

INSTITUTIONAL UNDERPINNINGS OF THE WATER CRISIS

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Traditional natural resource economists have approached water resources from a market failure perspective, in which it is generally accepted that externalities dominate water resource allocation, thereby necessitating legal restrictions on water transfers. In *Water Transfers*, Hartman and Seastone (1970) captured the traditional approach:

In the natural resources field generally, the problem of externalities is widespread, and various organizational arrangements and regulatory measures have been adopted or proposed to cope with it. Laws have been written and established by courts to protect the third parties in water transfers. Special districts have been formed to internalize some of the externalities. The general tendency in institutional development has been to modify market procedures or completely replace them. (pp. 2-3)

In their earlier work, Seastone and Hartman gave almost no attention to the market alternative, comparing instead the judicial process to the administrative process in the allocation of water among competing uses. They concluded that "the logic of the systems suggests that the administrative process of water allocation has provided a closer approximation to efficiency criteria than has emerged from the judicial process" (1963, p. 43). They attributed the difference to the administrative agencies' use of engineering data, procedures, and personnel while the courts "relegate the engineering skills to a minor role, when the nature of scarcity demands the type of skills and data collection which the legal profession cannot provide" (p. 43). Sea-

Cato Journal, Vol. 2, No. 3 (Winter 1982). Copyright © Cato Institute. All rights reserved.

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The contents of this paper are drawn from the author's forthcoming books: *Water Crisis: Ending the Policy Drought* (Cato Institute), and *Water Resources: Bureaucracy, Property Rights, and the Environment*, editor (Pacific Institute).

stone and Hartman contended that an engineering approach enables state engineers to dispassionately allocate water in a way that approximates efficiency.

As director of the water resources program at Resources for the Future, Allen Kneese examined the "Economic Related Problems in Contemporary Water Resources Management," emphasizing the inefficiency generated by third party effects or market failure. While he claimed that there was a growing conceptual and research basis for devising more efficient water transfer mechanisms, he concluded:

It is not yet clear that the best means will be the exchange of water rights in markets because of the difficulty of arriving at reasonably certain definitions of rights when major third party effects, resulting from water quality deterioration and return flow dependency, are involved. Perhaps the most satisfactory solutions will be some mixture of market transfers of rights and administrative allocations. (1965, p. 240)

Most recently, Howe, Alexander, and Moses (1982) have argued that "if more than two users are involved . . . any transaction between two users would ignore the return flow effects on the others" (p. 383). Because of these inescapable externalities, they call for several institutional reforms. First, they claim that a more flexible water ownership system would establish "an agency that files for (or buys) water rights under state laws and sells the water produced to another entity . . ." (p. 386). Second, they call for increased reliance on conservancy districts. Third, they suggest establishing a state or interstate agency that would "make a market" in water rights. "Such an agency would stand ready to buy rights at a known schedule of prices and to sell rights to new users" (p. 388). Fourth, they argue for better climatological data and forecasting programs to improve regional water programming. Finally, they call for more training of water users, especially irrigators, so that they will more efficiently apply the water.

Contrast these conclusions with those arrived at by Johnson, Gisser, and Werner:

Based on our findings, we would argue that the concern expressed by others that the appropriative system constitutes numerous obstacles to the efficient transfer of water is unfounded. It is not the appropriative system that is at fault but rather the manner in which rights are defined within that concept. We have demonstrated that efficient water transfer is facilitated when water rights are defined in terms of consumptive use coupled with protection for local third-party impairment. (1981, p. 288)

Johnson et al. (1981) focus on the possibility of market success, remaining skeptical of collective action as an alternative to water

allocation via markets. By focusing on the existing structure of property rights dictated by legislation and its interpretation by the courts, they conclude that there is a great deal more room for market solutions to water problems.

The emphasis on market success rather than market failure is part of a paradigmatic shift in natural resource economics. This "new resource economics" is in many ways simply new applications of old ideas found in property rights, public choice, and Austrian economics (see Anderson, 1982). Property rights economics focuses on the rules of the game that determine who has access to and use of resources. If property rights are well-defined, enforced, and transferable, authority will be linked with responsibility and individual actors will act as if they care about social benefits and costs. Public choice economics makes us skeptical about whether collective action can generate efficiency or equity. Voting provides a very imprecise way of aggregating preferences, and bureaucratic solutions are fraught with problems of linking authority with responsibility. There is certainly no a priori reason to believe that market failure is any more pervasive than governmental failure. Finally, Austrian economics focuses on markets as a process that generates valuable information. In this process, private entrepreneurs are at the heart of decisions, recognizing opportunities for improving resource allocation. As residual claimants, entrepreneurs gain by discovering unforeseen opportunities and acting on them. The entire process is part of what Hayek has called a "spontaneous order."

By applying the new resource economics to water allocation issues, it is clear that a market solution to the water crisis is possible but that it is difficult to prevent collective action. This paper will provide a background for the institutional causes of the water crisis, beginning with a discussion of how the doctrine of appropriations facilitated market solutions during the late 19th century. By early in the 20th century, however, these institutions had changed dramatically, moving from what Alfred Cuzan (forthcoming) has termed "appropriation to expropriation." The paper will conclude with a brief outline of some suggestions for institutional reform of surface, in-stream, and groundwater rights.

The Evolution of Water Institutions

It is important to recognize that the institutions or rules of the game that govern people's behavior are produced by human action. People will devote their efforts to defining and enforcing property rights as long as their perceived additional benefits from doing so exceed their

perceived additional costs. In this sense, establishing and protecting property rights is very much a productive activity toward which resources can and will be devoted.

At any point in time, a unique amount of effort will be put into definition and enforcement activities. Just as there are diminishing returns to putting more fertilizer on a field, there are diminishing returns to defining and enforcing activity. While the added benefits of producing property rights decline, the added costs rise. Following standard economic reasoning, resources used to protect property rights must be attracted from other higher-valued alternatives, and the opportunity cost of producing property rights rises. The combination of diminishing returns and rising costs limits the amount of resources that will be devoted to property rights production.

While this tells us that there is an equilibrium level of definition and enforcement activity, the more important question is why this level varies over time and between areas. The answer depends on the parameters that cause benefits and costs to change. The benefits will depend on the value of the asset and the degree to which definition and enforcement activity insures that the value will be captured by the owner. Any change in the price of a well-defined and enforced bundle of rights changes the return on resources devoted to producing property rights. Higher market values or greater scarcity will spur individuals to strengthen their claims to resources. Witness, for example, how as our air, water, and scenery have become more scarce, individuals or groups have attempted to better define their claims on these resources. Furthermore, an increase in the probability of losing an asset will usually result in an increase in the productivity of property rights activity. An increase in the neighborhood crime rate means that locks, burglar alarms, and watchdogs all will have higher benefits than before because each does more to insure appropriation of value. The probability of loss is also affected by such variables as population density, cultural and ethical attitudes, and the existing rules of the game or the institutional structure.

The cost of defining and enforcing property rights is a function of the quantity of resources necessary for a given amount of activity and the opportunity cost of those resources. Hence, anything that reduces the quantity of resources or lowers the opportunity cost will shift the costs. Changes in technology all cause such a shift. A perfect example is the introduction of barbed wire in the 1870s. To the homesteader whose land was invaded by cowboys and their herds, barbed wire defined his private property. It also allowed stockmen to control grazing and rotate cattle on pastures and to selectively breed their livestock.

It should be noted that the production of property rights does not depend on formal government. As Harold Demsetz said, "... property rights arise when it becomes economic for those affected by externalities to internalize benefits and costs" (1967, p. 354). In no place was this more evident than on the American frontier. Since the early settlers preceded the legal machinery of state and federal government, they found it necessary to generate their own rules. Without the power of coercion granted to government, those rules depended on voluntary agreements among the settlers. Wagon trains, cattlemen's associations, and mining camps all provide excellent examples of the evolution of social contracts.¹ Not all people had equal power in the bargaining process, and in some cases the six-gun introduced an element of coercion; but the image of the wild West often ignores the important role that contracts played in establishing property rights. This is no more evident than in the evolution of Western water rights.

*Riparian vs. Prior Appropriation*²

To the frontiersmen entering the Great Plains, it was clear that access to water was a prime factor in considering a location. Hence, initial settlement patterns can be traced to the river and stream bottoms. If an individual found a stream location taken, he simply moved on to another water supply. Under these circumstances, the right to use the water accrued to whoever owned the stream bank and had access to it by virtue of position.

It is not difficult to understand why such riparian water rights, whether implicit or explicit, were adopted by the frontiersmen. First, these rights found historical precedent in Eastern laws, which were in turn borrowed from English common law. Early judges and lawyers were only familiar with Eastern law and thus transferred it to the legal system in the West. Second, riparian rights were appropriate to the factor endowments of the region. Initially, land with adjacent water was abundant relative to the number of settlers; that is, water was not a relatively scarce factor. As long as these conditions held, rights that granted all riparian owners equal use of the flowing stream sufficed for resource allocation. The benefits of changing the institutions that governed water were not sufficient remuneration for the time and effort required to initiate the change.

Two factors, however, worked to change the benefits and costs of altering property rights over water. First, mining technology neces-

¹For a more detailed discussion of the establishment of property rights through contracting, see Anderson and Hill (1979) and Umbeck (1977).

²This section of the paper draws heavily on the work of Cuzán (forthcoming).

sitated that water be taken from the stream and moved to non-riparian locations. Since the riparian rules required that all owners have a right to an undiminished quantity and quality of water, diversions for mining and irrigation were not feasible. Second, vast amounts of public land meant that individuals did not own riparian land and, therefore, could have no riparian rights.

Since the California mining camps were the first to feel major population pressure, it is not surprising that miners played an important role in the evolution of the prior appropriation doctrine. As Charles McCurdy writes:

Following a tradition of collective action on the mining frontiers of other continents, the miners formed districts, embracing from one to several of the existing "camps" or "diggings" and promulgated regulations for marking and recording claims. The miners universally adopted the priority principle, which simply recognized the superior claims of the first-arrival. . . . The miner's codes defined the maximum size of claims, set limits on the number of claims a single individual might work, and established regulations designating certain actions—long absence, long diligence, and the like—as equivalent to the forfeiture of rights. A similar body of district rules regulated the use of water flowing on the public domain. (1976, pp. 236–37)

The miners quickly realized that gold was found not only along stream beds, where pan, shovel, and rocker were sufficient to extract the precious mineral. With deposits several miles from water, it made economic sense to appropriate water from the streams. Thus, McCurdy tells us that: "It universally became one of the mining customs that the right to divert and use a specified quantity of water could be acquired by prior appropriation" (p. 254). These customs, according to Kinney, had:

one principle embodied in them all, and on which rests the "Arid Region Doctrine" of the ownership and use of water, and that was the recognition of discovery, followed by prior appropriation, as the inception of the possessor's title, and development by working the claim as the condition of its retention. (1912, p. 598)

While there is no question that the original mining law was aimed at establishing private rights to water through appropriation, disputes over rights led to court cases, which in turn led to conflicts with the riparian doctrine of common law. Judges were torn between their training, which had taught them that decisions ought to "conform, as nearly as possible, to the analogies of the common law," and the Western traditions that law "ought to be based on the wants of the community and the peculiar conditions of things . . . rather than any

absolute rule of law.”³ The tension between riparian and prior appropriation doctrines is reflected in some courts finding appropriative principles “impractical” and others holding that cases “must be decided by the fact of priority.” The result was an interesting and eventually harmful mix of Eastern and Western law. Webb captures the nature of the mix:

The Easterner, with his background of forest and farm could not always understand the man of the cattle kingdom. One went on foot, the other went on horseback; one carried his law in books, the other carried it strapped round his waist. One represented tradition, the other represented innovation; one responded to convention, the other responded to necessity and evolved his own conventions. Yet the man of the timber and the town made the law for the man of the plain; the plainsman, finding his law unsuited to his needs broke it and was called lawless. (1931, p. 206)

From Eastern law came such concepts as usufruct, beneficial use, and reasonable use. From the Western mining camps and cattle ranges came absolute property, equal footing for uses, and transferable ownership rights. The riparian doctrine maintained an element of common property by continuing to support the view that riparian owners have co-equal rights on the water. That is, when water is put to new uses, existing riparian users may be required to cease current uses to make way for new ones. That riparian rights are generally not transferable further restricts the possibility of market allocation.

The doctrine of appropriations, on the other hand, established ownership rights that were clearly defined, enforced, and transferable. Rights were absolute and not co-equal. As a result, markets were left to determine the value of water. The California courts asserted that “a comparison of the value of conflicting rights would be a novel mode of determining their legal superiority.”⁴ “Anyone might take and use water flowing on the public domain for any beneficial use subject only to the rights of any prior appropriators” (McCurdy 1976, pp. 257–58). The doctrine of appropriations gave no preference to riparian landowners, allowing all users an opportunity to compete for water and to develop far from streams. Appropriations were limited according to the means used for appropriating or the reason for the appropriation.

In many cases, disputes arose and courts were called on to define rights. While cases were often complex and complicated, Judge Stephen J. Field contended that “the courts do not . . . refuse the consideration of subjects, because of the complicated and embarrassing

³*Hoffman v. Stone*, 7 Cal. 46, 48 (1857).

⁴*Weaver v. Eureka Lake Co.*, 15 Cal. 271, 175 (1860).

character of the questions to which they give rise.”⁵ The Field Court continually worked to define and enforce rights in order to promote efficient markets. Even pollution, which frequently occurred in the mining process, was handled by having polluters pay damages to those users who received lower quality water downstream. The impact of the Field Court decisions has been summarized by McCurdy:

By converting the possessory claims of so many trespassers into judicially-cognizable property rights, the California court effectively brought federal land-use policy into the realm of private, and, in some instances, constitutional law. . . . Moreover, the court also mobilized the still inchoate “public purpose” and due process doctrines to prohibit the miners’ “primary assemblages,” as well as the state legislature, from using the organized power of the community to divest the equitably-acquired claims of men who had evinced a growth inducing “incentive to improvement.” . . . Field believed that only the courts were capable of resolving allocation problems so as to simultaneously protect property rights, release entrepreneurial energies, and provide all men with an equal opportunity to share the material fruits of a vigorously-expanding capitalist society. (1976, pp. 264–66)

The law that evolved in the West reflected the greater relative scarcity of water in the region. As the settlers devoted more efforts to defining and enforcing property rights, a system of water law evolved, which:

1. Granted to the first appropriator an exclusive right to the water and to later appropriators conditioned on the prior rights of those who have gone before;
2. Permitted the diversion of water from the stream so that it could be used on non-riparian lands;
3. Forced the appropriator of water to forfeit his right if the water was not used, and;
4. Allowed for the transfer and exchange of rights in water between individuals.

Private Water Development

While the doctrine of appropriation was evolving in the mining camps, private institutions were developing to capture and deliver the water to where it was needed. One usually thinks of large federal reclamation projects as the main impetus to Western irrigation, but private development was dominant on the frontier. The American Indians and the Spaniards were the first to irrigate the American

⁵*Butte Canal and Ditch Co. v. Vaughan*, 11 Cal. 143, 152 (1858).

West, followed by groups such as the Mormons, who had 16,000 acres of irrigated lands under cultivation by 1850, 263,500 acres by 1890, and 1,176,116 acres by 1940 (Golzé 1961, p. 6).

Cooperative colonies also significantly contributed to early irrigation development. The Greeley Colony, named after its founder Horace Greeley, brought 32,000 acres under irrigation and set the stage for irrigation development in Colorado. The Anaheim Colony in California also demonstrated that private savings could finance the construction of irrigation canals. The main group stayed in San Francisco to work at their normal occupations in order to finance the colony, while others worked on producing crops on 20-acre, privately owned parcels irrigated by communally owned canals.

The contributions of private reclamation projects should not be underestimated. By 1910, over 13 million acres of land in the West were irrigated by private ventures. Between 1900 and 1910, the number of irrigated acres grew by 86.4 percent, with private enterprise accounting for almost all of the increase (Golzé 1961, p. 13; see Table 1). Even though public development greatly increased after the Reclamation Act of 1902, private development continued to provide a significant portion of the new irrigation development.

Many different forms of business organization were used to develop Western irrigation. For the smaller projects, especially in the mining districts, individuals and partners had sufficient funds to undertake the necessary investments. As already noted, the cooperative ventures of the Greeley and Anaheim colonies also contributed significantly. In 1920, cooperative ventures, including incorporated, unin-

TABLE 1
PRIVATE IRRIGATION DEVELOPMENT IN 17 WESTERN STATES
(in acres)

Census	Total Irrigated Acreage	Furnished Government Water	Private Development
1890	3,631,381	—	3,631,381
1900	7,527,690	—	7,527,690
1902	8,875,090	—	8,875,090
1910	14,025,332	568,558	13,456,774
1920	18,592,888	2,388,199	16,204,769
1930	18,944,856	3,049,970	15,894,886
1940	20,395,043	3,800,239	16,594,804
1950	24,869,000	5,700,000	19,169,000

SOURCE: Golzé (1961, p. 14).

corporated, and irrigation districts, irrigated more acres than individuals and partnerships did (see Table 2).

The private irrigation companies or mutual corporations usually organized themselves around six important rules:

1. The company issued shares of stock which were similar to any privately owned corporation.
2. Each share was treated equally with the total number of shares equaling the capacity of the irrigation system. Available water in any given year was prorated according to stock ownership.
3. The shares of stock were transferable with prices determined in the marketplace. In most cases, owners could rent any or all of their water rights.
4. The expenses incurred by the company for operation, maintenance service, and retirement of debt were also prorated according to stock ownership.
5. Stockholders' liability was not limited. The land of the stockholder could be used as a lien against any financial obligations of the mutual.
6. Private irrigation companies had the power to condemn land for right-of-way, provided they paid just compensation (Smith, forthcoming).

These rules are especially significant since they further contrib-

TABLE 2
AREA IRRIGATED IN 17 WESTERN STATES, BY TYPE OF ENTERPRISE

Item and Type of Enterprise	Primary Enterprises (acres)		
	1920	1930	1940
Individual and partnership	6,448,663	6,038,835	6,906,738
Cooperative, incorporated	6,569,690	6,271,334	5,706,606
Cooperative, unincorporated			907,242
Irrigation district	1,822,887	3,452,275	3,514,702
Reclamation district	—	—	59,052
Commercial	1,635,027	999,838	855,166
Bureau of Reclamation	1,254,569	1,485,028	1,824,004
Bureau of Indian Affairs	284,551	331,840	515,765
State	5,620	11,472	16,995
City and/or sewage	40,146	121,218	83,457
Other	531,735	233,016	5,316
TOTAL	18,592,888	18,944,856	20,395,043

SOURCE: Golzé (1961, p. 99).

uted to the operation of private markets in the West. By using members' assets as collateral, mutuals could enter capital markets to obtain the investment funds necessary to develop irrigation projects. The transferability of stocks insured that water could be moved to higher-valued alternatives, further insuring the success of the operation. These features, combined with the security of rights provided by the doctrine of appropriation, stimulated an effective marketplace. Writing in 1903, Elwood Mead concluded that investment with corporate capital in canals:

has been the leading factor in promoting agricultural growth of the Western two-fifths of the United States. It has been the agency through which millions of dollars have been raised and expended, thousands of miles of canals constructed, and hundreds of thousands of acres of land reclaimed. It has been the chief agency in replacing temporary wooden structures by massive headworks of steel and masonry, and, by the employment of the best engineering talent and the introduction of better methods of construction, has promoted the economy and success with which water is now distributed and used. (p. 57)

In discussing the water deeds or water-right contracts of the Colorado ditch companies, Mead concluded that "... if the water of streams is public property, the public should show the same business ability in disposing of its property as those to whom its control is transferred. Colorado can learn something about the management of the water of streams by studying how canal companies dispose of the water which they appropriate" (p. 167).

Summary

During the last half of the 19th century, the foundation was laid for an effective water market. Following the doctrine of prior appropriation, water rights were defined, enforced, and made transferable. In part, it was a sense of justice that led the early settlers to allocate water rights on the basis of "first in time, first in right." Out of this doctrine, however, grew an efficient set of institutions that allowed individual actors in the marketplace to determine the best uses of water. Authority was linked to responsibility, giving water owners the incentive to seek out the best uses of their resource. The scarcity of water west of the 100th meridian increased the benefits of activities designed to establish and enforce exclusivity. It is, therefore, not surprising to find that in Montana, Wyoming, Colorado, and New Mexico where rainfall averages 15 inches per year, the common law was eventually abrogated, while in North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas, common law was retained

in a modified form. The evolution of water law on the Great Plains was a response to changes in the benefits and costs of defining and enforcing rights to a valuable resource.

With an efficient set of water institutions in place, private individuals undertook projects to deliver water where it was demanded. Well-defined, exclusive rights provided the necessary tenure security to stimulate private investment. A variety of organizational structures were used to mobilize the necessary capital for building dams to store the water and aqueducts to deliver it. Irrigation and mining activities received most of the water, but population growth meant that municipal demands also had to be served. The leaders of the reclamation movement at the turn of the century were correct in asserting that without the application of water, Western lands would not be very productive. They failed to recognize, however, how effectively private institutions and markets could serve this purpose. Thousands of miles of ditches were constructed and millions of acres blossomed as a result of entrepreneurial efforts to employ water.

None of this should imply that water rights and markets are without defects. Resources had to be used to define and enforce water rights and to resolve disputes, which continually arose over who was first in time and what quantities of water were claimed. Water markets operated in a region and a time where information travelled slowly and risks were great. As a result, mobilization of capital for water development was not easy. The spontaneous order of the American frontier was an experiment with the evolution of property rights. Since the actors in that experiment had to bear the consequences of their actions, they developed institutions that conserved on the resources with which they worked.

Since the economic returns available on the frontier were associated with natural resources, the first generation of Westerners developed an institutional framework that promoted efficient allocation of those resources. In this way, they were able to increase their wealth despite harsh conditions. The new rules of the game unleashed the productive potential of entrepreneurs and allowed for what James Willard Hurst called the "release of energy." Today, wealth in the West still depends on natural resources, but we seem to have lost sight of the importance of private property rights and entrepreneurship.

What Went Wrong?

While the system of property rights that evolved in the American West was not perfect, it provided no good reason for the extent of

governmental intervention that has occurred during the 20th century. The early development of water institutions took place outside the framework of formal government, with contracting forming the basis of water rights and markets. Eastern institutions and laws were often not suited to the resource endowments of the American West and had to be modified or abandoned. When the courts arrived, the lawyers who manned them brought the baggage of Eastern law and formal powers of the federal government with them. As a result, it did not take long for the institutions to be changed. Perhaps the Colorado mining district knew what it was doing when it resolved that "... no lawyer be permitted to practice law in this district under penalty of not more than fifty nor less than twenty lashes, and be forever banished from the district."⁶

Rent Seeking Through Water Institutions

The economist defines rent as the return from the employment of a resource that exceeds the opportunity costs of that resource. Rents, therefore, provide a dynamic force to which entrepreneurs respond. It is this rent that entrepreneurs try to capture when they move resources from lower- to higher-valued uses. When others observe these rents, they try to replicate the activity in an effort to capture a share. As long as property rights are well-defined and enforced, the only way an entrepreneur can do this is to improve resource allocation. In this sense, the entrepreneur provides the only free lunch available to society. As long as entry and exit from markets are possible, rents will signal opportunities for efficient reallocation of resources. Efforts at such reallocation are known as productive or pie-enlarging activities.

Rents can also be obtained by using the coercive power of government to restrict entry or exit into a particular endeavor or to redistribute existing rights. Suppose, for example, that a firm's production is generating water pollution. If this firm succeeds in having legislation passed prohibiting new firms from having such pollution, the existing firm will capture some rents. Similarly, if a special interest group successfully obtains subsidies for water development, the subsidies will represent a redistribution of income and rents to those who receive the water.

Such efforts to influence governmental decisions are known as rent seeking. There is a possibility of rent seeking when the government can create barriers to entry and redistribute rights. Under these con-

⁶Quoted in Beadle (1882, p. 478).

ditions, entrepreneurial talents will be attracted to the political arena where they will be used to influence decisions. Since rent seeking represents a taking from one group and a giving to another, both losers and gainers will devote entrepreneurial talents to influencing political decisions. Rent seeking, then, becomes a negative-sum game that reduces the size of the pie. As long as entrepreneurs perceive that any rents exist, we can expect continued competition among rent seekers to dissipate the gains. The important point to remember is that this competition uses valuable resources.

The Founding Fathers understood that self-interested individuals would attempt to use the government for rent seeking, so they erected constitutional barriers to prevent it.⁷ The contract clause, the commerce clause, and the due process amendments were all interpreted by the Supreme Court during the most of the 19th century in ways that reduced the prospects for rent seeking. By not allowing the government to interfere with contracts or exchange (commerce) and by insuring that rules of law had to be followed, Court interpretations encouraged productive activity, which generated substantial economic growth. During the last quarter of the 19th century, however, the door was opened for rent seeking as more and more regulation of the marketplace was introduced.

It is important to ask how rent seeking in water could occur in light of constitutional barriers and the fairly well-established water rights discussed above. The first justification for governmental intervention centered on the uniqueness of the resource. The constantly changing physical nature of water makes it more difficult to define and enforce rights to it. In Blackstone's words, "For water is a moving, wandering thing, and must of necessity continue to be common by the law of nature; so that I can only have a temporary, transient, usufructury property therein."⁸ After John Wesley Powell's survey of the Rocky Mountain region, people were keenly aware of how important water was in the arid West.

While it is true that water could make "the desert bloom even as a rose" and that it is a moving, wandering thing, it does not follow that water is so unique that it requires governmental allocation. Water certainly is necessary for life, but we can survive on very minimal quantities of it. Clothing and shelter are also necessities, but this

⁷For a more complete discussion of constitutional barriers to rent seeking, see Anderson and Hill (1980).

⁸Quoted in Webb (1931, p. 434).

does not justify public allocation of them.⁹ Nevertheless, according to Hirshleifer et al., it is a widely held belief "that private ownership is unseemly or dangerous for a type of property so uniquely the common concern of all" (1960, p. 367).

Paraphrasing a section of the Water Rights Act of Iowa (substituting land for water), Hirshleifer et al. illustrate the absurdity of the uniqueness argument:

Land occurring in any valley, or along any water course or around any other natural body of water in the state, is thereby declared to be public *land* and the public wealth of the people of the State of Iowa and subject to use in accordance with the provisions of this act, and the control and development and use of *land* for all beneficial purposes shall be in the state, which, in the exercise of its police powers, shall take such measures as shall perpetuate full utilization and protection of the *land* resources of the State of Iowa. (1960, p. 367)

Although most people would not accept this reasoning for the control of land resources, it has been used to further public allocation of water.

Other arguments for governmental involvement in water have focused on three types of market failure: monopoly, imperfect capital markets, and externalities. Early water reformers continually feared that private water supplies would constitute a natural monopoly, which would allow suppliers to charge high prices for the resource. As William E. Smythe put it:

If we admit the theory that water flowing from the melting snows and gathered in lake and stream is a private commodity belonging to him who first appropriates it, regardless of the use for which he designs it, we have all the conditions for a hateful economic servitude. Next to bottling the air and sunshine no monopoly of natural resources would be fraught with more possibilities of abuse than the attempt to make merchandise of water in an arid land.¹⁰

Although Major Powell recognized that the cheapest and most dependable source of water was from water companies selling at a profit, he was concerned with "the danger of an evil monopoly which would charge an exorbitant price and force the homesteaders to pay

⁹Regarding the uniqueness argument for water regulation, Hirshleifer et al. (1960) have stated: "This is not to deny that, as a commodity, water has its special features; for example, its supply is provided by nature partly as a store and partly as a flow, and it is available without cost in some locations but rather expensive to transport to others. Whatever reason we cite, however, the alleged unique *importance* of water disappears upon analysis" (pp. 4-5).

¹⁰Quoted in Alston (1970, p. 128).

a heavy tribute.¹¹ This concern contributed to the rise of governmental involvement in the control of water rights and distribution.

The concern with monopoly, however, has little empirical basis. While it is true that water companies sold a product that was fairly inelastic in demand, many of those companies were not financially profitable, which suggests that their so-called monopoly power was not that great. There are three reasons for this. First, companies did compete with one another to provide irrigation water to the same regions. If one company raised its price too much trying to appropriate settlers' rents, the settlers could move to lands irrigated by cheaper water. With the development of technology that allowed irrigation from groundwater sources, this possibility was even greater. Second, the commercial companies that were the only suppliers of water to a region generally had only one group of buyers. This led to the possibility of a bilateral monopoly, where irrigation companies and farmers bargained over the price of water. Just as the companies could attempt to appropriate rents to the land by raising water prices, farmers could band together and attempt to expropriate rents to capital by forcing water prices down. Third, in order to effectively execute monopoly power, water companies must have withheld their product from the market, requiring the construction of large storage works. They may have been able to hold back enough water to keep prices up temporarily, but eventually the water would have to be released even from the largest storage facilities. When this happened, the courts held that the water was free to be claimed by others. Therefore, the possibility of increasing prices by restricting output was unlikely.

Another argument for nonmarket alternatives to water allocation was that capital markets were insufficiently developed to provide the necessary investment funds for large projects. Alfred Golzé (1961) stated that "while private enterprise had managed to bring under successful irrigation an impressive and substantial acreage of land, a point had been reached where further development would need stronger support by the Federal and state governments" (p. 12). The water reformers recognized that capital markets had mustered significant funds to build irrigation projects, but their visions included such large-scale reclamation that no one could imagine private capital that would be sufficient. In 1902, it was probably hard to envision a world capital market as extensive as that which exists today, but such a market did develop and does provide funds that can undertake many reclamation projects. Furthermore, the visions of the early

¹¹Quoted in *ibid.*, p. 129.

reclamation supporters included many projects that simply could not pass the benefit-cost scrutiny of markets. These projects would not have been profitable for private enterprise, and they were not profitable for the public either.

The final argument for governmental intervention was that the physical nature of water produced many third party effects, or externalities. If one party polluted a stream, the pollution moved downstream to affect other users. If one pumper took water from a common groundwater source, his actions could affect the pumping costs of others. These examples were used to justify public regulation of water rights.

In some cases, the concern for externalities was warranted. Among economists, the externality argument is one of the more powerful for nonmarket alternatives. The fact is, however, that the evolving system of private water rights was solving many of the externality problems. In the case of pollution from mining operations, McCurdy (1976) found that the courts "issued injunctions when debris buried the claims of miners below, destroyed the growing crops of preemption claimants, filled irrigation ditches and poisoned their fruit trees, or split the hoses of hydrolic miners downstream" (p. 262). In a California case in which a miner was held liable for damages when debris washed away the ditch of another appropriator, Judge Stephen Field stated that "no system of law with which we are acquainted tolerates the use of one's property in that way so as to destroy the property of another."¹² Externalities do present real problems for markets. They are not, however, a sufficient justification for nonmarket controls and are overused as an argument for government intervention in water markets.

The rent seekers who used the coercive powers of government to obtain control of water rights or subsidies for irrigation projects couched their arguments in the above terms. Backed by such public reclamation entrepreneurs as Powell, Davis, and Mead, politicians saw an opportunity to provide their constituents with rents created by restricting entry or by subsidies paid for by others. These people claimed that:

federal control would promote "scientific" management of land and water resources, simultaneously "conserving" and "developing" them; prevent the monopolization of water by corporations and "speculators"; streamline the system for establishing and enforcing water rights; and encourage the development of rural democracy by war veterans and other deserving pioneers. These policies received

¹²*Jennison v. Kirk*, 98 U.S. 453, 461 (1878).

the strong backing of at least three presidents, including the two Roosevelts and Herbert Hoover. (Cuzán, pp. 16–17)

Their arguments were extremely successful.

Limits on the Doctrine of Appropriations

We have already seen how the spontaneous order of the American West was evolving into an effective system of water rights. Provisions were made for definition and enforcement, and rights were transferable. There were all of the necessary ingredients for an effective water market for allocating the scarce resource.

While the California court, under the direction of Stephen Field, recognized the potential for “using the organized power of the community to divest the equitably acquired claims of men who had evinced a growth inducing ‘incentive to improvement’ ” (McCurdy 1976, p. 265), the late 19th century saw inefficient restrictions placed on the doctrine of appropriations. A law review article published in 1929, “From Prior Appropriation to Economic Distribution of Water by the State Via Irrigation Administration,” captures the essence of the transformation. Some state laws were recognizing prior rights, but other state constitutions and statutes throughout the West were essentially establishing the public ownership of water. Recall that appropriators received only a usufructuary right (a right to use the water), not an actual ownership right. The *corpus* of water was declared to be state property. This distinction was in sharp contrast to land laws and set up an immediate tension between use and ownership. As long as water was publicly owned, it was easy for groups who saw a potential to gain from regulation of use to do so.

As population and demands for water in the West grew, so did the number of disputes over ownership. When water was abundant, it did not pay to get involved in the disputes; but as the value of water rose, so did ownership disputes. From the outset of the doctrine of appropriations, courts were involved in settling conflicting claims, the cost being borne by those involved. But some found it in their interest to have states subsidize this process. In Colorado in 1874, for example, irrigators “met in convention to demand legislation for public determination and establishment of rights of appropriation, and then state superintended distribution of water in accordance with the thus settled titles” (Lasky 1929, p. 173). The transformation from prior appropriation to administrative law eventually brought with it, according to Cuzán:

requirements for the filing of new claims, first at the county, then the state level; the limitations on the the size of “excessive” claims and legal specifications on the duty of water; attachment of water

rights to specific land tracts; the disallowing of ownership to water by canal companies which did not irrigate lands of their own; regulation of canal company rates by states and counties; state encouragement to the formation of irrigation districts with the power to tax, condemn property and sell bonds to finance construction of irrigation works and buy out water companies; legislative determination of what constitutes "beneficial use" along with the ranking of uses by classes; prohibition on sale of water rights beyond state or irrigation district boundaries; administrative allocation of water during periods of "drought"; and the establishment of the centralized bureaucracy headed by a state engineer or water commissioner to administer policies and judicial decrees and, in some states, undertake irrigation projects. (p. 13)

Another cause of the erosion of the doctrine of prior appropriations was the inability of judges to forget the common law precedent of riparian rights. Recall that riparian rights grant that

every owner of land through which a natural stream of water flows, has a usufruct in the stream, as it passes along, and has an equal right with those above and below him to the natural flow of the water in its accustomed channel, without unreasonable detention or diminution in quantity or quality, and to the reasonable use of the stream for every beneficial purpose to which it can be applied, and none can make any use of it prejudicial to the other owners, unless he has acquired a right to do so by license, grant or prescription.¹³

Several elements of the riparian doctrine led directly to more public control of water allocation. First, riparian ownership meant that the resource was held in common and required regulations on open access. Second, since uses that were prejudicial to other owners required "license, grant or prescription," users naturally sought and obtained these special preferences through legislation.

The courts received from the miners a fairly well-settled doctrine for defining, enforcing, and transferring rights; but as disputes came before the courts, riparian arguments were continually introduced. As early as 1853, for example, the California Supreme Court argued that "the owner of land through which a stream flows, merely transmits the water over its surface, having the right to its reasonable use during its passage. The right is not in the corpus of the water, and only continues with its possession."¹⁴ Even though the ruling in *Eddy v. Simpson* was subsequently overturned, it did provide riparian precedent in California. Courts continued to state that rights were only usufructuary and that they were lost once the water left the

¹³Quoted in Clayberg (1902, p. 91).

¹⁴*Eddy v. Simpson*, 3 Cal 249, 252.

possession of its appropriator. John B. Clayberg (1902) saw that riparian principles were not being ignored in the evolution of the doctrine of appropriations:

There never seemed any doubt in the mind of the court about the true position to be taken, but it is almost amusing to read their statements as to whether the principle announced was in consonance with the common law, or departure from it, because of the conditions and necessities of the case. In one case the court would say that they did not depart from the common law but found principles there insufficient to sustain their holdings. In another, the doctrine would be announced that the common law was inapplicable, and that the reasons of that law did not exist in California. (pp. 97-98)

The inability of lawyers and judges to forget common law precedent and the mixture of riparian with prior appropriation doctrine led to confusion, stifling the effective establishment of private property and water. Without private property, the confusion could only be resolved through legislation and administration.

The doctrine that evolved through the spontaneous order and decentralized actions of miners and irrigators was slowly degenerating to the status of permits and licenses controlled by state officials. As early as 1929, Moses Lasky had declared that the principle of appropriation had reached its zenith. He argued that the changes were mostly coming from Wyoming and Colorado and that these changes were *away* "from various forms of extreme individualism and vested property rights of substance in water to . . . the economic distribution of state-owned water by a state administrative machinery through state-oriented conditional privileges of user" (p. 162).

If the introduction of riparian elements into the appropriation doctrine was not enough, the commerce clause of the Constitution also served to increase governmental regulation of water rights. Under the auspices of the commerce clause, the federal government chose to regulate all navigable waterways and their tributaries. This included restrictions preventing private parties from developing reservoirs, sites, or rivers. Navigable waterways were defined in terms of their ability to float logs. Since the commerce clause had been interpreted in ways that gave the government power to regulate interstate commerce, the federal government used it to restrict water development on the grounds that it might impede navigation. With navigation defined in terms of the stream's ability to float logs, almost no streams were exempt from regulation. Hence, the navigation doctrine provided a broad means for federal control. Charles E. Corker has noted the broad implications of this power:

... the Congress and the courts have been content to treat the word "navigation" as an open sesame to constitutionality. So long as Congress uses the word in statute and the case relates to something moist, the Court takes at face value the declaration that the legislation is in furtherance of navigation. Moreover, the test of what constitutes a navigable stream has been stretched to embrace most of the waters of the United States. . . . (1957, pp. 616-17)

To this day, the navigation doctrine muddles water rights and continues to interfere with a system of well-established property rights in water. In Montana, for example, a group trying to secure public access to the Deerborn River contends that a rancher cannot prevent access because the stream is navigable. Even though the stream has not been used in recent years for floating logs, the issue centers on whether it was used for this purpose in the late 1800s.

By using legislative and administrative rules, individuals have been able to limit water rights in order to capture rents. For example, junior users have engaged in rent seeking by arguing that the doctrine of prior appropriations is "unfair." With this argument, those users persuaded some state legislatures to substitute a different system of priorities than that provided in "first in time, first in right." First preference is usually given to domestic and agricultural uses, with commercial and industrial uses having a lower priority. Thus, even if the latter users purchase early water rights, those rights may be superseded. Similarly, legislation requiring forfeiture of rights for non-users has created the "use it or lose it" principle. While such laws were passed in an effort to prevent "waste," in fact they have created waste. Perhaps the most obvious example of rent seeking exists in those states where allocative decisions are placed in the hands of the judiciary, resulting in expenditures of resources by both losers and gainers from reallocation of water in the form of legal services to influence the judge's decision.

The final example of the results of rent seeking is the restriction on the transferability of water rights. Frank Trelease (1957) argues that the reason for such restrictions was that "many early adjudications gave the irrigators far more water than they really needed, so that the appropriator not infrequently sold his unused water to which he really had no right."¹⁵ Through restrictions on transferability, therefore, some water users were able to gain by obtaining those "excessive" water rights. Hirshleifer et al. (1960) note "that an attempt to correct past mistakes in vesting property rights by simple deprivation or confiscation may have only distributional effects (except

¹⁵Quoted in Hirshleifer et al. (1960, p. 235).

insofar as insecurity of rights affects incentive of others) but freezing the right to the original use of water has an adverse efficiency effect from which the community as a whole loses" (p. 240). In Montana, the state constitution prohibits the transfer and sale of water for the purpose of coal slurry pipelines. This effectively prevents coal slurry users from competing with other water users to satisfy consumer preferences. As a result, the price of water is kept artificially low, providing a gain to some users at the expense of others.

The "lawless West" produced the foundation for an effective system of water rights, but legal restrictions have essentially broken down that foundation. As Cuzán notes:

It is evident that the long-term trend of federal policy has been to mobilize financial, administrative, political, constitutional and judicial resources . . . to gain . . . control of western waters. . . . The appropriation doctrine has been undermined, water rights have been virtually expropriated and converted into licenses or permits, and control over Western waters has been centralized in state and federal governments. (pp. 20–21)

Instead of relying on markets, we have turned water allocation over to bureaucrats who have created a rent-seeking process that uses valuable resources without guaranteeing efficiency *or* equity. If we are to avoid a water crisis through a market solution, we must return to the original principles of the appropriation doctrine.

Reclaiming the West with Public Funds

Just as limits on the appropriation doctrine hinder water markets, public reclamation replaced much private enterprise and created a bureaucratic pork barrel that continues to thrive even when other public funds are cut. What was the rationale for public investment in reclamation, and what are its consequences?

As noted above, concern over private monopoly and imperfect capital markets led to the public control of and investment in irrigation projects. In his *Report on the Lands of the Arid Region* in 1878, Major Powell expressed concern that water rights would be "gradually absorbed by a few. Monopolies of water will be secured, and the whole agriculture of the country will be tributary thereto—a condition of affairs which an American citizen having in view the interest of the largest number of people cannot contemplate with favor" (1878, p. 43). Coupled with the argument that markets are not efficient enough to provide sufficient funds for reclamation projects, this concern led bureaucratic entrepreneurs to seek public funds for their large-scale plans to reclaim the American West.

Two pieces of legislation provided the cornerstones for govern-

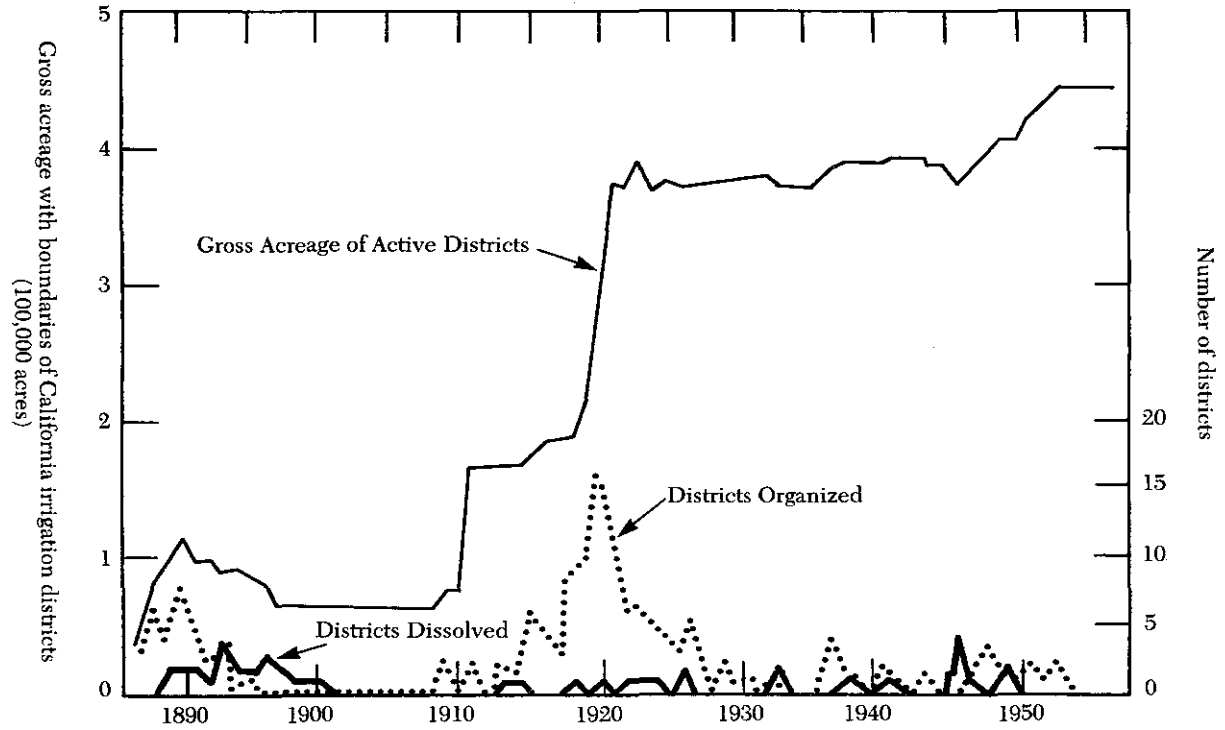
mental involvement in reclamation. First, the Wright Act was passed in California in 1887, providing the statutory emphasis for public ownership of irrigation facilities. It also established a procedure for petitioning for and voting on the question of public control of irrigation. If half of the landowners holding 50 percent of the affected land petitioned for a public irrigation district, county commissioners were directed to call a special election in which a two-thirds majority was necessary to support the petition. Once established, the irrigation district's board of directors had the power to incur financial obligations, impose property taxes, and establish water prices. While these policies had to be approved by a simple majority of the voters, they provided a way for collective action to influence the distribution of benefits and costs of irrigation projects. Other Western states adopted similar legislation during the next few decades, and the door was open for rent seeking through irrigation districts.

Public irrigation districts provided an opportunity for rent seeking in two ways. First, unlike private, mutual companies, public irrigation districts could use property taxes to finance projects, creating the potential for income redistribution. Second, because the legislation did not make the board of directors or the individual water users residual claimants, the incentive for efficient pricing was greatly reduced. Irrigators who could keep the price of water below its opportunity cost received a rent or subsidy paid for through water district taxes.

While there is a lag between legislation enabling the formation of public irrigation districts and their growth, the rent seeking that resulted from such legislation cannot be disputed. Between 1920 and 1950, public irrigation districts in California grew from 577,000 to 1,821,000 irrigated acres. During this same time, mutual irrigation companies and commercial enterprises were declining (Smith, p. 9). Figure 1 shows that the peak of district organization occurred in the 1920s, while gross acreages of active districts remained approximately constant until 1910, grew dramatically until 1925, and stabilized thereafter.

Rodney Smith's empirical analysis of the choice between private and public irrigation ownership in California supports the hypothesis that public districts provided a means for obtaining rents. Mutual water companies charged direct prices for their water while public irrigation districts collected taxes, forming an implicit price. In the former, when individual water use increases, payments to the company increase. In the latter case, however, an increase in an individual's water use influences not only the farmer's own property tax liabilities but also those of all other landowners in the district. There-

FIGURE I
CALIFORNIA IRRIGATION DISTRICTS ORGANIZED AND
DISSOLVED AND GROSS DISTRICT ACREAGE,
1887-1956



SOURCE: Brewer (1961), Figure V.

fore, the farmer in the district receives a direct benefit, and the costs are diffused over the district population. Smith's analysis shows that water demand in mutual water companies is much more responsive to direct charges than water demand in public irrigation districts is to indirect taxes (pp. 42–48). Pricing via taxes allows individuals to use public irrigation districts to redistribute income. Furthermore, it promotes inefficient water use by allowing the irrigator to face prices that do not reflect full costs.

While the formation of public irrigation districts provided a local mechanism for subsidizing water projects, the Newlands Reclamation Act of 1902 produced further subsidies through the federal government's massive water projects in the West. Initially, reclamation projects were to be funded from the proceeds from the sale of public lands. Costs were to be repaid within 10 years, though no interest charges were to be levied; and each Western state was to receive reclamation revenues according to its proportional contribution to public land sales. By limiting water delivery to farms no larger than 160 acres, the Act was to promote Jeffersonian democracy. Rights to the water delivered to the small farms were to be made appurtenant to the land.

These initial provisions were relatively harmless in terms of water subsidization. The program was to pay for itself, but some were skeptical about the Act from the beginning. A New York congressman estimated that the plan would ultimately cost the country billions of dollars. Dalzell of Pennsylvania believed it would "unlock doors of the treasury." Cannon of Illinois dubbed the bill a "direct grant in an indirect way." Payne of New York was of a like mind, while Hepburn of Iowa insisted "that this is a thinly veneered and thinly disguised attempt to make the government, from its general fund, pay for this great work—great in extent, great in expenditure, but not great in results. . ." (Hibbard, 1965, p. 442).

In retrospect, the critics were correct. The Reclamation Act has allowed irrigators and agents of the bureaucracy to engage in rent seeking. The projects allowed interest-free loans for construction costs with flexible repayment schemes. By altering the terms of repayment, the Bureau of Reclamation was able to expand and irrigators were able to receive larger subsidies. The Reclamation Act also promoted rent seeking by setting the 160-acre limit. Since enforcement of this restriction determined the distribution of benefits from federal irrigation programs, irrigators have attempted to alter the enforcement.

Though the initial legislation provided for 10-year, interest-free loans, the value of this subsidy to irrigators was increased signifi-

cantly through extensions of the repayment period, allowances for periods of no repayment, and combinations of irrigation and power projects that allowed revenues from hydroelectric power to repay irrigation costs exceeding the irrigators' "ability to pay." Table 3 shows the proportion of costs that are subsidized, depending on the interest rate and the repayment terms. It is clear that higher interest rates, longer repayment schedules, and grace periods increased the value of the subsidy. Because many Bureau of Reclamation projects were not economically sound, default was common. When loans could not be repaid, farmers and bureaucrats argued for extensions, the graduation of payments, and the postponement of the first payment. The Omnibus Adjustment Act of 1926 extended prepayment of contracts to 40 years and graduated the repayment schedule. When low agricultural prices between 1926 and 1930 made it difficult for farmers to meet their reclamation payments, Congress granted a moratorium on all payments from 1931 to 1936.

TABLE 3
THE INTEREST SUBSIDY

Payment Plan	Subsidized Proportion of Costs (Percent)		
	Discount Rate		
	3%	6%	10%
10 yr. repayment period; equal installments	14.7%	26.4%	38.6%
20 yr. repayment period; equal installments	25.5%	42.5%	57.5%
20 yr. repayment period; graduated installments ¹	28.9%	47.8%	64.0%
20 yr. repayment period; graduated installments with grace period and down payment ²	30.7%	50.3%	66.7%
40 yr. repayment period; equal installments	42.3%	62.5%	75.5%
40 yr. repayment period; equal installments with 10 yr. grace period	57.0%	79.0%	91.0%

¹Repayment schedule (outlined in the Act of August 13, 1914) was 2% of construction costs for first four years, 4% for next two years, and 6% for final 14 years.

²Repayment schedule (outlined in the Act of August 13, 1914) was 5% of construction cost down, followed by a five-year development period, then annual payments of 5% for five years and 7% for the final 10 years.

The Reclamation Project Act of 1939 empowered the Bureau to enter into more flexible repayment contracts. "Contracts negotiated under section 9(d) of this Act were permitted to have repayment periods of 40 years with development periods of up to 10 years. The contracts could be written to allow for charges that varied with productivity of different classes of land within the project area and for annual changes that depended on gross crop values" (Rucker and Fishback, p. 13). In addition to providing irrigators with larger subsidies, the ability to lengthen the repayment period gave the Bureau of Reclamation longer administrative control over projects, since that control was not relinquished until a certain percentage of construction costs was paid.

In the 1920s, the Department of Agriculture opposed Bureau of Reclamation irrigation projects on the grounds that they were aggravating the oversupply of farm products. To combat this attack, the Bureau diversified by engaging in multiple purpose projects, building Hoover and Grand Coulee dams, for example, to provide hydroelectric power, municipal water, flood control, improved river navigation, and irrigation. In addition to giving the Bureau support from other constituencies, this diversification enabled further subsidization of irrigation water. Table 4 shows the percentage of irrigation costs subsidized by power production for selected projects. When these subsidies are combined with those discussed earlier, subsidies to irrigation can run as high as 90 percent.

Summary

When the court cases that served to erode the basis of the doctrine of appropriations are combined with public reclamation efforts, there is little room for market allocation of water. In most Western states, water is the declared property of the state, the people, the public. Only in Colorado and New Mexico is this declaration limited to unappropriated water. Writing 20 years ago, Hirshleifer et al. concluded that:

the current trend, in sum, runs strongly against the development of a system of water law based on individual choice and a market mechanism. . . . [W]e think that the evidence is fairly clear that the tenor of the legislative and judicial edicts we have reviewed is the product of the ignorance of even importantly placed and generally well-informed individuals today about the functioning of economic systems—and, in particular, it is the product of the common though incorrect opinion that the public interest can be served only by political as opposed to market allocation processes. . . . That there are defects in the present systems of private water rights is very clear; but to abolish property rights rather than cure the defects is a drastic and, we believe, unwise remedy. (1960, p. 249)

With few exceptions, the legislative and judicial actions have contin-

TABLE 4
THE POWER SUBSIDY¹

Project	Costs Allocated to Irrigation	Costs to be Pre-paid by Irrigators	% of Irrigation Costs Subsidized
Central Valley California	682,152,000	606,646,000	11.1%
Chief Joseph Dam ² Washington	11,083,200	6,050,000	45.4%
Collbran Colorado	6,105,000	1,089,101	82.2%
Columbia Basin Washington	745,111,398	135,916,400	81.8%
Dixie Utah			
Fryingpan— Arkansas Colorado	69,946,000	50,512,300	27.8%
Rouge River Oregon	18,064,000	9,066,500	49.8%
San Angelo Texas	8,853,904	4,000,000	54.8%
The Dalles Oregon	5,994,000	2,550,000	57.5%
Venturia River California	18,273,128	10,746,300	41.2%
Washita Basin Oklahoma ³	10,403,011	8,221,000	21.0%

¹On some of these projects, a portion of the subsidy to irrigators came from industrial and municipal users. Source: Reclamation Payments and Payout Schedule, Department of the Interior, Bureau of Reclamation, U.S. Government Printing Office, 1965.

²Includes costs and repayments from Foster Creek and Greater Wenatchee Divisions.

³Includes costs and payments from Fort Cobb and Fass Divisions.

ued to erode the basis of private property rights in water. Moses Lasky's concern in 1929 about the shift from prior appropriation to economic distribution of water by the state was certainly prophetic.

The large-scale federal involvement in reclamation also contributed to the demise of water markets and the promotion of inefficiency. Without the proper information and incentives, alternatives to large-scale reclamation have not been considered carefully. Rudolph Ulrich estimated that the costs of bringing desert land into agricultural production were 5 to 14 times greater than the costs of clearing, fertilizing, and irrigating lands in the humid Southeast. In 1924, Benjamin Hibbard concluded:

In passing the Reclamation Act in 1902 as a nation we clearly forgot those things which were behind, the millions of unoccupied acres of the Mississippi Valley, consisting mostly of fertile, well-watered land needing only to be drained or cleared. Had we really been concerned over the future food supply as we pretended to be, or being so concerned, had we calmly asked how to increase it in the cheapest and easiest manner, certain of the reclamation projects would still be undeveloped. . . . (1965, p. 449)

Reclamation was able to make the desert bloom, but there is little economic justification for the blossoms.

Some Suggestions for Reform

It has been argued that the foundation for a market solution for water allocation was laid during the last half of the 19th century and that the foundation has been eroding ever since. The appropriation doctrine allows for the definition and enforcement of water rights, which are necessary conditions for market transfers. Administrative and judicial decisions, however, have weakened private property rights in water and restricted transfers that are essential for efficient allocation. Combining these impediments to the market with governmental subsidization of water supplies is producing what U.S. Secretary of the Interior James Watt has called "the most serious domestic crisis of the next decade."¹⁶

Secretary Watt contends that the crisis exists because the nation lacks the billions of dollars needed to solve water problems: "Frankly, we do not have the economic strength to do what needs to be done." Such a perspective differs little from that of any other administration since the Reclamation Act was passed in 1902. While the Reagan administration has called for reclamation reform by making water users pay for the projects, the basic mentality is still one of pouring billions of dollars down the drain. While such solutions are consistent with economic models of bureaucracy, they are not consistent with the espoused free-market orientation of the current administration. Furthermore, it is unlikely that more dollars for water delivery and reclamation systems will do much good. The perverse incentives and information under the current institutional framework will always enable demand to outstrip supply.

A real solution to the water crisis must encompass reform of the property rights structure. The new resource economics is focusing attention on these reforms and is producing suggestions that, if adopted,

¹⁶"Watt Forecasts Water Woes to Stir U.S. Crisis," *Denver Post*, August 13, 1982.

would move us toward a real solution to the water crisis. Three proposals are suggestive of what might be done.

1. *Surface water rights.* Simply eliminating the many restrictions on water transfers would take us a long way toward solving the water crisis. Currently, rights are to divert water for a specific use; hence, courts have imposed limitations on transfers when the use changes. Limits are also placed on transfers between basins and states. By eliminating these restrictions, the market could determine beneficial use and eliminate the need for costly administrative rulings.

The main argument posed by economists against allowing unrestricted transfers is that return flows produce third party effects. Space does not permit developing this argument, but it is easy to see that the transfer of water from one use to another could dramatically alter the return flow. Johnson et al. and Tregarthen have argued that the New Mexico system that specifies consumptive rights rather than diversion rights eliminates this problem. While there will be transaction costs involved in specifying consumptive rights, they do not appear to be prohibitive for most situations. Such a specification could greatly reduce third-party effects and improve the efficiency of market allocation.¹⁷

2. *In-stream water use.* With the growing demand for recreational water use comes increased pressure to leave water in the stream. Diversion for consumptive use often harms fish habitat, reduces possibilities for water reclamation, and reduces aesthetic value. It is generally assumed that this problem cannot be handled by markets and, therefore, that administrative agencies must regulate diversion. Idaho sets stream flows by legislation; Washington sets them by bureaucratic expertise; and Montana reserves water rights to maintain instream flows. In Colorado, the Water Conservation Board can acquire unappropriated rights, but it also has the power to purchase existing rights. While this solution comes closer to a market alternative, the most frequently used methods pit consumptive users against in-stream users, resulting in a zero-sum game.

One reason that states are so heavily involved in determining in-stream flows is that most states prohibit the ownership of water for in-stream purposes. Since use is generally taken to mean consumptive use, leaving water within the confines of the stream's banks is not, in the eyes of the law, a beneficial use. The Colorado Supreme Court's finding that there is "no support in the law of this state for the proposition that a minimum flow of water may be 'appropriated' in a natural stream for piscatorial purposes without diversion of any

¹⁷For a more complete discussion, see Johnson and Gisser (forthcoming).

portion of the water 'appropriated' from the natural course of the stream" indicates the nature of the problem. By allowing such ownership, states could provide an incentive for environmental, fish and wildlife, and conservation groups to purchase existing water rights for in-stream uses. Such property rights exist in England and perform well.¹⁸

3. *Groundwater rights.* Agricultural, municipal, and industrial users are increasingly turning to groundwater as their source of supply. The nation's aquifers contain billions of gallons of water, some of which has been stored for thousands of years. By mining these aquifers, users are able to get relatively cheap water that is available with considerably more certainty than surface water. In many cases, the aquifers have not been adjudicated, so no rights have been assigned. The classic common pool problem often results, and the call goes out for governmental allocation.

An alternative, however, is to assign rights to both the stocks and the flows in the basin. Allowing individuals to own stocks assures them of being able to capture water in the future and gives them some incentive to "bank" water. Assigning rights to the natural recharge enables users to choose between consuming and banking the flow. While this does not eliminate all externality problems, it does turn most allocative decisions over to the market process. Assigning the rights does require substantial hydrological data, but they are becoming increasingly available. Evidence from the Tehachapi Basin in California suggests that this method does have potential.¹⁹

Getting from here to there in institutional reform presents the real problem. Calling for politicians living in a rent-seeking society to decentralize water decisions offers little hope for reform. Nonetheless, this decentralization is necessary for a market solution to the water crisis. From the American West came water rights that evolved through a spontaneous order, a result that is likely only when authority is decentralized. Hirshleifer et al. capture the importance of decentralization:

Other things being equal, we prefer local to state authority, state to federal—and private decision-making (the extreme of decentralization) to any of these. Our fundamental reason for this preference is the belief that the case of human liberty is best served by a minimum of government compulsion and that, if compulsion is necessary, local and decentralized authority is more acceptable than dictation from a remote centralized source of power. This is an

¹⁸For a more complete discussion, see Huffman (forthcoming).

¹⁹For a more complete discussion, see Smith and Anderson, Burt, and Fractor (forthcoming).

“extra market value” for which we at least would be willing to make some sacrifices in terms of loss of economic efficiency. . . . Even on grounds of efficiency, however, we have some faith that the more nearly the costs and benefits of water projects are brought home to those who make the decisions, the more correct those decisions are likely to be—a consideration which argues for decentralization in practice. (1960, pp. 361–62)

Until their conclusion is recognized, accepted, and implemented, there is little hope of solving the water crisis. Furthermore, without returning to a system of private appropriations, individual liberty will continue to be eroded.

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