the lessons to be learned from the entire commons drama, from the successes as well as the failures, can be applied with beneficial results in many places. This historical narrative, even when traced in one small province, has important implications for policy, since it shows that, in the Andes at least, the tragedy surrounding the sharing and management of water can be avoided, halted and perhaps even reversed.

The Study of Irrigation History

My historical analysis, and my effort to generalize from ethnography done in one part of the highlands, are based on the assumption that, throughout the region, the existing pattern of hydraulic and landscaping practices in each community is the outcome of three gradual processes. These processes, or sets of changing historical conditions, have framed the specific history of

every community by providing a context in which changes in irrigation were likely, indeed almost certain, to take place.

They were: 1) the establishment, during pre-colombian times, of deliberate methods for managing scarce water resources, among populations that approximated those found in the region today (N. D. Cook 1981); 2) a massive reduction in the intensity of land and water use during the colonial period due to a sustained population collapse, one that must have created an extraordinary situation of water abundance (P. Trawick 2001b); and, finally, 3) a fairly rapid re-intensification, in response to demographic recovery of the indigenous population during recent times (P. Gootenberg 1991), combined with the simultaneous growth of regional export economies in many areas, growth that was based on the expansion and proliferation of haciendas, or private agricultural estates.

Table 1. Cotahuasi Valley Population, 1572-1981

	1572	1621	1689	1724	1785	1831	1876	1940	1981
					Coahuasi (district)				
Total	3,000	1,266	1,000	1,214	1,151	958	2,958	3,353	3,126
Men	506	302	--------	251	179	149	1,436	-------	------
					Alca (district)				
Total	4,490	2,731	580?	1,030	624	1,882	6,863	5,440[a]	5,374
Men	938	630	-----	213	129	365	3,040	----	-----
					Tomepampa (district)				
Total	3,070	2,666	416	372	299	527	934	1,311	1,022
Men	730	283	----	77	62	85	461	----	-----
					Huaynacotas (pueblo)				
Total							672	1,114	1,073
Men							318	-----	-----
					Papmpamarca (pueblo)				
Total							616	806	942
Men							310	-----	-----

Sources: 1572, cook 1975: 129-30; 1621, Vasquez de Espinoza 1943: 577; 1689, villanueva 1982: 319-20; 1724, 1785, Poole 1987: 271 (except Cotahuasi 1785 total, from ADC 1785a); 1831, ADC 1831; 1876, DNE 1876: 434-37; 1940, DNE 1940: 120-23; 1981, Peru, Oficina del Consejo provincial.

Note: No figures are available for Huaynacotas and Pampamarca until 1876 because they belonged to a different administrative province in the earlier years. I have included the districts of Alca and Tomepampa for illustrative purposes.

[a] Includes Puica.

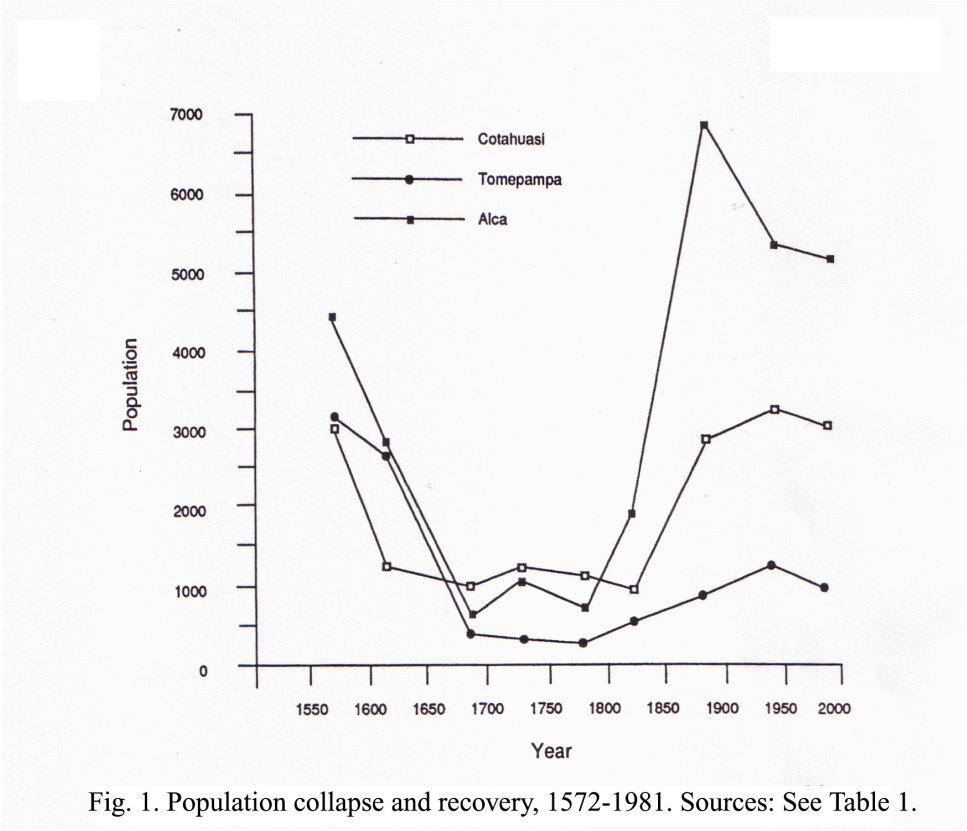

Fig. 1. Population collapse and recovery, 1572-1981. Sources: See Table 1.

Figure 1 and Table 1 show the available population data for three communities in the province where I did my research, including the districts to be discussed below. The figures reveal the magnitude and duration of the collapse in most communities and show how rapid the subsequent rebound was: roughly 66 to 80% of people, sometimes even more, either died or left the valley during the first century of Spanish rule, and the numbers only began to recover after 1830, if indeed they ever recovered fully at all.

It is clear that, in all cases, the recovery has taken place under ecological, economic and political circumstances never before experienced by Andean people. However, a critical variable is that, in many villages, the re-intensification of water use has been dominated by Spanish merchant elites, the owners commercial estates, who gradually appropriated much of the resource for their own use. In other locales this has not taken place. This dominant ethnic minority, which formerly ruled over most of the Andean countryside, operated locally with the aid of the legal and administrative institutions of the State and often benefited from the physical presence of its bureaucracy. Yet, in at least some rural communities, neither of these alien and dominating influences has been physically present, or been strong enough to have any significant effect on local irrigation.

By doing an historical and ethnographic study of three very different communities in one highland valley, I was able to show how these exogenous agents--the landlords and the State--together introduced a new kind of political ecology to the whole region, one that produced rather diverse outcomes in the end, yet did leave a few local communities fairly intact (P. Trawick 2001a,b; 2003). They thereby contributed to, indeed drove, a process of ecological, technological and social decline in many places, a “tragedy of the commons” whose symptoms have been widely

documented but that has never, itself, been adequately explained and understood. [1]

The villages are located in the Cotahuasi valley of Peru's Department of Arequipa, one of the more remote provinces on the arid western Andean slope. I chose them for study for two reasons. They have in common the typical kind of hydraulic structure found virtually everywhere throughout the sierra--small-scale, vertically-oriented canal systems fed by mountain springs--yet they differ systematically and cover a wide range of the variation found among irrigation communities in the region today. All three are stratified into groups of large and small landowners—called mayoristas and minoristas, respectively--all grow basically the same array of crops, including cultivated pasture for animals (alfalfa), but they vary in their ethnic composition and their degree of autonomy in water management. As in the vast majority of places, the irrigation systems are unified and run by some kind of central authority (R. Hunt 1988, 1989), but in one case that authority is a representative of the Peruvian state. The villages also differ systematically according to altitude, proximity to roads and adjacent provinces, and other factors, and form a kind of rural-urban continuum (S. Mintz 1953), though all within a very urban context.

The first, called Huaynacotas, which I describe in detail elsewhere (P. Trawick 2001a,b; 2003) but will discuss briefly here, is a remote village, located at high altitude, of people who identify themselves as *runakuna*, indigenous people, native Quechua-speakers who in many ways are typical of their neighbors and counterparts elsewhere in the valley and throughout the highlands in general. During the late colonial and modern periods, however, they have remained relatively independent of hacienda influence, never having allowed landlords to actually colonize their community and acquire land there. The second community, Pampamarca, also to be briefly discussed, is a predominantly indigenous village, again remote and lying at high altitude, but one that has long been dominated by a small group of resident Spanish landlords. These elite families long ago expropriated large amounts of the community's land and water in order to found private agricultural estates. Here, however, as in Huaynacotas, the impact of state institutions has not been directly felt in irrigation.

The third example, Cotahuasi, is a *criollo* and mestizo district that has historically been the center of local commerce and state provincial administration, including water management. Up until Peru's agrarian reform in 1969, it remained thoroughly dominated by a group of merchant-landlords and their families, people who identify themselves as Spanish and claim to be of direct Iberian descent. This dominant ethnic minority nevertheless makes up a sizable percentage of the local population. These people, like their relatives in Pampamarca, are notorious throughout the Arequipa region for having maintained their dominance over most local communities through the end of the 20th century (R. Montoya 1980:144), a preeminent position based in part on the rather strict practice of ethnic and class endogamy. In this case, three outlying satellite villages that were formerly indigenous (the only ones in my study that are accessible by road) have long shared their irrigation system with a dominant town and provided the local agricultural estates with both water and servile or tenant labor.

The fieldwork, most of which took place over a period of three-and-a-half years (1986-1990), thus encompassed three distinct types of community and amounted to a kind of controlled ethnographic comparison, carried out along and across a major economic, political and cultural divide. One could usefully characterize the dimension along which the three communities vary as the extent of their economic, political and cultural domination by outsiders, people who are not peasants and, in the case of the indigenous villages, are not even considered to be members of the community.

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1. The fieldwork, which was largely culture-ecological in focus, was carried out from 1986 through 1990, and was funded by generous grants from the Fulbright Foundation and the National Science Foundation in Washington, DC. Subsequent trips back were made during the summers of 1997, 1998 and 1999. See P. Trawick (2003:1-16) for a thorough explanation of the research methodology. Many people contributed to the research and the subsequent writing, but here I especially want to thank Ellen Messer of Tufts University and Bill Mitchell of Monmouth University for the great help and encouragement they have given me throughout the years.

Huaynacotas: an 'autonomous' peasant community

In the first village (population 1080; elevation 3,400m.), traditional methods of sharing water and irrigating with it are distinctive and seem to remain intact, since they are found together as a set only here and in a few other places. Significantly, these same practices seem to be present in the three other local villages that have maintained their autonomy in the same way, and not anywhere else,[2] i.e., the few that are not dominated by landlords. In my opinion, we see in Huaynacotas an evolved modern version of a hydraulic tradition that once prevailed throughout arid parts of the highlands, which is to say in most of the region.

The members of the community claim that this heritage is Inca, a remarkable assertion of cultural continuity which I discuss elsewhere (P. Trawick 2001b; 2003) and which there is good evidence to support, both ethnohistorical and ethnographic. Here I will say only that the Incas do appear to have had a policy for water management, as some of the early Spanish chroniclers insisted (I. Garcilaso 1966[1609]:248; F. Guaman Poma 1978[1613]:356,246, 848, 1040,1237). They may have officially adopted and endorsed it because the tradition had become widely established in the Andes long before them and was ultimately of local origin. The tradition that lives on in Huaynacotas today is probably one component of what appears to have been a dual tradition with two modes of operation (see J. Treacy 1994a,b for a contemporary ethnographic example): one for use on rare occasions when water was abundant, of which more will be said below, the other for use when it was scarce, the normal state of affairs today in Huaynacotas and most other places in the highlands. Scarcity, it should be noted, probably prevailed widely during Inca times too, which we know came toward the end of a long dry period lasting several hundred years (I.G. Thompson et. al. 1985).

Although I will not take up the argument here, I think that the water-conserving mode or tradition was probably used at most times and in most places in the Andes, which would help to explain why it still has a fairly wide geographic distribution among peasant communities in the region today. In any case, in order to sidestep that issue here, I will refer to the water-conserving tradition of Huaynacotas simply as a local one that originally prevailed throughout most of this particular valley, at least when the resource was scarce. This seems a reasonable assumption, since we know that the valley was inhabited during late pre-Inca and Inca times by a single, very powerful ethnic group (I. Garcilaso 1966[1617]:56-57; P. Cieza de Leon 1959[1553]}199-200). My intention here is primarily to tell a local story that reveals important dimensions of the history of this particular province, whatever may be the implications of that history for other parts of the Andes, which were once part of the same Inca empire.[3]

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2. These families consider themselves to be of Spanish descent and heritage, distinguishing themselves from indigenous people and mestizos as "*españoles*" (see Y. Onuki 1981:14).

3. It now seems clear, based on the ethnographic work of numerous people, that this same tradition, based on the same set of operating principles (see below), also exists in many other parts of the world: e.g., Mexico, Spain, India, Nepal, the Philippines. This includes some of the acequia irrigation systems in northern Mexico (T. Sheridan 1988), which appear to be of Iberian and Islamic origin, since they bear a striking resemblance to some of the better-known communities in Spain, such as Valencia (T. Glick 1970; A. Maass and R. Anderson 1978; E. Ostrom 1990). It seems unlikely, however, that such an historical connection exists in the Andean communities where I did my research. The tradition I have described here appears to be found in indigenous communities that were never directly settled by the Spanish, and not anywhere else, and it corresponds precisely to the accounts of Garcilaso and Guaman Poma in describing what they claim was the Inca system of water management (see P. Trawick 2001b). I argue that the tradition is an optimal one, whose basic operating principles have been worked out independently by local people in many different parts of the world as a way of dealing with water scarcity (P. Trawick n.d.a).

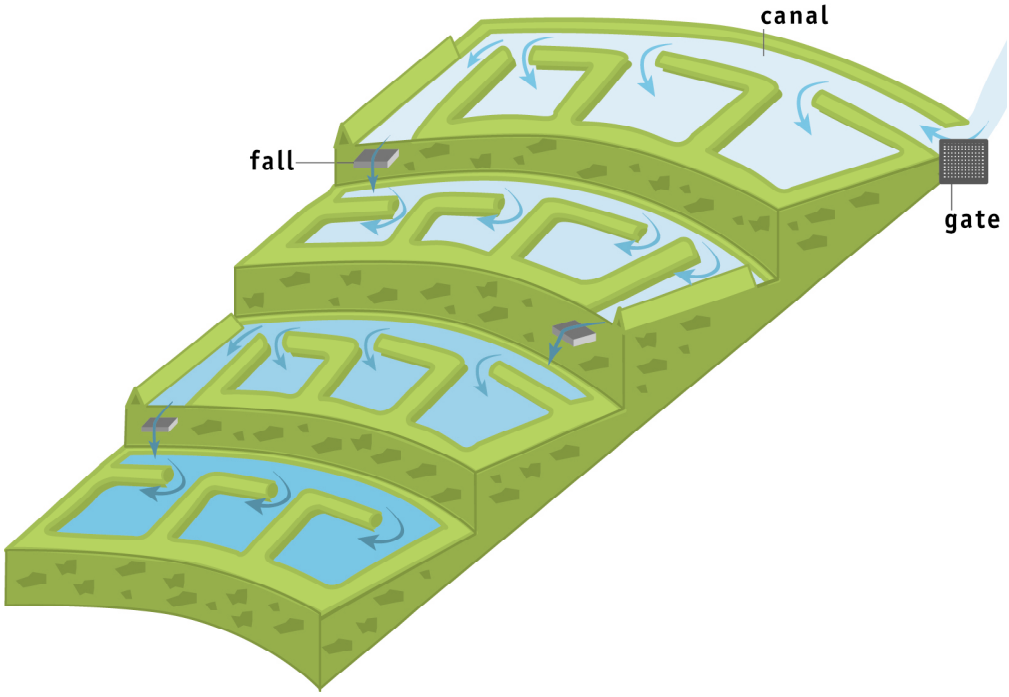

Figure 2. A Typical Terrace irrigation Unit

The hydraulic system itself (see Figure 2) is a dual one with two main water sources (alpine springs), two storage tanks, and two separate networks of canals. It is operated independently by the village members through a system of rotating, allocated authority in which customary procedures are exclusively followed, essentially identical ones in the two halves of the system. During each distribution cycle the elected water officials, called campos, divide the flow of each main canal approximately in half, into two standard and roughly equivalent portions called *rakis*, in the act of diverting them into the secondary canals. They then allow the water to flow on down to the fields, where each *raki* is dispersed and used, or consumed, by a landowning family or household (see R. Montoya et. al. [1979] and J. Treacy [1994a,b] on *rakis* in other Andean communities).

Because the entire landscape is terraced, the actual watering can be carried out by means of a uniform water-pooling technique. This minimizes waste by ensuring that nearly all of the water soaks into each terrace, and it also ensures that the duration of irrigation, and the amount of water consumed by people in each allotment, are strictly proportional to the extent of that person's property. Though some adjustments are made for differences in soil type, this basic symmetry exists because all cultivated surfaces are virtually level and standard water containment features, called *atus*, are used by everyone (see Figure 2). Since liquid is pooled on the surface to a uniform depth, the regulation of irrigation time, and of water consumption, are inherent features of the technology. Once the pooling structures are full, irrigation is considered complete and watering immediately moves on to the next plot, without any repetition. The water distributors do not allow any departures from this arrangement, such as the destruction of terracing and the irrigation of slopes, practices that are common in most hacienda-dominated places. These customary procedures, and all the ones to be described below, are not just techniques but also rules according to which irrigation and water use are supposed to take place.

Other procedures ensure that all parcels of land served by a given spring, and all households,

receive water with the same frequency, though one that varies with seasonal and long-term fluctuations in the supply. First, the land sectors that make up the village territory, which are defined according to patterns of micro-environmental variation, are allotted water consecutively in a fixed sequence based on planting order and crop maturation times (see Figure 3). During each cycle of the system, watering passes through all the sectors currently in production, reaching every parcel before beginning again.

Secondly, the plots within each sector are likewise given water in a rigid contiguous order, starting at the bottom of the sector and moving systematically 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 specific crops in which they are planted. Alfalfa, for example, is grown here in tiny plots, an irrigated pasture that was introduced in the region long ago by the landlords of the lower valley. But, unlike the situation nearly everywhere else, here the plant is watered in the same way and on the same schedule as any other crop.[4] Thirdly, a standard method of adjusting allotments guarantees that households absorb rather equally the impact of chronic shortages.[5] As a result, even though the springs that supply this community are the most vulnerable in the entire province to droughts, which have reached alarming frequency during the last thirty years, conflict over water is far less prevalent in Huaynacotas than in most other places. I can say this with confidence because my study included the two other communities; there, favoritism and water theft occur often, are a common focus of conversation, and a source of constant concern. That is not true in Huaynacotas, as the village members readily point out.

In addition to providing a uniform frequency of irrigation--a basic right of all community members--the contiguous watering pattern limits waste of the resource due to evaporation and filtration (a serious problem in all highland villages) by minimizing the total surface area of canals in use at any point in time. Thus it is considered an ideal arrangement. The reason was explained to me by the campos: water loss through filtration decreases dramatically once a canal surface and the soil beneath it have become waterlogged or saturated. Thus it is best to concentrate irrigation in one small area at a time rather than jumping erratically around, as happens in Cotahuasi and most other places in the valley.

Just as importantly, contiguous distribution has the effect of making irrigation a public activity, rather than an isolated and covert one as it is in so many other places. Since everyone knows the rules of 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 preparing their fields, waiting and watching, while their neighbors finish their turns. This pervasive monitoring, which goes on all the time and is an inherent aspect of irrigation under this kind of arrangement, helps the distributors in ensuring that traditional methods are followed and the rules are respected (cf. E. Ostrom, R. Gardner and J. Walker 1994:325-326). It has the vital effect of providing restraints upon theft, favoritism on the part of water officials, and other forms of corruption,[6] (P. Trawick 2001a), a responsibility that elsewhere falls solely upon the water distributor.

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4. Alfalfa is extremely drought-resistant plant that has an extraordinary capacity to respond to more frequent watering by growing faster and blooming more often. It has probably had more impact on life in the Andes—much of it negative, than any other crop that the Spanish brought with them, with the possible exception of sugar cane, which is used to make alcohol (see below).

5. At times of real emergency, when the period between waterings begins to exceed 90 days, the water distributor must take action to ensure that it does not extend beyond 100 days. The most effective way of adapting to drought is to truncate the distribution sequence by taking some of the upper sectors of land—the irrigated fallowing lands, or t'ikras--out of production. The water itself determines this by causing the first irrigation of the year to advance very slowly. When the time comes for the second irrigation, whose date is fixed, any of the higher sectors that have not yet been watered are simply dropped from the order after a community vote. The impact falls rather evenly on everyone, since everyone has land in those sectors.

6. The only kind of infraction that is really possible, other than water theft, is double irrigation, returning to "top-off" one's terraces after they have had time to drain somewhat. This is

Thus the principles that govern irrigation in the village (see list below) create an extraordinary kind of transparency, making possible an equally remarkable capacity for self-management by the *comuneros*, the community members. Ultimately, it is the individual's active role in asserting and defending his or her own rights--the right to withdraw one proportional share of water for their land during each distribution cycle--that allows the system to function effectively, by preserving the 'egalitarian' principle upon which life in this community is based. People's rights--*de facto* claimant rights,[7] in the terminology of E. Schlager and E. 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, everyone in the village knows not only how to irrigate a terrace but also how to operate the entire system, since the male heads-of-household do this in rotation, also sponsoring and directing the yearly Water Festival, Yarqa Aspiy, the ritual cleaning of the irrigation canals.

Even more importantly, water rights here are quantitatively proportional to each other, varying only with the extent of a person's land. In practical terms, 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 most other places, by getting it more often than everyone else. According to my experience in this valley and elsewhere, including the better-known Colca Valley, such proportionality is crucial, amounting to a basic moral principle that clearly defines everyone's rights (P. Trawick 2001b). And where it does not exist, as in the other two communities to be described below, this is a major source of conflict and a primary reason for the ongoing breakdown of communal and civic life, of the commons tragedy.

Note that in Huaynacotas some families have more land and use more water than others, just as in any other stratified community, but that a fundamental symmetry prevails, not only in the size and frequency of household allotments but also in the corresponding maintenance duties that people must fulfill in order to preserve their rights. The latter is the most basic of all forms of reciprocity, an exchange between the household and the community, done each year in return for the family's use of communal water (E. Mayer and C. Zamalloa 1974; E. Mayer 2002:124-5), and life in this village is very much centered around an equitable arrangement. Because *mayoristas* 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, food and other inputs, than those of the *minorista* majority.

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 the lower end and moving steadily along each canal;
3) *Uniformity*: among water rights: everyone receives water from each major source 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 proportional 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 directly proportional to the amount of irrigated land that they have;

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prohibited and, again, easily detected.

7. In this system, users participate in setting, or continually ratifying, collective-choice rules of management, but they cannot alienate their rights, which are tied to the land, nor can any landowner in the community be excluded. These have more commonly been called communal rights (see E. Schlager and E. Ostrom 1992:253), but they are not recognized by law since, as of 1969, the Peruvian state, which has no presence here, has been the legal owner of all the country's irrigation water (CEPES 1984).

5) *Transparency*: everyone knows the rules, and has the ability to confirm, with their own eyes, whether or not those rules are generally being obeyed, 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.

Largely because of this, the infrastructure is well maintained (Figure 3), in contrast to what one sees in the hacienda-dominated villages, and in many other communities throughout the highlands today, where such proportionality between rights and duties no longer exists. The breakdown of these communal work traditions has been widely noted in the Andes for many years (e.g., C. Erasmus 1965; J. Hendriks 1986), but in my opinion the main reasons for it, a lack of this proportionality, and the resentment and conflict that arise among people because of this (especially *minoristas*), have never been understood (see D. Guillet [1992:204-205] on its significance in the Colca valley). As we will see below, the loss of proportionality has generally occurred in the region as communities have become more stratified, due to the accumulation of land--and also water--by certain prominent families, without an accompanying obligation proportional to their rights, rights that in many cases were simply imposed by force.

The principle of proportional symmetry or relative equality, as I have just defined it--or equity, as it has been more appropriately called (R. Hunt 1992)--is based on long-standing continuities in the irrigation system: the uniform watering frequency and the proportionality among rights and duties. Ultimately, however, these commonalities are expressions of the will of the smallholder majority, who, through constant vigilance and a continual process of negotiation and confrontation, have been able to maintain constraints on the terms under which the wealthier minority operate, not just in irrigation but in the domain of reciprocity generally.

Note that water is extremely scarce here, with irrigation cycles roughly two to three months long, and that people do occasionally fight over the resource because it is sometimes stolen, given illegally, or otherwise taken out-of-turn. Huaynacotas is not some kind of social utopia, nor is its hydraulic tradition a panacea for all conflict and all social ills. The bigger landowners in particular, who get more water than most people, must assert and protect their rights personally, and quite publicly, with a shovel in the act of irrigating. Due to the various risks and responsibilities involved, they cannot afford to turn this task over to someone else, such as a peon or wage laborer, someone to work in their place, nor can they afford to do so in communal labor.

That, like other practices common in Pampamarca, Cotahuasi and other hacienda-dominated places, would be considered behavior befitting a Spanish landlord, people who traditionally shunned all manual labor and who continue to do so for the most part today. It would not be tolerated but instead readily taken advantage of, leading to water theft, other kinds of negative feedback and informal sanctions. It may seem paradoxical that such a contentious reality should help to sustain a fundamental equality, but that is evidently the case. This idea, that no one is above certain kinds of work--irrigation, cultivation, and communal maintenance work—appears to be the main principle governing labor relations in Huaynacotas.[8]

Although each of the basic principles is crucial to the functioning of the system, the most pivotal one in terms of the incentive to cooperate is the uniformity of the watering frequency.[9] In

8. Note that the large landowners here, although possessing no more than three irrigated hectares each, are involved in the same activities as those in communities like Pampamarca and Cotahuasi--subsistence combined with some cattle-raising for the market and petty trade--and that some of them even have small herding estates on the altiplano above the village, lands that once belonged to the community. Now, as in the recent past, they would have to be seen, from a purely socioeconomic standpoint, as roughly equivalent to hacienda owners and other large-holders in terms of class. Yet their behavior is distinct in fundamental ways; they are accountable, as *comuneros*, to the interests of the other village members. They are subject to certain constraints that those members impose on their activity, an accountability that is integral to their social identity and is rooted in the exercise and defense of their water rights.

9. The irrigation system, like that of Pampamarca and Cotahuasi too, also incorporates

the rugged terrain of the Andes, this is the only place where such a motive can be found, in the link between the efficiency and orderliness of water use—in terms of avoiding waste and respecting other people's rights—and the duration of the irrigation cycle. And that link is at its most direct and obvious, to the individual farmer, under the conditions described here. When everyone irrigates their land on a single schedule, and any sudden expansion is prohibited, the water saved by people 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, conversely, in a situation of uniformity, "free-riders"—people who ignore the rules and steal water or irrigate excessively—interfere with the efforts of others to shorten the cycle and instead cause it to slow down. Consequently, the arrangement generates strong social pressures against this kind of behavior.

The incentive to comply is thus remarkably strong under this kind of regimen, especially when one takes the pervasive monitoring and the threat of sanctions into account (sanctions are quite severe, but graded according to the gravity of the offense). People tend to act in terms of a widely perceived compatibility or correspondence between individual self-interest and the common good. And the tragedy of the commons, far from being inevitable, is actually quite difficult to bring about. Such a situation, which might be likened to 'comedy' in the classical sense, i.e., "the drama of humans as social rather than private beings, a drama of social actions having a frankly corrective [and mutually beneficial] purpose" (Smith 1984, cited in B. McKay and J. Acheson 1987:15) is created by the scarcity of the resource, which in this community is especially grave, and the arrangements that these people have worked out for dealing with a situation that is far from ideal. That is the dilemma that the people of Huaynacotas face, but it is not one that they have brought upon themselves.

Pampamarca: a colonized indigenous community

Centralized or unified systems like the one described above are found in most peasant villages, both within and outside the region (e.g., W. Mitchell 1976, 1994; P. Gelles 1994; R. Valderamma and C. Escalante 1988; D. Guillet 1992; J. Treacy 1994a,b), sometimes accompanied by the same procedures and techniques. In most cases, however, the egalitarian arrangement has been modified, as in Pampamarca, a colonized indigenous community. This village (population 852; elev. 3,600 m.) is composed of four *ayllus*, or corporate kinship groups, each of which has its own territory, its own irrigation system with its own water sources (alpine springs), and its own campo, or water distributor (see Figure 3). The principles of water distribution and use are, with a few minor exceptions, exactly the same in each *ayllu*, forming a distinct local tradition.

During the 19th and early 20th centuries, the community was colonized by a handful of elite merchant families, who established small agricultural estates and expropriated communal water in each *ayllu* for their own private use. These people were part of the provincial Spanish elite, members of the dominant extended families who came here to settle from Cotahuasi or from adjacent provinces. The ensuing expansion of the haciendas, a process that affected most of the Andes during this time, is known to have been promoted by the early 19th century reforms of Bolivar and later pieces of legislation. These reforms, basically the same as the liberal reforms passed in Mexico during the previous 18th century, supposedly sought to make Indians full citizens and enable them to participate more fully in the market economy, by legalizing the buying and selling of indigenous community land. The ultimate effect, however, was to unleash an assault, by outsiders such as the elite families, on common property resources, including water,

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numerous small secondary springs that emerge within it, each of which has a small tank. However, this water is also distributed communally and equitably, on the same schedule, as the water from the main springs and canals. It is used locally to water the surrounding sector of land, after which the spring water is combined with the main water in order to complete the cycle. At the appropriate point it is then used locally again, so that the frequency of its use is uniform and comforms with that prevailing in the rest of the canal system. No duplication is allowed. Note that this is the same arrangement that prevails in Pampamarca, and it is a basic feature of indigenous irrigation in the valley.

and to undermine village organization at its very heart (G. Kubler 1952; T. Davies 1970; E. Grieshaber 1979; P. Gootenberg 1991).

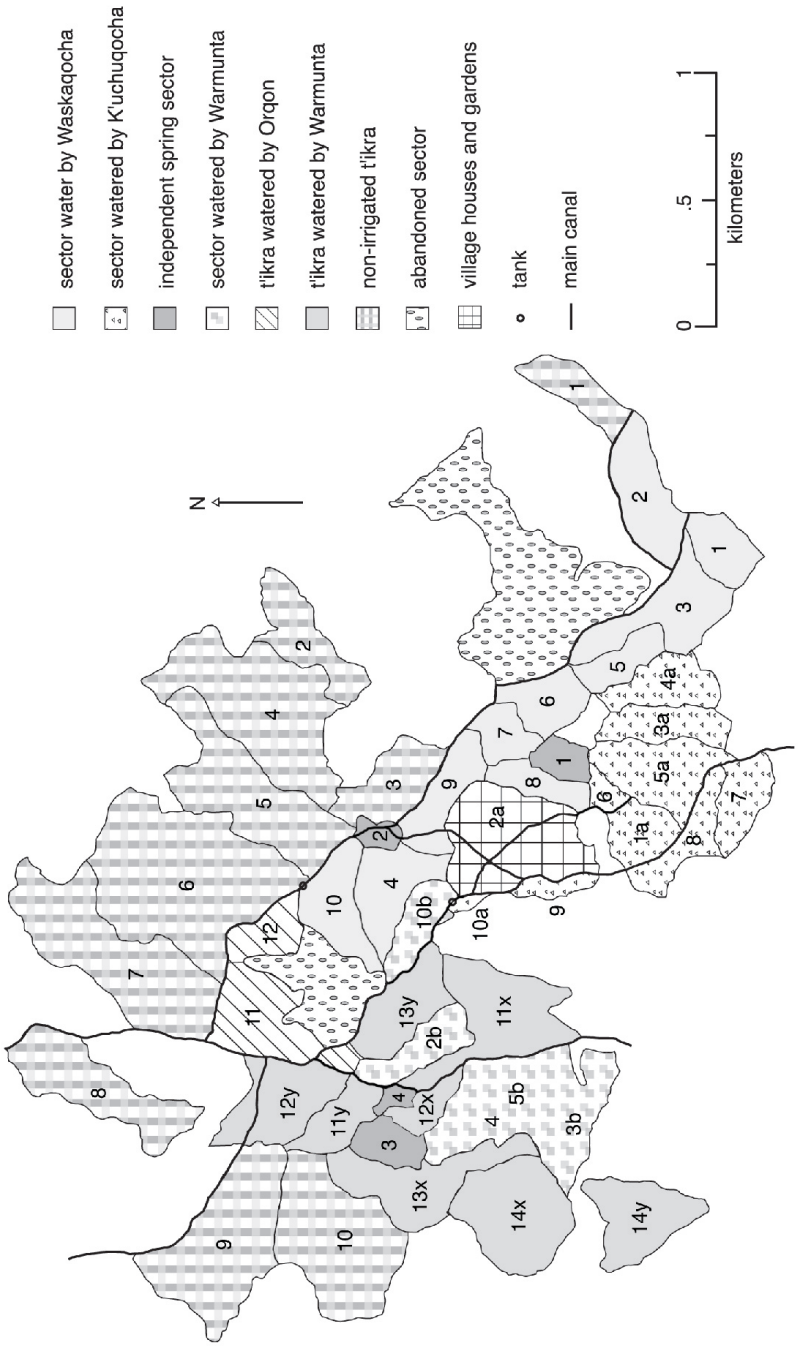

Figure 3. Irrigation and Land-Use System of Huaynacotas

The hydraulic impact of Bolivar's reforms has not been widely recognized. Ultimately stimulated by the rapid growth of Peru's international export economy, specifically the trade on the altiplano in alpaca wool, the expansion began and was largely played out during the long era of depopulation and water abundance, which did not really end in most places until the early part of the 20th century (see Figure 1 and Table 1). As in most highland valleys, the estates whose growth the State encouraged specialized to a great extent in producing pasture, in order to feed mules, horses, and cattle--animals that were the basis of commerce and long-distance transport in the countryside. Muleteering, in particular, was the backbone of regional trade throughout the length and breadth of the Andean sierra (N. Manrique 1983). Consequently, hacienda expansion brought about a major shift in adaptation in which the cultivation of alfalfa, a non-native plant with an almost limitless thirst for water, became preeminent.

In order to maximize pasture production, the landlords not only irrigated their land more often than *ayllu* members--every two weeks--but also destroyed the prehispanic terraces on their estates, replacing them with large corral-fields that typically have a pronounced slope, called potreros or canchones (see Figure 4). These sloped pasture fields, which are the distinctive feature of the hacienda landscape in the region (see, e.g., E. Mayer and C. Fonseca 1979; D. Guillet 1992:166-167), cannot be irrigated through the water-pooling method, which still prevails for the most part throughout the remaining terraced landscape. Thus a new technique emerged, one in which liquid is released at the top of a field over an extended period of time and directed continuously downward. This method, very common in the Andes today, instills a tendency to prolong irrigation, quite excessively in many cases, in an effort to ensure that the soil is deeply saturated, an act that typically leads to a lot of waste. This is because there is no way of easily telling when saturation has occurred and the soil has had enough. The chief advantage is that it requires less work than the pooling method, a feature that must have made it attractive during and era when labor, rather than water, was the scarce resource.[10]

For these reasons, when the elite families began to buy community land in response to Bolivar's reforms, in order to take advantage of the opportunities provided by growth in the wool trade and the mercantile economy, they also confiscated inordinately large portions of communal water. These private shares were defined in terms of fixed periods such as specific days of the week, during which the landlords had exclusive use of the alpine springs. Such rights were recognized by the State and made legitimate by Peru's first water law, the Water Code of 1902, as we will see below (M. Pasapera 1902), and in many cases legal titles were obtained to validate them, though this did not happen in Pampamarca. Such privatization occurred widely throughout highlands during the period of estate expansion (R. Montoya et. al. 1979:77-80; E. Mayer and C. Fonseca 1979:29-30; W. Mitchell 1994), but its impact has generally been overlooked. Significantly, here as elsewhere in the valley—no doubt throughout the entire region—these private water rights, having been established by force, were not contingent on any duties in canal maintenance. The landlords, who universally shunned all forms of manual labor and who were the biggest water users in the community, simply refused to contribute anything to the 'communal' work.

In Pampamarca, we can see the impact that these developments and others have had on a predominantly indigenous community, but one with a unique feature. The springs that supply this village are almost impervious to drought, and water has remained abundant here despite major population growth during recent decades. Because of this, the privatization of water by a few elite families, though introducing a major inequity among peoples' rights, and between their rights and duties, did not seriously affect the hydrological balance, nor have other related changes that

10. Apparently, a similar practice was adopted in many indigenous communities during this same period, for use on terraces, for example those in the Cañete and Colca valleys (E. Mayer and C. Fonseca 1979:26,30; C. Fonseca 1983:64; R. Valderamma and C. Escalante 1988:79; J. Treacy 1990:169-172; D. Guillet 1992:59-59). In some cases, the inundation method seems to have completely displaced the pooling method, probably because it requires less labor, but in most communities a mixture of techniques is still found. Such changes were perhaps inevitable during a time when labor, rather than water, was the scarce resource, but they had negative consequences that were not felt until later, when water became scarce because of sustained demographic growth.

occurred before or have happened since.

First of all, the contiguous order of distribution, if it ever existed here, was modified long ago and replaced by another pattern, a hierarchical one that remains the tradition today. As the watering cycle is taken up consecutively for each sector of land (which, as before, are watered in a fixed sequence determined by the planting order), the landlords are first in the sector order, and are allowed to irrigate for as long as they care to, without supervision, for the first few days. After that a routine procedure is carried out by the water officials for the community members (*comuneros*): water is given to households, rather than to fields, in an order that is hierarchical. Within each sector, the community members are allotted water consecutively according to the positions that they hold in a prestige ranking based on civil and religious service to the community, the well-known cargo system. They are then free to distribute that water to their fields in any order that they like.

The presence of this kind of hierarchy in irrigation, which has been noted in several other provinces and regions (P. Gelles 1986; E. Mayer and C. Fonseca 1979; R. Montoya et. al. 1979), is apparently not merely due to Spanish domination such as we find here. Rather, it also seems to reflect the continuation of another ancient tradition of water use. As previously mentioned, ethnohistorical and ethnographic sources suggest that the Inca water policy may have been a dual one with a second mode, a hierarchical one in which the watering order for each cycle was determined by the age and prestige of the landowners within each ayllu (P. Trawick 2001b; 2003:110-149). Although the watering frequency was probably the same for everyone, as it is here, the exact sequence may have been determined by the social and symbolic order, rather than the lay of the agricultural land. This procedure, also widespread in the Andes today, was apparently used only when water was abundant. That situation is now extremely rare, and it probably happened only occasionally during Inca times, which we know were generally arid (I. G. Thompson et. al. 1985).

This kind of system is found in many villages in the highlands, only occasionally accompanied by the other, more conservative way of doing things when the resource is scarce (see J. Treacy 1994a,b). The hierarchical tradition appears to have been widely adopted as a permanent arrangement during the long era of population collapse, when water became abundant and remained so for centuries, eliminating the need for conservation. Unfortunately, that situation reversed itself some time ago in most places, and yet the hierarchical tradition persisted, here and probably elsewhere too, setting the stage for conflict as time went on, as we will see below. The landlords appear to have simply superimposed themselves on top of this communal system when they colonized the community, claiming the first few days of water in each distribution cycle as theirs. This clearly distinguished the "*agua de las haciendas*", the private water, from the communal, the "*agua de la comunidad*."

In theory, the hierarchical mode is not supposed to create any inequity among the water rights of the village members, as it does for the landlords, since everyone is supposed to receive their proper share of water during each cycle of the system. In practice, however, inequality has emerged because of a second, more recent change in practice. Although terrace irrigation and water pooling have apparently always remained predominant, some *comuneros* have recently built sloped pasture fields, which they now irrigate using the top-down method. This practice, which emerged during the last few decades and is slowly expanding, is the work of a small peasant minority who have basically followed the landlords' example.

Thirty years ago, due to the demise of the hacienda economy through agrarian reform, the Spanish families began a slow exodus to the city. This led to the emergence of a small group of these indigenous middle-proprietors (six families), *comuneros* who slowly accumulated land and who are in the process of occupying the commercial and political 'niche' being vacated by the landlords. Because the wool economy had gone into decline previously, during the 1950s, and been replaced by the cattle trade, it is now the latter, as well as a bit of petty commerce, that provides them with their livelihood, the political economy of food export to the cities. Unlike most *comuneros*, who typically have a cow or two which provides the family with milk and an occasional calf to fatten for sale, these people may own up to a half dozen head at any one time, animals that they generally purchase in other communities. The animals are fed partly on alfalfa, but also grazed on the village's fallow lands and the surrounding uncultivated slopes.

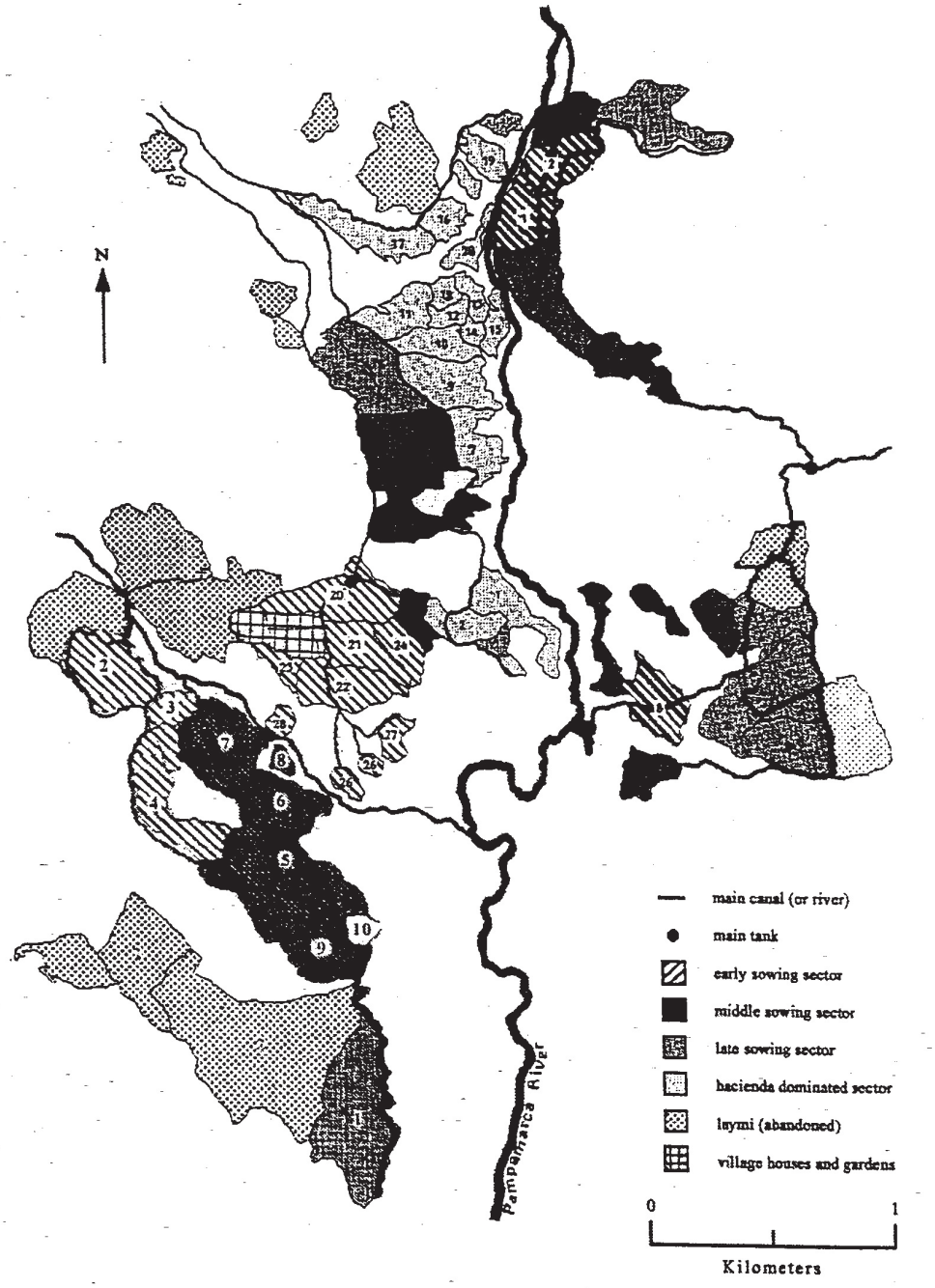

Figure 4. Planting and Water Sequences in Pamparca

It is these families, still only a handful, who raise cattle and cultivate pasture in *canchones*, and they are among the top-ranked members of the village hierarchy. In recent years, some of them have used their newly acquired power to manipulate and even defy the water authorities. At times they have been able to water more often than everyone else, or to do so at times most convenient for them. There have been many cases recently where they have taken the water of others as they pleased (P. Trawick 2003:144-149).

As for why this kind of behavior has been tolerated, under some protest, by the community, some of them simply reflect the growing economic power of these particular families. The most important one by far, however, is that there is more than enough of the resource to go around: people generally irrigate their fields in Pampamarca every two to three weeks, depending on the alpine spring, a frequency that would be considered optimal in any other local community. A second reason is that, while the occasional breaches of custom do cause inconvenience and resentment, the delays they create for others are usually brief and do not consistently fall on the same individuals. Therefore, few victims seem to perceive their water rights as truly threatened, and few get upset enough about the situation to do anything about it. I say this based after having asked people repeatedly about a problem that they acknowledged to exist and to be slowly spreading.

A final crucial reason is that most of the infractions occur unobserved, behind the scenes. Because social hierarchy is the basic principle of distribution here, irrigation patterns tend to be dispersed rather than concentrated in one small area, and to vary between cycles, to such an extent that distributors have to inform users of the specific watering order for each week. The prestige ranking is not inscribed anywhere but rather has to be 'read' by the *campo*, and several people often occupy roughly the same position. More importantly, the distributors constantly have to adjust to people's requests to be allowed to irrigate when it is convenient for them, especially the high ranking members, according to the contingencies of the moment during a particular cycle, even when not convenient for the rest of the landowners in a given sector of land.

As a result, irrigation is less predictable, less transparent and less public here than in Huaynacotas. And vigilance among neighbors is much less systematic and effective. Water theft and favoritism on the part of the distributors can occur more easily because the restraints on them are not as strong. Of course, people are generally aware that such abuses do occur, but they have to go to a lot of trouble to detect particular cases and to do anything about them. That is the impact that hierarchy has ultimately had. Such incidents have not yet become widespread enough to seriously disrupt the traditional system of distribution, and probably will not for some time. But they are causing problems in the *ayllus* that, according to what people told me, did not exist before.

In the other local villages where elite minorities have long resided, conditions seem to be similar to those just described, and similar events are said to occur. However, in places where the landlords achieved their dominance much earlier and in greater numbers, as in Cotahuasi district, these kinds of changes began to take place a long time ago. That is why this particular case has a special historical significance. Being the only community in the valley where water is plentiful today, Pampamarca reflects hydrological conditions that must have prevailed throughout the entire highland region up until the late nineteenth or early twentieth century, before local populations had recovered fully from collapse (N. D. Cook 1981; P. Gootenberg 1991; see Figure 1 and Table 1).

It was during this period, when pressure on resources had remained relaxed for centuries and land and water were still abundant, that the indigenous tradition began to change in the hacienda-dominated communities. Thus, Pampamarca provides a unique glimpse at some of the dynamics that must have been at work. Basically, the negative impact of non-local practices--alfalfa cultivation, terrace destruction, slope irrigation, privatization, hierarchy and inequity in water use--elements that were introduced within a depopulated system, were not strongly felt until later, when resources became scarce because of rapid population growth. This, I think, was the context in which some Andean people first began to depart from tradition and adopt attitudes and practices more typical of the Spanish elite. Their motivation, of course, came from the opportunities provided by the changing political economy of the region--opportunities, limited though they were, to specialize in producing pasture for animals, to accumulate some capital, and to increase their own power and prestige. But along with those activities came special water 'needs.' This, in an ecological and economic sense, in terms of both structure and process, is how the tragedy of the commons began.

Cotahuasi: a hacienda-dominated district

The third case in my study is a district composed of several communities--a town (Cotahuasi, pop. 1,073, elev. 2,700 m.) and three outlying, high-altitude villages, all of which use a common set of alpine springs (see Figure 5). Here elite families of Spanish descent have made up a significant percentage of the total population ever since early colonial times (H. Bingham 1922). Until recently they were the owners of small estates that together took up over half the irrigated land in the district, and they owned an even greater percentage of the water.[11]

Most of this property was acquired by the landlords, and lost by the communities, a long time ago. The first estates (like the two oldest haciendas in Pampamarca) were founded early in the seventeenth century (Villanueva 1982 [1689]:319-320), when the discovery of gold in the upper part of the valley brought an influx of Spanish settlers to the area. That initial encroachment was then followed by two long periods of expansion. The first occurred throughout the 18th century: moderate hacienda growth associated with an expansion of mining, one stimulated, in all likelihood, by the Bourbon reforms back in Spain (Lynch 1989:329-370). Although the local gold mines were small, and the colonial government probably never knew of their existence (Purser 1971; Fischer 1975), the colonial reforms imposed conditions, particularly new taxes on mercantile trade, that must have given the early estate owners an incentive to expand.

The second period began in the late 19th century and continued through half or more of the 20th. This expansion, like the establishment of most of the estates in Pampamarca, was spurred by the international trade in alpaca wool on the surrounding altiplano, a development that reflected a more general and exponential increase in foreign investment in Peru's economy (G. Appleby 1976; B. Orlove 1976). The landlords made their living as merchants and middlemen in the trade, collecting wool by bartering food crops, alcohol, and imported merchandise with herders on the plateau (R. Montoya 1980:144-142). The expansion began in the late 1800's, surged dramatically as wool prices reached their peak during World War I, then slowed gradually after mid-century (A. Flores Galindo 1977:150-153). The entire system of exchange was based, of course, on muleteering and on alfalfa production, and it remained so until the road finally reached the valley in 1960

The eventual result, from an hydraulic point of view, was the loss, through privatization--both *de jure* and *de facto*--of more half the water in the district, water that came to be referred to as the "*agua de las haciendas*," or, appropriately enough, the "*agua de alfalfa*." Peru's Water Code of 1902, which was itself based on the Spanish Water Law (Pasapera 1902), would ultimately recognize as private property any spring or subsurface water that emerged on privately-owned land, provided that the owner had actually been using it. Anyone who had been utilizing such water for twenty or more years was authorized to continue, as of 1902, followed by the next landowner down-slope, provided that he or she had been using it, and so on for each major source. Any remaining water, such as the part still controlled by the indigenous communities, known as the "*agua de las comunidades*", was declared to be public water, which would continue to be used by existing communities of irrigators. The landlords, however, by somehow gaining ownership of all the high-altitude pasture lands in the district, where the major springs are located (something that happened in the middle part of the 19th century), were ultimately able to gain legal titles to much of the water as well.

Many of the newer properties were not accumulated, however, until after the turn of the century. During previous decades, members of the dominant extended families, the Spanish *castas*, who generally had estates located around the town of Cotahuasi itself, had begun to acquire land and water and actually settle in the surrounding villages, like their relatives in

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11. The system of water tenure was a dual one, a kind of regime that was quite common in the highlands. In the case of two of the major springs, certain days of water belonged to the landlords, referred to as the "*agua de las haciendas*", or "*agua de alfalfa*", and the remainder to the comuneros, referred to as the "*agua de las comunidades*". The third major spring was entirely private property. R. Montoya et. al.(1979:78-79) were the first to describe this kind of system, which was ratified by the Water Code of 1902, in Puquio in southern Ayacucho.

Pampamarca, communities that at the time were still indigenous (P. Trawick 2003:162-165). The penetration of the annexes resulted in the establishment, within each one, of the same kind of water distribution system described in the previous case. The landlords took the first few days of water as their own, and distribution among *comuneros* was hierarchical, directed by a *campo* based on the prestige hierarchy lying at the heart of the cargo system. Here, however, where the water sources are drought-prone and the resource was relatively scarce to begin with, the consequences of this process were dramatic. The landlords further expanded their holdings of both land and water during the next few decades, at a time when the indigenous population experienced rapid growth (see Figure 1 and Table 1). The effect was to bring indigenous practices and their Spanish counterparts into conflict, and to create a parasitic relationship between them that steadily worsened with time.

Although this process began before the turn of the 19th century, I was able to get a glimpse of what must have happened by interviewing the oldest people in the district. Without exception, they described a decline of the communal tradition in the villages marked by increasing scarcity and water conflict and expressing, in their words, a growing "lack of respect" for the water distributors. First of all, as the landlords privatized more and more of the communal water during the early part of the century,[12] the distribution cycles of the villages were gradually elongated. As they continued to acquire land within community territory, the landlords simply claimed the first few days of water as 'theirs', and allowed the comuneros to use what was left over for their subsistence crops, after which the water passed to the estates again for the irrigation of alfalfa. This *de facto* privatization ultimately reached a point at which the watering frequency on community lands was less than half that of estate lands in the villages--which remained at twice per month--and was insufficient for reliable crop production.

Second, in an effort to increase the amount of land and water available to them, large numbers of comuneros began to work as sharecroppers on the haciendas, an arrangement known as al partir. This, of course, allowed them to cultivate fields that were extremely well watered and productive. But in addition, such work involved an arrangement whereby private water was occasionally given as a sort of wage, in exchange for labor, a practice that became a local institution. The buying and selling of estate water became very common, even within the elite community, in what amounted to a local water market. Peasants, however, who rarely had any cash actually in hand, usually acquired the water by working for it. This was only done, however, with the truly private water, validated by legal titles, of the older Cotahausi estates (see W. Mitchell 1994 for a similar case).

Thirdly, in an effort to cope with the growing scarcity, village members increasingly resorted to stealing communal water as well as other breaches of custom, a process that could not easily be controlled. Favoritism on the part of distributors reportedly became more common and, with irrigation occurring only once a month under even the best of conditions, conflict over water evidently increased. The dynamics of this breakdown of tradition seem to have been similar to those described in Pampamarca. Here, too, the role played by an emerging group of comunero middle proprietors was pivotal, highly-ranked individuals who worked for the landlords as contracted muleteers (and therefore alfalfa producers) in the wool trade. However, in this district, as in several others in the valley and throughout the highlands in general, the State also played a crucial, complementary role.

By promoting the privatization of land and water and the expansion of the estates, the Lima government created a situation that eventually forced the villagers to take action to protect the remaining communal supply. During the first half of the century they acquired legal titles authorizing their traditional rights to communal water, now known as "public" water under the Water Code of 1902. Unfortunately, at the same time a number of individuals, notably including the middle proprietors, took advantage of the situation to acquire false titles as well, which they used to irrigate long-abandoned lands that had not had water before. This problem, which is said

12. Because some of this expansion occurred after the Water Code was passed, in 1902, some of the estate water came out of the communal supplies, the "*agua de las comunidades*". Officially, this was still "public" or communal water, but the landlords used it as if it were their property, and their rights were actually equivalent to private ownership in every way. On fixed days of the week, they controlled all of the communal supply.

to have been severe, stretched the communal supplies even thinner and seems to have pushed the water conflict to a higher level. Significantly, the same problem of false titles also emerged in the use of private water.

It was at this point in time, 1940 to be exact, that the State intervened and changed the system of water management in the district. This event was a consequence of the founding by the national government in Lima of the Consejo Superior de Aguas, which set up the first official procedures for rural water administration (R. Costa 1934), and, most of all, of the worst environmental disturbance of the twentieth century, the five-year drought of 1939-1944, which induced a true subsistence crisis. The district appealed to the State for help and, in compliance with the new legislation, the water supplies were taken out of the control of communal organizations and put in the hands of a Technical Administrator, a local man appointed by the new state bureaucracy.[13]

Among the Administrator's first official acts were: 1) to carry out an inventory of irrigated lands that had legitimate water rights; 2) to restrict irrigation to those lands only; and 3) to make the granting of water, both public and private, contingent on payment of a small tax, as the new law required. Perhaps most importantly, he appointed new water distributors for each village--individuals who were paid and could serve for several years, rather than serving voluntarily and in rotation, as these authorities always had in the past.

The consequences of the changes were profound, but they fell almost exclusively on the indigenous population. State policy had no significant effect on the private water used by the landlords on the older town estates, simply because those rights were protected by legal titles. In fact, the landlords soon refused to pay the water tariff, so that in this case the new system of management lasted only two years. After that brief interlude, they returned to using their water exactly as before, without charge or supervision.

On the other hand, state administration had a serious impact on the customary rights of peasant community members. Initially this was positive, since their allotments increased in frequency because the lands that had been receiving water illegally no longer got it. But that benefit was soon negated by another change in practice. In 1942 the first major reservoir was constructed, to store the water of the largest spring in the district, one that served many hacienda lands as well as the lands of the biggest annex community. This, too, would have been entirely beneficial, were it not for the fact that the daily tank outflow was not divided into two portions to be used at the same time, as the spring had been before.

In this case, private and communal water had consisted of two flows in continuous use--one on the major haciendas around the town, and the other on the comunero lands and estate properties near the village. However, in compliance with the newly established procedures, the Administrator imposed an arrangement whereby the landlords and the villagers alternated in using the outflow of the huge tank. Each week, the water was used privately on the town estates for three days, after which it passed to the village, where it was allotted for the remaining days by the new distributors. The eventual impact of this change was that the overall watering cycle for comuneros was stretched out even further than it had been before. It soon took six weeks or even more for all the village lands to be serviced.

The reason why this elongation occurred is that the same frequency did not apply to the estate owners whose property lay within community territory. There, the landlords continued to use the communal water on their traditional days, the first two out of each weekly period, and without supervision, just as they had before. The implications for poor people's subsistence are obvious, but it is crucial to note that the new arrangement evidently facilitated, even more than before, the extraction of peasant labor. Most *comuneros* now worked as sharecroppers on the estates, and continued to do so until the agrarian reform of 1969, and they did this, not just to gain access to well-irrigated land, but also to private water for use on their own subsistence fields at home. Because the price of water in labor was quite high, they bought it only occasionally, when it was most needed, but according to former tenants it could be a lifesaver in times of drought.

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13. One of my key informants, and one of the oldest people in the province, was this individual, who described the events, and the conditions leading up to the reform, to me in these terms. Another key informant, whose story of the water crisis and the water reform corresponded on the main points, served on the three-person local committee that was in charge of assisting the Administrator in implementing the new policy (P. Trawick 2003:165-167).

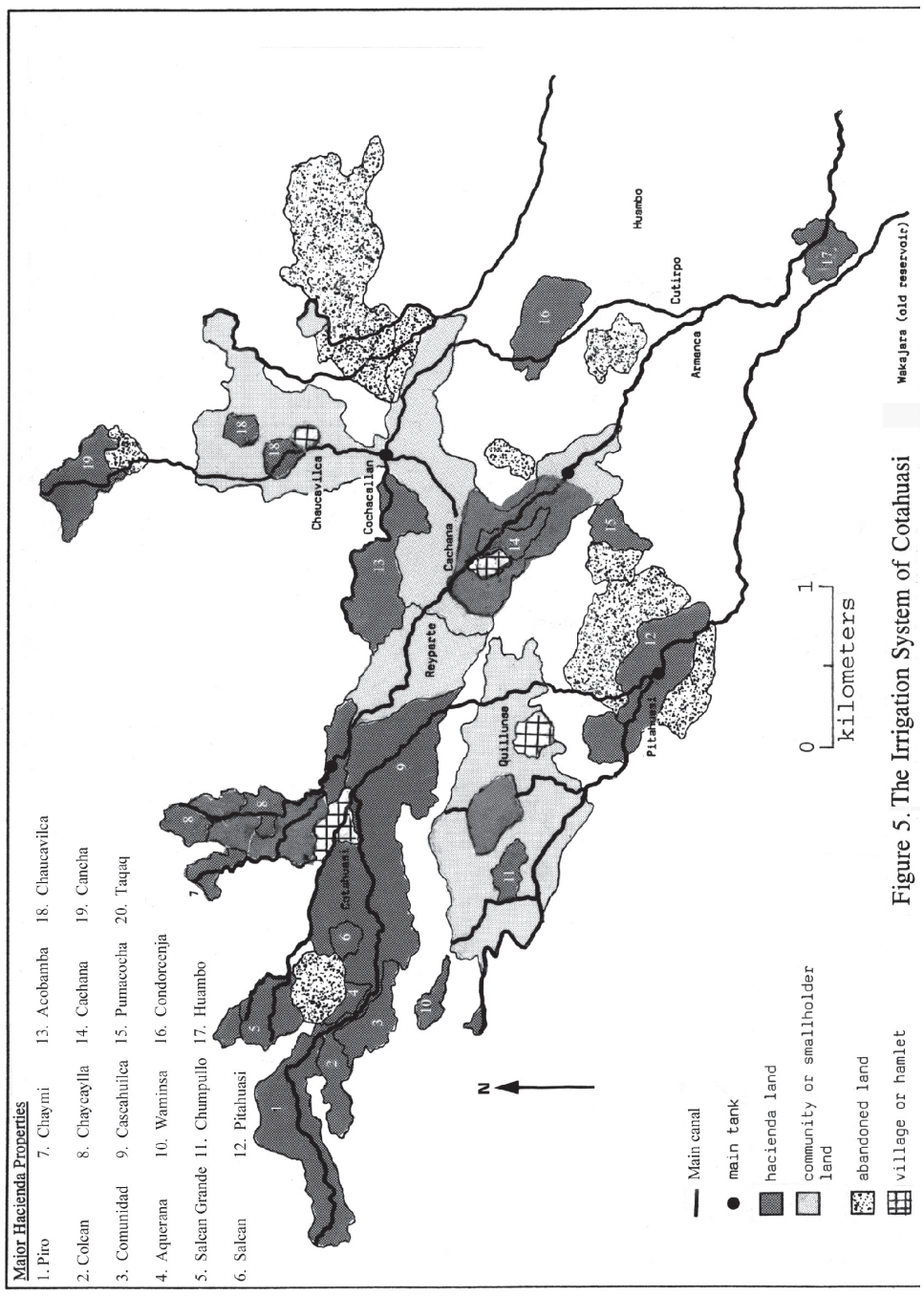

Figure 5. The Irrigation System of Cotahuasi

Under such conditions of scarcity and hardship, it was inevitable that serious problems would emerge among the villagers as a result of the other changes that had been imposed. Although the new system of management lasted only two years, that hiatus apparently helped to undermine the authority of the Distributors, a process that was already underway. During the next two decades, the civil-religious hierarchy, of which these officials had always been a vital part, went into decline in each annex village, as fewer people became willing and financially able to serve the community and sponsor its fiestas, a decrease in cargo participation that is still underway today. The landlords, who were the wealthiest people in these communities and who set the standards by which others were judged, were able to gradually drive their poorer competitors out of the status competition and, through the practice of holding land as collateral on loans to fiesta sponsors, in many cases to acquire some of their property as well. This is in stark contrast to the situation in Huaynacotas, where the cargo system is still quite strong and where this kind of ritually-induced stratification has not occurred.

The major offices, both political and religious, soon came to be held exclusively by the wealthier members of each community, mainly the landlords, while the position of Campo was divorced from the prestige hierarchy altogether. It became a purely technical post, typically held by young men, often in lieu of military service, and these people no longer fulfilled the ceremonial function that had been so important before: the financing of Yarqha Aspiy, the Canal Cleaning. This rite continued, of course--again, without the help of the landlords--but did not involve the Campos' sponsorship anymore. Soon their work, the distribution of the resource most vital to the community, ceased to have much ritual significance, and it remains largely secular today.[14]

The result was that the Distributors ceased to be widely respected, and they seem to have become more vulnerable to pressure and bribery.[15] Under these conditions, the problems that already existed--water theft, favoritism, and conflict--evidently became more common and more serious than before. There were even some well-known incidents of bloodshed between peasants as comuneros fought over their turns and their water rights.

An attempt was made to solve these problems in 1960, when irrigation was again reorganized, once more according to the law and other official regulations and procedures of the State. The Jefatura de Aguas y Riego was established, headed by a Water Boss or Administrator, a local man appointed by the national bureaucracy, who was assisted by a small group of elected officials. The water tariff was reinstated, for both public and private public users, based on another inventory of irrigated lands, and new Distributors were appointed, people who, as in 1940, received a small wage. Allocation of the resource was now to be carried out according to the revised Water Code and the technical guidelines of the Ministry of Agriculture.

Unfortunately, these changes did little to solve the existing problems and instead created new ones. Traditional water rights were to be respected by the new officials, but the regulations did not specify the order in which this was to be done, saying only that it was to be both customary and "rational" (R. Costa 1934:13-16). Traditionally, watering sequences in each village had been determined by the ranking system as perceived by the communal authorities, but, with these people no longer in charge, the order evidently became an issue that was open for debate and negotiation.

Village members therefore began to struggle to gain the favor of the water officials, something that still goes on today, so that they could get preferred placement in a flexible watering order, or even get special allotments. When they could not get either or both of these, some of them simply took the water from someone else. Basically a free-for-all situation developed, one encouraged by the fact that the Administrator and the new distributors were resented--especially because people were now having to pay for their water--and, now being paid a wage themselves,

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14. The Canal Cleaning, now called the Escarbo de Asequia, is still done in an atmosphere of celebration involving much drinking and even a small brass band, but ritual offerings, or *pagos*, are no longer made to the mountain springs, as they once were by the campos. This is still done in Pampamarca and Huaynacotas.

15. R. Montoya et. al (1979:79-81) describe a similar sequence of events, and a similar process of decline in traditional authority, in Puquio, a pueblo in the southern part of Ayacucho. I am indebted to Montoya for making me aware of the importance of such changes, and for encouraging and supporting me in my own work.

they were extremely vulnerable to pressure and bribery. Under these conditions, inequity prevailed because it went virtually unrestrained. Allotment patterns had become so dispersed and irregular--and they remain so today--that vigilance and accountability were no longer features of the distribution system, as they must have been at one time, if Pampamarca is any indication.

Water was reportedly "running all over the place" because small amounts were constantly being traded, bought and sold, or given in exchange for peasant labor, in the local water market. Even the estate owners were having serious problems with their water being stolen, which is why they were in favor of the changes and submitted to them along with everyone else--including, for the first time, the duty to contribute every year to canal maintenance. The juxtaposition of a now highly-centralized system of 'communal' distribution, at the district level, with a water market operated by the landlords individually, at the local level, had created a situation so chaotic that the hacendados were unable to protect their water rights effectively even through brute force, as they always had in the past. The system had apparently become rather opaque even to them, as any water market would eventually become under such circumstances, with small amounts of water running everywhere, on no regular cycle or schedule.[16]

These were the conditions prevailing in the district when the State again intervened, in 1969. At that time a major program of agrarian reform was imposed by the nationalist government of General Juan Velasco Alvarado, a military junta that had recently seized power in Lima. As part of their extraordinary effort to establish a more equitable distribution of resources in the countryside, new water legislation was drafted and imposed by decree. Known as the General Water Law (D.L. 17752; CEPES 1984), this document called for radical changes that seemed to promise major improvement.

First, all irrigation water was to become the property of the State, and was to be redistributed and administered locally by a Technician of the Ministry of Agriculture on the State's behalf. Secondly, user groups were to be established--Commissiones de Regantes—whose elected representatives would assist the Technical Administrator in implementing official management policy and drawing up a Cultivation and Irrigation Plan for each year. Thirdly, water flows were to be measured and divided equitably among those lands that had previously had legitimate water rights. Finally, distribution was to be "equitable," a term whose meaning unfortunately is not defined in the legislation, and yet also "rational," in the sense that it was to be adjusted precisely to the 'needs' of specific crops (according to a list of priorities), and to the various soil types and microclimates within each local irrigation system.

The water reform was a bold attempt to eliminate a pervasive kind of inequality and hardship in the countryside and to end a long legacy of conflict. But unfortunately the program failed to achieve its goals. For one thing, because the State in Peru has always been relatively weak and poor and limited in its administrative reach, the reform never even got to the majority of Andean communities, places like Huaynacotas and Pampamarca. Its impact on rural communities has rarely been examined closely, perhaps for this very reason, even in places where it was fully implemented (but see D. Guillet 1992, 1994; J. Treacy 1994a,b; P. Gelles 1994; I. Bolin 1994).

In Cotahuasi, the reform not only failed to improve management of the resource; it made distribution even less systematic and stable than before and exacerbated the scarcity that already existed. In spite of the expropriation and redistribution of private water, the state of irrigation declined in the district after the new law was implemented, and it had reached a crisis by the time I began my fieldwork (P. Trawick 2003:228-272). This decline was accelerated greatly by the effects of recurrent droughts, which fortunately appear to have since ended, but which have occurred with alarming frequency in the central Andes during the last thirty years. However, these only exacerbated the symptoms of the underlying problems, which are structural and systemic, inherent in the situation as defined hydrologically, legally, economically, and in terms of its institutional configuration.

Several basic flaws prevented the General Water Law and the attached Regulations from making conditions any better, instead creating a regime that is unworkable, opaque and rather corrupt. These flaws arise from the inappropriate model for management on which the law is

16. This assertion is based on the accounts of several former landlords, who emphasized how easy it had become to steal water and get away with it, and tried to explain why. It is also based on my subsequent experience of the water problems in the district.

based, an agronomic and technocratic one that probably originated in land grant universities in the United States. The defects could be corrected (P. Trawick 2003: 228-272), but their impact, an acceleration of the tragedy already long underway, has probably been felt in most districts formerly dominated by haciendas, which is where the reform was implemented. They continue to plague Cotahuasi district today, even though the government turned responsibility for operating and managing irrigation systems over to the local communities, i.e., to their Water-user Groups, in 1989.

Thus the Administrator has been replaced locally by the elected water officials—a great improvement, in principle. The system is still unified, operated according to certain rules and procedures, but not truly centralized as before, i.e., not run by a representative of a distant central government (R. Hunt 1988, 1989). Unfortunately, however, the Law and the attached Regulations have not been modified and are still in effect, which provide the only model for management--a quite irrational one--that the local people have. It is a model that is probably familiar to many people who work in 'developing' countries, many of which have similar laws. Familiar, too, are the serious problems that this kind of law has allowed to continue, or that its implementation has somehow entailed.

First of all, the legislation did nothing about the fundamental contradiction between local irrigating techniques and the resulting inequity among water rights, failing to impose any controls on individual practice. In spite of the chronic scarcity that prevails in the district today, large landowners continue to waste a great amount of water by irrigating sloped fields for as long as they like, as do most middle-proprietors, the people who are most heavily involved in the cattle trade. Meanwhile, the smallholder majority, the peasants, who generally only have a cow or two to meet their subsistence needs, tend to conserve the resource by relying primarily, though not exclusively, on their traditional landscaping and irrigating method. Although there are numerous exceptions, they generally maintain their terraces and use pooling structures (again, called atus) to contain the water, just as in Huaynacotas and Pampamarca.[17]

In my research, I found that the slope-watering technique is known to be extremely wasteful and to contribute to the water shortage, and that the resulting lack of proportionality among water shares, and among people's rights to the resource, is a major source of resentment and conflict in the district.[18] The same can be said of the lack of proportionality between people's rights and duties. The landlords and other big proprietors still have to contribute to the yearly canal cleaning and to other repairs, but, just as before, they only have to provide one person per workday, the same amount as any smallholder. And that is nearly always a peasant paid to work in their place.

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17. There are many reasons why, despite its disadvantages, the slope-watering technique has proliferated during the last thirty years, expanding slowly, along with alfalfa production and the destruction of terracing, among the peasant population. A major one is the *kikuyo* or *grama*, a weed that unfortunately was introduced from East Africa in the 1940's (R. Montoya et.al. 1979:69), which continually invades alfalfa fields and chokes off the plants, eventually necessitating a complete breakup of the soil in order to remove its deep roots (P. Trawick 2002:174-179). This encourages the conversion of terraces into sloped fields.

18. There is also the related problem of dual or duplicate water rights by the larger landowners, the most serious kind of inequity but too complex a situation to include in this analysis (P. Trawick 2003:170-171). As in Huaynacotas and Pampamarca, numerous small secondary springs are scattered throughout the irrigation system in various community territories, many of which were formerly owned by the landlords, so that these people had duplicate supplies—particularly those in Cotahausi sector, where the biggest estates were located. This private water ownership was ratified by the Water Code of 1902, as explained previously, because the springs are located on private land. The hacendados typically used this water on their fields, so that they could sell the main irrigation water that also belonged to them to other people. In contrast, in Quillunsa and the other sectors, these smaller springs have always been communally owned and cooperatively managed, as in Huaynacotas and Pampamarca. Even after the 1969 water reform, the springs have continued to be used in Cotahuasi sector mainly by the larger landowners (former *hacendados*), in addition to their dose of main water. This additional inequity is central to the water conflict and contributes greatly to the standoff between communities discussed below.

All of this creates a great conflict of interest, one that has both ethnic and class dimensions, and that has had the effect of dulling to the point of nearly killing the communal impulse, the incentive that people can have to cooperate and work together in a mutually beneficial situation.

This chaotic outcome exists in part because Cotahuasi, like most highland districts, lacks the equipment needed for controlling precisely the volume and time of water flow: a current-meter and a set of adjustable canal gates. Absurdly enough, the General Water Law made such control the cornerstone of the current system, and did not provide any well-defined backup procedure for use in cases where that control cannot be achieved. The law is based on the notion that water is being supplied to crops, rather than to people or households, crops whose 'needs' are thought to vary widely. It is also based on the assumption that irrigation is therefore too complex for local people themselves to oversee. Finally, it is based on the assumption, equally absurd, that enough water is available to meet those needs.

Such precise control is difficult to accomplish in the Andes, not just for technological reasons, but mainly because the steep and rough topography makes it almost impossible for a single person--even the most physically fit individual--to run up and down over the landscape and really handle the task of controlling and monitoring water use. In such vertical and rugged terrain, always lacking in many points of access by road, the amount of human energy needed to operate such a highly-centralized and precise system is prohibitive, to say nothing of the knowledge supposedly required, which is just as problematic. I say this based on having done this myself on numerous occasions by accompanying the Distributors on their rounds. Yet this kind of precision is not at all necessary for an efficient and equitable use of the resource, as the people of Huaynacotas show so clearly by their example.

Because it is based on such a model, the law fails to assert any kind of general comparability among peoples' rights, leaving them subject instead to a highly technical process of calculation and disbursal that never gets carried out. And unfortunately, where such precision cannot be achieved, lack of volumetric control ultimately translates into a total lack of control over irrigation, even by the hour, since water distributors do not have the authority, under the General Water Law, to curtail the watering process. They can only report problems like wasteful use to the Administrator, which rarely results in any action being taken, since wasteful use is not even defined clearly in the Law or the attached Regulations (CEPES 1984). The end result in this case is a license for users to continue irrigating, no matter how wasteful that may be, until they are satisfied that they are finished. This situation, based as it is on features of the law itself, is extremely common throughout the highlands today, where water seems to be so chronically scarce (J. Hendriks 1986; W. Mitchell and D. Guillet 1994).

Secondly, the reform failed to establish a consistent distribution sequence within the four community territories, one that would be known to everyone, be somewhat transparent, and that would put all the users of each spring on the same schedule, so that their rights would be clearly defined and comparable to each other in a basic way. The various Administrators who served in the district during my fieldwork had neither the equipment nor the technical knowledge needed to calculate crop water 'requirements' or even control canal flow in the way dictated by the law, so that a standard pattern of distribution was never established and a high degree of disorder and discord prevailed. Although there have been a few improvements since the system came under local control in 1989, the situation today remains much the same as it was before the reform, with people trying to gain favorable placement in a watering order that is flexible, sometimes resorting to pressure or bribery. Naturally, this is a competition in which the large landowners and other influential people tend to prevail.

The Administrator did follow a general sequence in granting and scheduling allotments: a Cultivation and Irrigation Plan, as required by the law, which the communities had to decide upon each year based on the relative importance to them of each crop. This plan should, theoretically, have closely approximated a contiguous pattern. Wisely enough, Peru's Ministry of Agriculture has for many years promoted contiguity in its official guidelines as the basic principle of distribution, a procedure known as "*de canto a canto*" ("from one side to the other"), apparently because it is considered to be the most conservative and efficient way of doing things (see Gelles 1994, 2001). But unfortunately, the law allows the Administrator to modify the pattern in order to accommodate 'emergency' water needs, special soil or crop conditions, or for almost any reason he deems fit, provided that enough water is, in his judgment, available. Indeed the law actually defines this as the "rational" way to allocate the resource, as we have already seen. The end result, according to my experience, was and is a basic sequence that is constantly being modified and

broken up in ways, and for reasons, known only to the water officials.[19]

Theft and favoritism have thus been able to continue because the rules of distribution have not been clearly and firmly defined, and because the primary mechanism that should restrain such abuses, systematic monitoring by the irrigators themselves, has virtually ceased to function. The end result is that, even though everyone now participates to some extent in deciding upon the yearly Cultivation and Irrigation Plan, water allocation has become a largely private and covert affair, one dominated, much as before, by the local elite.[20] Of course, people are very much aware of this, of the inequities and abuses that commonly happen, but they have little power to do anything about it, a fact that widely causes resentment, cynicism, suspicion of others, and generally discourages cooperation.

That 'perverse' incentive (E. Ostrom 1990), which is the main cause of the ongoing tragedy, does not reflect innate human selfishness. Rather, as I believe I have shown, it is structurally based and socially and historically derived. The system as it stands now basically nullifies the communal impulse because there is no longer any sense among people of sharing the water scarcity. There is simply no equity or fairness in the system as it now stands. Not surprisingly, the canal system is consequently poorly maintained, due to people's minimal and reluctant participation in communal labor, another problem that is pervasive throughout the sierra. The situation is tragic indeed and has been for a long time.

Finally, and perhaps most importantly, the reform did not correct the illogical manner in which water is divided between the communities, each of which now has its own user group. During the 1970's additional reservoirs were built with State support, so that all the major water flows could be stored at night, and the same sharing arrangement previously discussed, between pairs of communities, was instituted—apparently a typical policy decision in this kind of situation. As a result, communities that are rather distant from each other now alternate in using the tank outflows, rather than watering independently with separate flows at the same time. This arrangement creates a situation analogous to the previous case, in which people who share water are not able to observe each other irrigate on a regular basis, but on a bigger scale and between different villages, groups that in this case are separated by rough terrain and have a long history of water conflict. It has many negative consequences.

Perhaps the most unfortunate one is that, within each user group, the conflict of interest between large and small landowners over major inequities in water use--the resentment that I spoke of earlier--is deflected outward and turned into a conflict now perceived to be mainly between communities. The arrangement creates a situation in which the groups that share water vie against each other, just like competing individuals, in an effort to get increases in their allotments, i.e. to get more days of water in their turn. I saw each of the local user groups doing this constantly, jockeying for position and for the favor of the Administrator, throughout my time in the valley. It goes on because the members perceive this competition, and the whole effort to improve water use, quite rightly, as a "zero-sum" game, in which one group's gain is entirely the other's loss (P. Trawick 2003: 248-250).

As a result, people tend to overlook the abuses and inequities on the part of their neighbors within their own group--particularly the peasant smallholders, who potentially have a lot to gain

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19. This problem becomes even more serious during drought emergencies, which for the last two decades have been the rule. As the law requires, the irrigation cycles in each community are then separated into two phases, including an *auxilio* turn for food crops only, which has the effect of putting alfalfa on a separate longer cycle. This produces an even more chaotic and dispersed pattern that is truly opaque to the water users, and extremely wasteful as well.

20. I do not mean to suggest that all wealthy people try to influence the water administrator and manipulate the law in their favor. This is apparently done by a small minority, and, though it is quite common, it does not happen all of the time. There are many people of Spanish descent who abide by the rules, and who genuinely want to see the problems in local irrigation solved. Nor do I mean to suggest that peasants are entirely innocent of such behavior. Indeed, everyone in the district is involved in a struggle over scarce water, one whose aspects and dimensions they do not fully understand.

by attending to these--because they do not really see these as depriving them of water. Instead, they focus the blame for the water shortage on the defects and problems within the other user group.[21] Under these conditions, it is nearly impossible to get people within each group to conserve the resource by improving and standardizing their own habits and methods of water use, at the cost of a small amount of additional labor, because they have no rational reason for doing so. In their eyes, the resulting savings would only pass to someone else, probably in the other village, and, unless the same conservation measures were undertaken by everyone there--something about which there is strong doubt based on past experience--would not benefit them in any way.

This, of course, is the "free-rider" problem, and it becomes endemic, both within the communities and between them, under such an alternating arrangement. In Cotahuasi district, and no doubt many other places like it, the arrangement has created a social and political stalemate between local communities whose main features, paradoxically enough, are constant rivalry and conflict. This is the primary reason why all efforts to impose restrictions on field irrigation times, and to make other improvements that would conserve water, have failed.

In general, nothing has been done about waste of the resource by the people themselves and, as I showed by estimating it as accurately as I could in my research, this is massive, takes many forms, and is the real cause of the water shortage (P. Trawick 2003: 228-272). The hydraulic system as currently organized, the leadership, and the community members themselves, create and maintain a kind of chaotic stasis in the system, one that promotes waste, discourages conservation and cooperation, and yet preserves an illusion of absolute scarcity. There are constant complaints and disputes over the resource--especially between communities--occasionally even physical confrontations between people, and periodic crises that result in assemblies at the district and community levels, where changes are recommended and approved by vote, year after year. Yet nothing has really changed, in a positive sense, in thirty years.[22]

The perceived scarcity of the resource, and the resulting struggle to get more of it than everyone else--that tragic impulse--are thus socially constructed and maintained. They have arisen from changing institutional arrangements that, according to the conventional theory, should have prevented the tragedy instead of bringing it about. In the case of water at least, Hardin got it backward, confusing causes with solutions to a problem that immediately changes character once the history of the region is known. A private water market, superimposed upon a system of communal management involving, in its various forms, highly centralized state guidance and control—these policies together have brought the tragedy about.[23] They have created a growing

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21. It is important to note that the annex villages are still largely peasant communities, whereas Cotahuasi sector as a whole, which is divided into three divisions that share water with the villages above, is largely composed of businessmen and former landlords. Thus the water conflict is in many respects a class conflict. Space does not permit a precise description of the hydraulic arrangement or the social dynamics here.

22. The main reason for this is that the large landowners, who feel that they stand to lose if the changes are actually implemented--especially their aforementioned duplicate or dual water rights—support the measures publicly in voting assemblies, but then act to subvert the improvements behind the scenes and keep them from being implemented. This is what transpired after a remarkable event: in 1999, shortly before I returned to Cotahuasi for some follow up research, my work (my dissertation and my articles published in Peru) and my recommendations for improving the system were discussed in several public meetings of the province's User Group. They were ultimately put to a vote and officially approved at the provincial level. They were not implemented, however, and, although they still may turn out to be, this was partly because the bigger landowners voted for them publicly but subverted the effort privately in this way.

23. There are numerous case studies demonstrating that state management has led to tragic outcomes, particularly in fisheries management (see, e.g., E. Pinkerton and M. Weinstein 1995; also B. MacKay and J. Acheson 1987), but few have taken up this question in studies of irrigation. P. Gelles (2000) describes an indigenous community in Peru that has resisted the implementation of the General Water Law, and D. Guillet (1992) analyzes a community where the results have been mixed at best (also see E. Otrom, ed. [2002]).

scarcity while imposing an increasingly opaque structure that has ultimately given people little choice but to act at least somewhat selfishly and in a shortsighted manner.

This all began, of course, with the impulse to grow food for animals rather than people, to tear down the sculpted landscape and start irrigating slopes in a different manner, to want water and need it more often than everyone else. These practices, and their underlying motivation, have gradually spread, especially among the middle proprietors, a stratum that is much larger in Cotahuasi district than in the other two communities, but still comprises only about 20% of the population. Wherever the tragedy has occurred in the Andes, I suspect that the process has had this kind of material and structural basis. It began with changes in practice, with non-local or Spanish practices that must have had little negative impact initially, because of the general abundance of water, but that set the stage for a drama of unintended consequences and resulting social conflict in the long run. Ultimately, however, the tragedy is the outcome of a particular social and economic history, a contested history of power and struggle, in this case between different classes and even opposed ethnicities, basically between people with different water 'needs.' Here, as in most places, it is the ending to the story of the spread of capitalism and the gradual advance of the market--initially through the activities of an elite minority, and usually with the help of the State--and the consequent undermining of the indigenous way of life, especially of its most important institutions.

This is how capitalism expands, in its changing articulation with 'pre-capitalist' modes of production: by gradually subverting and weakening the very heart of social life, giving people less and less choice but to join others and play a different 'game' and live another kind of life, even to become a different Self. Not everyone in Cotahuasi district has done this, by any means. Many people, especially peasants and other smallholders, seem to have insight into the water problem, to avoid contributing to it, and to really want to solve it. And a lot of people, of course, stand somewhere in between these two extremes. But negligence and greed have spread nonetheless, creating a situation that preoccupies everyone and that few people want, but about which they can seemingly do little. The people of the district face a truly serious dilemma, a social, political, and cultural one that they have in part, but only in part, brought upon themselves.

Conclusion

The tragedy of the commons can be, indeed often has been, avoided, as a visit to Huaynacotas and other villages like it shows. This is not startling news, since we now know that there are many such places, both in the Andes (e.g., P. Gelles 1994; D. Guillet 1994; J. Treacy 1994; K. Paaeregaard 1994; P. Trawick 2001b) and in other parts of the world (e.g., E.W. Coward 1979; R.Y. Siy 1982; A. Maass and R. Anderson 1978; R. Wade 1986; E. Ostrom 1990; S. Lansing 1991; E. Ostrom and R. Gardner 1993). What is surprising is that the rules and principles that people have worked out for managing water effectively appear to be highly similar, if not exactly the same, in each region, at least when the resource is scarce. This is a pattern with major implications for policy that will have to be discussed at a later time (E. Ostrom 1998; P. Trawick n.d.a.). Space does not permit a summary here of all the requirements for local success in governing the commons, which are too many (see P. Trawick 2001a), nor does it allow us to look comparatively at them around the world. The main ones can be briefly reviewed, however, in dealing with the one important question that remains: how can the ongoing tragedy in Cotahuasi district and other places like it be stopped or perhaps even reversed?

The answer is obvious and seems to be the only possible solution. The tragedy has unfolded in places like Cotahuasi through changes in practice that have systematically undermined and dismantled all the design principles needed for success, which we saw working so well in Huaynacotas. They were clearly a part of the local tradition in this particular valley and were once widely in place, here and probably in other parts of the highlands too. The process can be halted and even reversed by re-instituting those basic principles, as requirements in a revised General Water Law, and by modifying local practices accordingly in districts that were formerly administered by the State. This could be done in Cotahuasi and other places like it without having to rebuild the original terraced landscape, precisely measure and control all canal flows, or change the whole political economy of alfalfa and cattle production (P. Trawick 2003:270-272).

First of all, autonomy in water use could be restored to each community by permanently dividing the outflows of the major reservoirs (the arrangement up until 1940), and building two separate out-takes of the appropriate size, based on the average amount of land irrigated in each community during the last several years. This would restore a rough proportionality between land and water in each village, and therefore also between community water shares, and would immediately enable most people in each local society--especially the peasants and smallholders--to see that waste, inequity and corruption within their own group do indeed deprive them of water by slowing the distribution cycle down.

Secondly, the law could be modified so that its management model is an appropriate one based on an assumption, not of water adequacy or abundance, but of scarcity as the normal state of affairs. That change would seem to require, as a logical consequence, that the scarcity be shared in some kind of equitable manner. There is no such equity under the General Water Law, nor can there be, because the law is based on the idea that irrigation and water allocation are a technical problem, rather than a social one. All of that clearly needs to be changed.

Thirdly, based on the principle that a scarcity should be equitably shared--the only 'rational' and fair arrangement--the law could define "equity" explicitly by: 1) mandating a uniform frequency of irrigation for all users of each major water source, and 2) requiring proportionality among existing use rights, and between rights and duties, in each case. In systems characterized by scarcity and chronic insufficiency, the idea that certain crops or certain fields should get proportionally more water, or get water more often than others, is pathological in its effect, even if it might be defensible in theory on certain grounds (microclimatic variation; crops with special water 'needs'[24]). Furthermore, in communities highly stratified in terms of landholdings and of water consumption, the idea that everyone should contribute the same minimal amount of labor to canal maintenance is equally absurd and harmful in its effects on the communal tradition.

Thirdly, the law could require each community to decide upon explicit standards that limit the amount of time a given expanse of land can be irrigated with a given canal flow and a given technique—a specific time-per-hectare figures for each secondary canal, one for irrigating terraces, the other for irrigating slopes.[25] More importantly, it could give Water Distributors the legal authority to enforce these standards by shutting off the water at the appropriate time. If upheld, the limits would restore a rough uniformity of technique as well as a basic proportionality among water shares. Finally, and perhaps most importantly, the law could not just recommend a contiguous pattern of distribution, as the official guidelines do now, but explicitly require it, also mandating a uniform frequency of irrigation with no modifications or exceptions allowed.[26] This would have the effect of establishing regularity, transparency and public accountability within each local irrigation system.

If all of these changes were made, the local communities would be well prepared to manage their resources themselves, with no help from the State.[27] A direct and obvious link would have

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24. The Ministry of Agriculture's figures on crop water 'needs' are in fact optima or upper limits—clearly inappropriate in a region where water supplies are insufficient under even the best of conditions.

25. According to my experience in Cotahuasi, these figures are known. The canals are fairly uniform in size, and people know how much time is enough to adequately water a terrace or a field, even a sloping one: roughly nine hours per hectare, or three hours per *topo* (1/3 ha.), is widely acknowledged to be sufficient even for the latter. That most people exceed this figure (four to five hours per *topo* seems to be the average for slopes), adopting the attitude that "a little more won't hurt," is perhaps the most exasperating aspect of the situation and shows how tragic it really is.

26. It is important to point out that one kind of exception to this rule is allowed in Huaynacotas, and should be allowed elsewhere because it does not contribute significantly to water loss. If a person cannot water a given field along a canal at the proper time, they are put last in the order for that particular secondary canal. If they then fail to irrigate, they simply lose their turn. The rule is that, once the water leaves the canal, it does not return again until the next cycle.

27. The State's role could be limited to upholding the legal framework allowing community use

been re-established between the orderliness and efficiency of water use and the length of the irrigation cycle, giving the systems a functional rather than a dysfunctional logic. And an enormous amount of water would have been saved in each case, to the benefit of everyone involved, probably enough so that everyone in the district would end up better off than they are now[28] (P. Trawick 2003: 270-272). It is there, and only there, that a solution to the 'commons dilemma' can be found, in a tangible reward for cooperating and pursuing the common good.

As individuals we can be selfish and manipulative, maximizing our own short-term 'utility;' like Hardin's universal free rider; or we can be more sociable and essentially conformist, doing what is expected of us and sometimes just blindly bending under the coercive weight of the rules. Or we can be more "enlightened" and moral, doing what we think is right and acting in ways that are thought to be noble, with regard for the welfare of others and an appreciation of the primary importance of the long-term point-of-view (R. Wilk 1996; M. Bloch and J. Parry 1989). Most often we act through a combination of motives, shaped by, and in turn shaping, the institutions that reinforce the various sides of our nature, to varying degrees and in different fields of interaction and discourse (P. Bourdieu 1977). Those acts are usually guided, however, by some kind of image of who we ought to be and would like to be as individuals, as well as a strong sense of the kind of behavior that is most likely to be rewarded.

The challenge in governing the commons is to create a system that appeals strongly to all of these sides of human nature, making our main impulses complementary rather than contradictory, one where we can be self-interested, yet social and moral at the same time. A system where virtue is its own reward, in a material as well as a social and philosophical sense, and that does not rely mainly on coercion, the solution that Hardin recommended long ago. In the Andes, and probably many other parts of the world, that feat can be achieved, and often has been achieved, in the sharing of water. The process can just as easily lead to comedy as to tragedy, and the different roles that we play, like the outcome of the drama itself, depend in part on how the stage is initially set.

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and management of the resource, subject to these conditions, perhaps assisting with improvements of the infrastructure, and dealing with any serious incidents of litigation. Only the most highly privileged people in the district would really have to be coerced, from what I have seen, but for that reason I would recommend that the State remain the legal owner of all water for the time being. Eventually, I would prefer to see the communities have full ownership of their water supplies as well.

28. The apparent losers in this scenario, the most privileged users of the system and its biggest manipulators, are of course some of the bigger landowners and the biggest producers of alfalfa. However, according to my measurements and calculations, even they would be able to water more often than they do now if these changes were made and the community systems were truly put in order. Coercion and state control would be necessary, however, to convince them of that and get them to try it.

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Abstract

In the Andes of Peru a familiar story has unfolded in many communities around the sharing and use of water, a tragedy often attributed to an irresolvable conflict between the inherently selfish interests of the individual and the cooperative needs of the group. This article traces the history of irrigation in one highland valley based on comparative ethnographic research, examining the reasons for both success and failure in governing the commons and trying to explain why the former has given way to the latter in many, but by no means all, places. It reveals that success can be relatively unproblematic and was once widespread at the local level, and that failure has occurred where institutional arrangements have been imposed that, according to the conventional theory, should have prevented the tragedy instead of bringing it about: privatization of the resource, on the one hand, and State control of it on the other. Where selfishness and discord have prevailed they are driven by an apparent water scarcity that is socially constructed, the product of a new political ecology imposed initially by the local elite and then dominated by them with the State's help, at the expense of the peasantry. The author argues that, far from being inevitable, the tragedy of the commons in water management can be avoided, arrested, and

perhaps even reversed, in the Andes and other arid and mountainous parts of the world.

Key words: Andes, tragedy of the commons, political ecology, water scarcity, water management, arid, mountain.

Résumé

Aux Andes de Peru une histoire connue se déroule dans plusieurs communautés autour du partage et l'usage de l'eau, une tragédie souvent attribuée au conflit irrémédiable entre les intérêts égoïstes des individus et les besoins coopératifs du groupe. Cet article trace l'histoire d'irrigation dans une vallée montagneuse à travers la recherche ethnographique comparative. L'auteur examine les raisons pour le succès et l'insuccès de la gérance des terres communes et fait un effort d'expliquer pourquoi le succès a été remplacé par l'insuccès dans plusieurs mais pas tous les cas. L'article révèle que le succès peut être non problématique et était très répandu au niveau local tandis que l'insuccès est arrivé là où des cadres institutionnels ont été imposés qui, selon la théorie conventionnelle, auraient dû prévenir la tragédie des communs au lieu de la faciliter: la privatisation de la ressource, d'un côté, et son contrôle par l'Etat, de l'autre côté. Là où l'égoïsme et la discorde ont dominé, il y a une pénurie de l'eau apparente qui est en fait un construit social et le produit d'une nouvelle écologie politique : une pénurie d'abord imposée par les élites et puis maintenue par eux avec l'aide de l'Etat aux dépenses des paysans. L'auteur maintient que, loin d'être inévitable, la tragédie des communs, en ce qui concerne l'aménagement de l'eau, peut être évitée, arrêtée, et même renversée aux Andes et aux régions arides et montagneuse.

Mots clefs: Andes, tragédie des communs, écologie politique, la pénurie d'eau, l'aménagement de l'eau, aride, montagne.

Resumen

En los Andes del Perú una historia familiar se ha manifestado en muchas comunidades sobre el compartimiento y uso del agua, una tragedia atribuida a menudo al conflicto insoluble entre los intereses y las individualero y las demandas cooperativas del grupo. Basado en la investigación ethnografica comparativa, este artículo remonta la historia de la irrigación en un valle alto en las montañas, examinando las razones de los éxitos o los fracasos en el manejo de los comunales, y se intenta explicar porqué el anterior ha llevado al último en muchos lugares, aunque de ninguna manera en todas. Se revela que los éxitos pueden ser relativamente no problemáticos y antes eran muy comunes al nivel local, y que los fracasos han ocurrido donde se han impuesto sobre ellos arreglos institucionales, que según la teoría convencional, debia de haber prevenido estas tragedias en vez de causarlas: la privatización del recurso por un lado, y el control del estado de ello en el otro lado. Donde el egoísmo y la discordia han prevalecido son conducidos por una escasez evidente del agua, que ha sido construiada socialmente, y es el producto de una nueva ecología política impuesta inicialmente por los élites locales y después dominada por ellos mismos con la ayuda del estado, al costo de los campesinos. El autor discute que, lejos de ser inevitable, las tragedias de los comunales en el manejo del agua puedan ser evitadas, ser arrestadas, y quizás incluso ser invertidas, en los Andes y otras partes áridas y montañosas del mundo.

Palabras claves: Los Andes, tragedia de los comunales, ecología política, escasez del agua, manejo del agua, árida, montaña.