Western Groundwater Wars

Will increased demand for groundwater and new population pressures put western farms out of business?

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Most people take water for granted. As long as it flows out of the tap in a relatively unadulterated form and doesn't look, smell, or taste bad, we give very little thought to where water comes from, how it got into our homes, or what impact changing water uses will have on our communities. In the arid western United States, however, one of the greatest natural-resource management problems in coming decades will be the quantity of available groundwater, its quality, and how it is to be used.

In large sections of the West, groundwater is the only dependable source of water. For the 19 western states as a whole, roughly 35 percent of the water consumed comes from the ground.[1] Furthermore, dependence upon groundwater in many areas will increase in the future since the best surface water sources—rivers, lakes, and streams—have largely been developed or appropriated. As dependence on groundwater increases, a number of subtle shifts in local management policy, economics, and uses will occur. In areas where inexpensive surface water has been available, for example, additional agricultural expansion will be possible only through pumping more-expensive groundwater. In addition, population shifts from rural areas to cities will cause changes in patterns of land use, economic activity, and the sociopolitical composition of the area. The twin pressures of existing agricultural water use and the need to facilitate new population concentrations will, without proper management, eventually deplete groundwater supplies through overdrafting, as water is extracted at a rate that exceeds recharge.[2]

Moreover, as groundwater supplies become depleted, and the cost of water increases, the rising price will result in changes in water usage. In some areas, groundwater will become uneconomical for agricultural use, and the lands will revert to dry farming or go out of production altogether. These changes have social, political, aesthetic, and economic impacts and will change the character of local communities and the West as a whole. The importance of groundwater cannot be overstated.

Resource at Risk

It is estimated that more than 90 percent of freshwater in the United States is in the form of groundwater. The balance is in lakes, rivers, and streams.[3] Use of groundwater has increased dramatically in the recent past. From 1945 until 1980, groundwater use more than quadrupled, increasing from 21 billion to 88 billion gallons a day.[4] In the mid-1990s, approximately one-half of all the people in the United States used groundwater as a primary source of drinking water.[5] Nationally, groundwater provides 39 percent of the water used in public supply systems. Groundwater also provides 75 percent of the water used for rural domestic consumption and livestock pur-

poses, 37 percent for irrigated agriculture, and 2 percent for self-supplied industrial purposes.[6]

In the West, however, where 33 percent of the freshwater comes from groundwater sources, most of the water, 78 percent, goes for irrigated agriculture. Public supply systems consume 14 percent, and rural domestic and livestock use accounts for 4 percent.[7] Although these percentages vary significantly from state to state, it is clear that in the West, where agriculture plays a large role in the economy, groundwater will weigh heavily in determining the future and direction of the economy. And, as we might expect, shifts away from agricultural uses will have ripple effects throughout those economies. Unfortunately, despite its obvious importance, many people do not understand the nature of groundwater.

The Resource

When precipitation falls to the earth as rain or snow, some percolates through the soil to a water table, which is the top of what is referred to as the zone of saturation. A zone of saturation is also fed by surface water from wetlands, lakes, and streams. Water that reaches the zone of saturation from the surface is said to percolate; hence, such water is sometimes referred to as percolating groundwater. Whatever the source, groundwater moves very slowly, its actual speed depending on the composition of the material in which it is held. When the water in a saturated zone is sufficient and the composition of the material is adequate to store amounts of water for human use, it is referred to as an aquifer.

There are two types of aquifers: confined and unconfined. Confined aquifers, also called artesian aquifers, are overlaid by impervious matter such as clay or shale. These aquifers are under greater than atmospheric pressure; hence, the water sometimes flows to the surface. Unconfined aquifers are those that are under atmospheric pressure, and water level variability in such aquifers depends on natural conditions, particularly the rate of replenishment, or recharge, to the water table. When water is withdrawn from an aquifer at a rate that is greater than its rate of natural or artificial replenishment, the aquifer is said to be mined, or overdrafted. When such conditions continue indefinitely, the water table drops and the resource is depleted. Then, of course, pumping stops. In such situations pumping often stops before total depletion because the increased cost of drawing the water from greater depths makes further use of the water uneconomical.

Evolution of Technology

Although humans have been taking water out of the ground since ancient times, it has only been within the last century—indeed within the last few decades—that the means have been developed to withdraw large amounts of water from the ground. For most of the history of the West, the major problem has been how to get water out of the ground.

The first successful and widely adapted device for extracting groundwater was the windmill. Although windmills took various shapes and forms, the early designs all had in common a dependence on erratic wind patterns, inefficiency, and overall low productivity. A windmill with a 25-foot diameter wheel, which was large, operating in a 16-mile-an-hour wind was capable of lifting approximately 37 gallons of water a minute from a maximum depth of 70 to 80 feet. Although such yields were sufficient for domestic uses, they did not allow for widespread irrigation.[8]

After the windmill came the centrifugal pump. Early centrifugal pumps had a number of serious drawbacks. First, they had to be located within 20 feet of the water table. This sometimes required quite deep and relatively wide pits, with the pump operating at the bottom of the pit. Since these pumps were expensive to purchase and operate, their use was limited to high-value crops such as rice. These early pumps were also often belt driven and powered by steam, requiring frequent adjustments and constant care. Later, steam was replaced by low-compression oil-burning engines. The cost of such pumps in the first decade of the century was approximately $4,000.[9]

Through the 1920s, pump designs improved. Centrifugal pumps were developed that allowed for operation at much greater depths and with higher capacity. Inefficient steam and low-compression oil-burning power plants were replaced by hooking up an old car motor on a direct drive to the pump. By the 1920s, the cost of the pump, power plant, and drilling had dropped to approximately $2,000. Further improvements in pump design in the 1930s and the availability in many areas of cheap electric power combined to rapidly increase the number of wells and the yield of these wells throughout the West and the Midwest. By the end of the decade, the techno-

logical problems associated with groundwater pumping had largely been overcome, and concerns over water supply began to emerge.[10]

Improvements in pump design allowed the total amount of groundwater withdrawn for western irrigation to increase from relatively small amounts in the early 1930s to about 10.7 million acre-feet by 1945 and up to 56 million acre-feet by 1975.[11]

Most of these early expansions took place on the high plains, a semi-arid region characterized by relatively low rainfall—averaging less than 20 inches, or about 50 centimeters—and climatic extremes. From World War II to the mid-1960s, the greatest increases in groundwater use were concentrated in the Southern Plains, most notably in the area surrounding the Texas Panhandle.[12] Groundwater withdrawal for irrigation in the Southern Plains grew from less than 1 million acre-feet in 1945 to approximately 13 million acre-feet by 1965. The same technological advancements allowed for increased use of groundwater in the Northern Plains, home to 28 percent of the nation's farmland, although that expansion occurred somewhat later.[13] In 1950, 26 percent of the water used in irrigation in the Northern Plains came from the ground. By 1975 this had increased to 78 percent.[14]

The development of center-pivot sprinkler irrigation systems has also facilitated the expansion of groundwater use in the West. First patented in 1952, center-pivot irrigation systems are made up of a long line of sprinklers that move in a circle around a fixed pivot like the large hand of a clock. Water is supplied from the central pivot point. Most systems are designed to irrigate a quarter of a section of land—160 acres—but because of the circular pattern, they actually irrigate only 130 acres. Sprinkler irrigation and center-pivot irrigation have the advantages of using less water than flood or furrow irrigation. Sprinklers may be used in areas with sandier soil or hillier land than is possible with other types of irrigation. Also, given that one person can irrigate from 10 to 15 quarter sections—1,300 to 2,000 acres—center-pivot systems can reduce labor costs significantly.[15]

Evolution of the Law

The technological changes that facilitated rapid expansion of groundwater pumping and the development of irrigated agriculture in the West put pressure on the legal doctrines governing groundwater use and ownership. As it became possible to withdraw greater amounts of water from greater depths, competition for water developed in some areas.

Legislatures in the West reacted to conflict over groundwater resources in a variety of ways. They changed their laws—or perhaps not—depending upon the controversies involved, the participants, the interests, and the pressure lawmakers felt. Because of early conflicts over groundwater, some states—New Mexico, for example—were quick to write relatively comprehensive groundwater management statutes. In other states, notably Texas and California, early water law has changed greatly yet retained significant parts of the law as it existed prior to the rapid development of groundwater resources. In some states, the line between the old and the new laws is not always clear, and this lack of clarity amidst competition for and demand on the resource has sometimes led to what many feel are inefficient uses and overutilization of groundwater.

There are, in fact, four major groundwater law doctrines in the United States, and groundwater law has changed since the turn of the century. The four primary legal doctrines governing groundwater use are the English—or common law—rule of absolute ownership, the American rule of reasonable use, the correlative rights doctrine, and the doctrine of prior appropriation. Generally, groundwater law in the western states has evolved during this century from the English, or common law, rule of absolute ownership to either the American rule of reasonable use or, in most western states, the doctrine of prior appropriation.

■ **Absolute Ownership**. The common law, or absolute ownership doctrine, holds that the water beneath one's land is the property of the landowner and may be withdrawn, without malice, with no regard to the effect that withdrawals have on any other landowner. In theory, and in practice in many areas, this has meant that landowners could pump at will the water beneath their lands as well as the water beneath the lands of their neighbors. The absolute ownership doctrine was developed in England and transferred to the relatively wet East, where it is largely still the law.

This doctrine works reasonably well in areas where water is abundant. However, in the more arid western states, many courts and legislatures, familiar with water law in other parts of the country, have adopted the common law

rule. In early western history, minor amounts of groundwater were withdrawn because of technical obstacles and relatively small demand. Since competition for groundwater resources had not yet become an issue, the absolute ownership doctrine seemed the reasonable course to pursue. However, when competition for water did develop in the West, the drawbacks to the absolute ownership doctrine in an arid environment became apparent. It was shortly after competition for water developed—as early as the late 1800s—that modifications of the rule started to be made.

One case that dealt with problems in the rule was *Bassett v. Salisbury Mfg. Co.* (1862). In this case, the court recognized the potential dangers of absolute ownership for both the resource and for users without high capacity pumping devices. Short of any modification, it was clear that there was nothing in place to dissuade high-capacity pumpers from depleting the resource and leaving other users at their mercy. Moreover, prior to any change in the rule, even malicious depletion aimed at intentionally harming a neighbor was legal under strict interpretation of the law.[16]

■ **American Rule**. One modification made by many courts in the West was the reasonable use doctrine, or the American rule. Basically, the reasonable use doctrine limits a landowner's right to the water beneath his or her land to the amount necessary for some reasonable and beneficial purpose on the land above the water, such as domestic uses, irrigation, and livestock watering. Wasting water or diverting it off the land was not considered a reasonable beneficial use if such use interfered with the right of adjacent landowners to use the water beneath their own lands for the beneficial use of those lands.

While this approach may sound rational, it is not without problems. Most notably, there is often conflict over the definition of "reasonable" use—a concept discussed below.

■ **Correlative rights**. Some states, notably California, developed the correlative rights doctrine as an alternative to the absolute ownership doctrine. This approach is an extension of the American rule of reasonable use. Basically, the correlative rights doctrine recognizes the landowner's right to use the water beneath his or her lands but limits that right somewhat by providing that landowners overlying a common source of groundwater have rights to a reasonable amount of that water when the water is applied to a reasonable beneficial use on the land overlying the groundwater basin.

Under the correlative rights scheme, the quantity of a water right is often determined by the amount of acreage owned; there is a correlation between proportions of water supply allocated in times of shortage and the ration of land overlying the aquifer. The problem with this approach, in addition to the "reasonable use" dilemma inherent in the American rule, is that it ignores traditional uses of water and actual need—a person holding a smaller piece of land may actually require more water than the law allows, while larger owners may need less. This can lead to hostilities and attempts at gaining water through adverse possession or prescription—a practice that often encourages overdrafting.[17]

■ **Prior Appropriation**. Most western states have adopted the prior appropriation doctrine. The prior appropriation doctrine simply provides that the first appropriator of water, by putting that water to beneficial use without waste, has a right to continue that use. And such rights are superior to the rights of people who appropriate water at a later date. In prior appropriation states, water rights are usually administered by a state office or official—often a state engineer—through a permit procedure.

The strength of the doctrine of prior appropriation—its permanence and predictability—has also become the greatest source of potential conflict. As demographics in the West change and become more urban-based, the doctrine tends to favor those who perfected their water rights in more agrarian times. As we will see below, the degree to which the doctrine of prior appropriation is able to be manipulated and adapted to fit changing times will determine the social, political, and economic future of the West as it relates to water.

Legal Concepts

Besides these four major doctrines that have shaped western water law, two legal concepts also play an important role in the evolution of the law in modern times. The concept of beneficial use repeatedly comes up in the domain of groundwater policy and law. The Utah Code is typical, stating that beneficial use "shall be the basis, the measure and the limit of all rights to use water in this state."[18]

The beneficial use concept was developed during the 19th century to encourage economic effi-

ciency. Although some uses have always been considered beneficial—for example, water for domestic purposes or for irrigation, manufacturing, or stock watering—outside these traditional uses, conflict and controversy sometimes arise over what constitutes a beneficial use. For example, some state legislatures or courts, such as in Arizona and Colorado, have found water needed for the protection and propagation of fish to be a beneficial use, while others, including Idaho and Utah, have not.[19]

Courts and state legislatures have also been split on the issue of whether or not water necessary for recreation, aesthetic, or scenic uses is a beneficial use of water.[20] This can be a problem in groundwater regulation because of the relationship between surface water and groundwater in streambeds. Hydraulic continuity, or the interrelationship between surface and groundwater, is a particularly hot topic in the state of Washington, where groundwater permits are increasingly denied because of the impact withdrawals would have on stream flow. If surface water for recreation, aesthetic, or scenic uses is protected, many groundwater permit applications—most often of new users of water—will have to be denied. While such an approach is environmentally sound, it is not politically popular.[21]

Another issue in the development of groundwater law in some states is whether or not water rights may be acquired by adverse possession. Basically, adverse possession, or adverse use, allows for the acquisition of water rights by the open and notorious use of someone else's water for some statutory period, usually five years. Acquiring rights by adverse use or adverse possession is not unique to water law, but its application in water law in some states has proven problematic.[22]

The application of legal principles in the West may vary significantly even though states may, in theory, follow the same doctrine. New Mexico, for example, follows the prior appropriation doctrine and manages groundwater quite differently from North Dakota, which follows the same doctrine. In New Mexico, where, for all practical purposes, many groundwater basins are virtually nonrecharging, those basins are managed with the understanding that they will eventually be depleted. In contrast, in North Dakota, many groundwater basins do recharge regularly, and that water is managed, for the most part, on a safe-yield basis; that is, the amount of water withdrawn from an aquifer roughly equals the amount of water returning naturally or artificially to the aquifer over an extended period of time.

What the Future Holds

To understand groundwater law, it is crucial to consider the social functions water law has served and how changes in the law have mirrored changes in water use and society. Stability of water ownership is essential for economic growth and long-term planning. Farmers or cities are not likely to build expensive water development facilities if their title to the resource may be called into question in the future.

Early in the history of the West, policymakers may have believed that the common law doctrine, or the absolute ownership rule, would provide the stability necessary for long-term planning. In fact, before competition for water resources intensified, the common law doctrine did provide that stability. However, when competition began to create conflict for groundwater resources, it became clear that one pumper might find the use and enjoyment of his or her groundwater threatened by the activities of pumping on adjacent lands. Converting to the doctrine of prior appropriation, as most western states did, provided the stability necessary for pumpers to understand what their rights were and to plan for the long-term use and development of their water.

This same stability, however, has tended to favor those who acquired their water rights early on, such as irrigators, and to the extent that water laws prevent the transfer and change of ownership of water rights—as they do in some states—the law has favored those historical uses and has prevented change in water-use patterns and the development of alternative uses.

So groundwater law has provided the stability necessary for economic growth and expansion. Yet, more recently, that same stability has, in some states, prevented changes in water use and, some would argue, further economic growth and development. Politically, this can lead to pressure for unsound management of the resource—for example, the attempts by some political factions in parts of Washington to deal with groundwater and surface water appropriations separately to accommodate a greater number of uses.

In general, the law has proven itself to be capable of adaptation to change. Some states, however,

have lagged behind in responding to changing groundwater use and conditions. The result, in some cases, is that the resource is poorly managed, if managed at all. Most of the states, however, seem to be doing a fairly good job of managing groundwater on a statewide basis. Hawaii, for example, passed a comprehensive water code in 1987, and Arizona's 1980 Groundwater Management Act has led to a substantial decline in statewide overdrafting.[23]

Groundwater law is only one part of groundwater policy. In some states, for example, who gets the water depends more on who can afford to drill the deepest hole or sustain the longest court battle than it does on the formal policy followed in the state. Just as some air polluting corporations can sustain their practice in the face of litigation—the benefit of continued operations offsets any penalties or attorney fees—some groundwater pumpers may find that the use of the water apart from traditional appropriation systems justifies the cost of a potential court battle.

In other states, in spite of glowing constitutional language about beneficial uses and preventing waste, economic and political realities make it beneficial for farmers and others to waste a great deal of water. Appropriative rights require use of the resource, and water left in the ground for an extended period of time can revert to the state for reallocation to other users. There is often an incentive to continue using water, even when such withdrawals are unnecessary, to protect an existing right for future use.

Many parties are involved in groundwater use and control. Public servants in federal, state, and local water resource and natural resource agencies, legislators and their assistants at all levels of government—as well as researchers in a variety of fields, including geology, hydrology, law, public administration, and political science—are all among the actors with an interest in groundwater use and management.

Although groundwater has always been an important supply of water in the West and today provides roughly 35 percent of the total water used in the 19 western states, demands on groundwater will increase significantly in the future. Surface-water sources in the West are, for the most part, already developed or appropriated. Given federal budget constraints and the resistance of various administrations, beginning with the Carter administration, to building new surface-water delivery systems, it is unlikely that major new surface-water systems will be built in the future. Consequently, demands on and interest in groundwater will undoubtedly increase in the future.

As demands and interest increase, so will the inherent conflicts that have developed around the distribution of groundwater. The early and rapid growth of groundwater pumping and agricultural development in western states resulted in the vesting of the majority of water rights to farmers. This laid the groundwork for future conflicts over water use and development, as other users have competed with agriculture for rights to water.

Often, the political battles for water have become heated and fierce, and the stakes are high. When Mark Twain commented that "whiskey is for drinking and water is for fighting," he could not have known how fierce the fighting would become. These battles are likely to continue, and the outcome will determine the future of the West.[24]■

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NOTES

1. Alaska, Arizona, California, Colorado, Hawaii, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, Wyoming.

2. Estimates vary on depletion rates across states as a number of factors come into play. The type of aquifer, permeability, precipitation, and management of the resource will all affect the degree to which an aquifer is depleted or remains at a steady state. Thus, any attempt to generalize depletion of western groundwater becomes problematic. For more on the status of individual states, see Jeffrey S. Ashley and Zachary A. Smith, *Groundwater Management in the West* (Lincoln, NB: University of Nebraska Press, 1999).

3. Wendy Gordon, *A Citizen's Handbook on Groundwater Protection* (New York, NY: Natural Resources Defense Council, 1984), p. 10. Although estimates of total groundwater storage in the United States are problematic at best, estimates range from 90 percent to over 98 percent of freshwater.

4. Ibid, p. 11.

5. National Resource Council, *Groundwater Recharge Using Waters of Impaired Quality* (Washington, DC: National Academy Press, 1994), p. 1.

6. U.S. Geological Survey, Circular 1081 (Washington, DC: U.S. Government Printing

Office, 1993), pp. 13-17.

7. In million gallons per day. Public supply, rural and livestock, irrigation, and self-supplied industrial figures are for groundwater use only. The percentage of water used in a state that is taken from the ground can be found by dividing the total groundwater figure by the total freshwater figure. Compiled from data in U.S. Geological Survey Circular 1081 (1993).

8. Charles Bowden, *Killing the Hidden Waters* (Austin, TX: University of Texas Press, 1977), pp. 82-119.

9. Ibid.

10. Zachary A. Smith, *Interest Group Interaction and Groundwater Formation in the Southwest* (Lanham, MD: University Press of America, 1985), ch. 10.

11. Kenneth D. Frederick and James C. Hanson, *Water for Western Agriculture* (Washington, DC: Resources for the Future, 1982), p. 73. An acre-foot is the amount of water that would cover one acre to a depth of one foot, or about 325,000 gallons.

12. References to the Southern Plains generally refer to areas of New Mexico, Texas, and Oklahoma.

13. References to the Northern Plains generally refer to Colorado, Kansas, Nebraska, Wyoming, North Dakota, South Dakota, and Montana. The common denominator among all plains states—northern and southern—is the reliance on the High Plains, or Ogallala, aquifer.

14. Ibid.

15. Frederick and Hanson, *Water for Western Agriculture,* p. 163.

16. David H. Getches, *Water Law*, 3rd ed. (St. Paul, MN: West Publishing, 1997), p. 249.

17. See, for example, *City of Pasadena v. City of Alhambra* 33 Cal. 2d 908, 916 (1949) and *City of Los Angeles v. City of San Fernando* 14 Cal 3d 199 (1975).

18. Utah Code sec. 77-1-3.

19. Getches, *Water Law*, pp. 97-98.

20. For more on beneficial use, see Getches, *Water Law*. In this text, Getches describes the complexity of beneficial use and the ever-changing nature of the concept. He writes, "All prior appropriation states consider domestic, municipal, agricultural, and industrial uses to be beneficial uses. Recognized types of beneficial uses may be defined more elaborately by statute or case law. Just because a use is among the types listed, however, does not mean it will be deemed 'beneficial' under the circumstances for all time. Indeed, yesterday's beneficial use may be unreasonable or wasteful, and thus impermissible, today. In *Empire Water & Power Co. v. Cascade Town Co.* (205 F 123 (CCA 8th Cir. 1913), a federal appeals court refused to consider recreation a beneficial use. Most states now have accepted recreation as a beneficial use. Some even specify that scenic or aesthetic uses are beneficial." For how long? Nobody knows.

21. See Ashley and Smith, *Groundwater Management in the West*.

22. Appropriation rights generally cannot be lost through adverse possession. However, some courts—such as those in Idaho, Montana, and Utah—have ruled that a junior appropriator could take over the rights of a senior appropriator through adverse possession. (See Getches, *Water Law*). The problem lies in when to apply the doctrine and when not to. To date, there is no clear consensus, and the mere threat of adverse possession leads to potential mismanagement of the resource. Rather than allow water to sit when it is not needed, an appropriator feels pressured to use the water in a questionable manner rather than allow someone else to use it, which might contribute to a future adverse possession claim. For example, some might argue that Arizona's Water Banking Authority is nothing more than a veiled attempt to keep California from "borrowing" Colorado River Water. See Ashley and Smith, *Groundwater Management in the West*, for more on the Arizona Water Banking Authority.

23. See Ashley and Smith, *Groundwater Management in the West*, for a summary of the groundwater law and problems in the 19 western states.

24. Portions of this article appeared originally in Zachary A. Smith, *Groundwater in the West* (San Diego, CA: Academic Press, 1989).