

Resource Governance in the American West: Institutions, Information, and Incentives

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THE AMERICAN WEST IS A peculiar place. Depending on the location, the West can be drier, wetter, hotter, colder, or more rugged than the eastern United States. Much of the West receives only five to fifteen inches of precipitation each year, compared to thirty to fifty inches in eastern states. Regional variation is also much greater in the West. For example, while eastern Washington and Oregon receive about ten inches of annual precipitation, the western parts of those states receive more than one hundred inches per year. In addition to differences in precipitation patterns, the overall climate, soil types, and topography of the West are strikingly different from those of the East.

Not only are the climates and landscapes of the West vastly different from those of the eastern United States, the formal institutions that have been developed to govern the West's natural resources differ as well. In particular, top-down institutional governance of land and natural resources has prevailed to a far greater extent in the West than in the East. This trend includes the Homestead Acts and other nineteenth-century land disposal laws, which imposed strict limits on the size of land settlement claims, as well as various policies in the early twentieth century

that placed large amounts of western land and natural resources under federal control. The legacies of these policies are evident in many ways today. The federal government owns 46.4 percent of the land in the eleven coterminous western states, compared to only 4.2 percent of the land outside the West.¹ As a result of this large-scale federal ownership, the management of timber, rangelands, minerals, water, and other natural resources throughout much of the West is controlled by centralized government policies and mandates.

This top-down institutional governance presents challenges for efficient management of the West's natural resources for two primary reasons. First, adjusting management methods to the region's varied landscapes and climates requires the use of local knowledge and continual adaptation to new realities, but both of these practices are often anathema to centralized control. Second, top-down institutions are often less adaptable to changing circumstances and new values than bottom-up solutions. In recent years, for example, federal and use regulations are based on consumptive uses, particularly timber harvest and cattle grazing. In the meantime, amenity values and other environmental demands have increased pressure for changes in use, yet the existing institutions don't allow for these new demands and have often contributed to rigidity and inefficiency. The result is that disputes over resource use are often resolved through top-down political means such as regulation and government mandates or through litigation, if they are resolved at all.

Elinor Ostrom's influential work provides useful insights into the various institutional frameworks for resource governance in the American West. In particular, her work demonstrates the importance of locally responsive institutions that are well adapted to circumstances of time and place. When such institutions are unable to emerge—whether because of institutional rigidity, top-down control by external authorities, or other reasons—resource

governance is often inefficient, costly, and conflict-ridden. However, when such institutions do emerge, conflicts over resource use in the West can be resolved more efficiently and cooperatively.

Drawing from the insights of Ostrom and others, this chapter explores the emergence of various institutions governing the management of natural resources in the American West, both past and present, and discusses modern challenges associated with natural resource governance. It concludes by exploring policy reforms that would enable more cooperative, bottom-up solutions to today's resource management challenges in the American West.

1. Polycentric Governance

Much of Ostrom's work refutes the notion that there is "a single solution to a single problem."² She argues instead that "many solutions exist to cope with many different problems."³ Specifically, much of her work has explored the conditions under which local resource users can develop bottom-up, self-governing institutional arrangements to manage resources—but a broader critique of top-down control is embedded in much of her work as well. "Instead of presuming that optimal institutional solutions can be designed easily and imposed at low cost by external authorities," she wrote in 1990, "'getting the institutions right' is a difficult, time-consuming, conflict-invoking process," one that "requires reliable information about time and place variables as well as a broad repertoire of culturally acceptable rules."⁴ Ostrom's work suggests that the different formulations of governance structures to manage natural resources are best discovered through a process of experimentation driven by people who have localized control—in other words, through bottom-up institutional evolution.⁵

Ostrom also describes well the problems with centralized solutions to resource governance issues:

When analysts perceive the human beings they model as being trapped inside perverse situations, they then assume that other human beings external to those involved—scholars and public officials—are able to analyze the situation, ascertain why counterproductive outcomes are reached, and posit what changes in the rules-in-use will enable participants to improve outcomes. Then, external officials are expected to impose an optimal set of rules on those individuals involved. It is assumed that the momentum for change must come from outside the situation rather than from the self-reflection and creativity of those within a situation to restructure their own patterns of interaction.⁶

Ostrom's work is useful for understanding resource governance challenges in the West, both in the past and in the present. A historical perspective of resource governance in the American West reveals that many western resource-governance institutions were initially developed in a bottom-up manner that was responsive to local conditions and local knowledge, similar to those institutions described by Ostrom. Before the establishment of formal government control in the American West, Euro-American settlers developed locally responsive institutional innovations that were well adapted to the region's unique and varied landscapes. This system required a process of learning about and adapting production to a largely unknown resource base, including new climates and landscapes. In some cases, governance of these natural resources remains relatively decentralized today. In other cases, the political institutions developed in the nineteenth and early twentieth centuries to govern western natural resource use were top-down in nature and have continued to be so throughout

the past century, contributing to rent dissipation, high transaction costs, and political conflict.

2. The West: A Different World

The region of the United States west of the 100th meridian is strikingly different from the rest of the country.⁷ Not only is much of it arid, but the variation in rainfall is much greater than in the region east of the Mississippi. Droughts and extended periods of low precipitation are common. Detailed precipitation records only go back to around 1900, but tree-ring studies suggest that drought has been a recurring phenomenon over long periods of time. For instance, one study of western Nebraska found an extended thirty-six-year drought from 1631 to 1667.⁸ Reconstructions of California's drought history reveal frequent "mega-droughts" throughout history that were severe and long-lasting.⁹

Economic historians Gary Libecap and Zeynep Hansen capture well the West's weather conditions and the challenges therein: "The Great Plains could either be wet and lush or dry and barren, with no particular pattern," they write. "These conditions presented unusual learning and adaptation challenges for all parties on the frontier in ways not fully appreciated in the existing literature."¹⁰ Historian Warren Beck and cartographer Ynez Haase also describe the very different terrain explorers and settlers encountered: "Americans moving westward may have been ill prepared for the strange conditions of Great Plains; they were totally unprepared for their encounter with the mountain ranges and desert terrain. In fact, some considered the Rockies to be an impassable barrier."¹¹

Throughout the nineteenth century, both settlement and transportation became issues of much experimentation as Euro-Americans struggled to deal with the West's strange new environments.¹² Agricultural practices that were successful in one portion of the West were not readily transferable to other areas.

The twenty-inch rainfall line, an approximate north-south boundary beyond which there is not enough precipitation to grow crops without irrigation, lies fairly close to the 100th meridian. Even using that as a dividing line, however, is misleading because of the large variations in yearly rainfall: rainfall statistics can vary widely over short distances in the western United States.

Historian Walter Prescott Webb aptly describes the necessity of experimentation and adaption of new institutions and techniques in the West:

For two centuries American pioneers had been working out a technique for the utilization of the humid regions east of the Mississippi River. They had found solutions for their problems and were conquering the frontier at a steadily accelerating rate. Then in the early nineteenth century they crossed the Mississippi and came out on the Great Plains, an environment with which they had no experience. The result was a complete though temporary breakdown of the machinery and ways of pioneering.

As one contrasts the civilization of the Great Plains with that of the eastern timberland, one sees what may be called an institutional *fault* (comparable to a geological fault) running from middle Texas to Illinois or Dakota, roughly following the ninety-eighth meridian. At this *fault* the ways of life and living changed. Practically every institution that was carried across it was either broken and remade or else greatly altered. The ways of travel, the weapons, the method of tilling the soil, plows and other agricultural

implements, and even the laws themselves were modified.¹³

Given the wide variation in topography in the American West and the necessity of experimentation and local knowledge, it is somewhat surprising that resource governance in the West today is generally more top-down than bottom-up. One can argue, in fact, that the West is characterized by more top-down resource governance institutions than the eastern United States.¹⁴ Moreover, the perception of the highest and best use of the West has also changed dramatically over time. In the face of such changes, one would again expect bottom-up institutional evolution to be appropriate to allow resources to be allocated to their highest-valued uses. Top-down governance, however, has hampered much of the adjustment process, especially the move from commercial agriculture to amenity values and other environmental demands.

3. Institutions, Information, and Incentives

Ostrom developed a framework that helps one understand the importance of institutions and institutional change in the context of natural resource management.¹⁵ People make decisions on the basis of the information available to them, the incentives they face, and the belief framework they use for processing and judging information flows. The institutions—or the rules of the game governing resources—play an important role in the decision-making process.¹⁶ Institutions, both formal and informal, also determine the locus of decision making and the process by which decisions by one person are coordinated with the choices of others.¹⁷

In much of her work, Ostrom used detailed case studies to demonstrate how resource users can often develop self-governing institutions to effectively manage common-pool natural resources. Whether such institutions emerge, however, depends on certain conditions. Ostrom outlines several “design principles”

that help explain the success of existing self-governance arrangements for common-pool resources. They include clearly defined resource boundaries, locally tailored rules that reflect the specific attributes of a particular resource, sufficient monitoring and sanctions undertaken by participants, conflict-resolution mechanisms, and the ability to devise locally adapted institutions without interference from external governmental authorities.¹⁸

Such bottom-up institutional arrangements rely extensively on what F. A. Hayek describes as “the knowledge of the particular circumstances of time and place” that is of primary importance for effective decision making.¹⁹ In the context of natural resource management, the physical environment is important for determining the value of such local knowledge. If one compares two environments, an environment in which there exists unknown or contradictory knowledge about appropriate production decisions and another environment with more uniform circumstances, one would expect that the varied environment would require more decentralized decision making. Moreover, if environmental conditions are dynamic, or if human demands on natural resources are evolving over time, centralized control will tend to impose rigidities on natural resource use that are inefficient and difficult to modify.

It is an obvious anomaly, then, that as Euro-American settlers moved into the western half of the United States, the institutions governing decisions about natural resource use largely became more centralized. Compared to the East, far more aspects of resource management in the West are under federal control.²⁰ Government involvement in agricultural investment through massive irrigation projects is primarily a western phenomenon. Federal management of rangelands for livestock grazing is unique to the West. National forest management is largely a western issue. Public ownership of vast stores of energy and mineral wealth such as oil, gas, and coal is limited to the western

half of the United States. This pattern of large-scale, centralized control means that questions of natural resource governance in the American West are fundamentally political questions decided by federal decision makers rather than by local decision makers responding to local knowledge.

Such centralized control would perhaps make sense if expert knowledge were superior to local knowledge. Yet whether this is true in the context of natural resource management has been a matter of extensive debate dating back to the Progressive Era.²¹ Hayek discusses the relative importance of technical knowledge, or the knowledge of experts versus the knowledge of individuals on the ground. He argues that if expert knowledge is of more importance, the institutional order does not have to be exclusively centered on bottom-up, local knowledge. Expert knowledge, however, is “frequently contradictory knowledge,”²² and if the knowledge of experts is incorrect and institutions favor that knowledge over local knowledge, then greater errors will occur than would in a more decentralized decision-making setting. In a setting with many unknowns, the discovery process is important, and the rule of experts is often mistaken.

Three examples in the settlement of the West illustrate this point: the theory that the “rain follows the plow,” the theory that forestation would increase rainfall in the arid West, and the dry farming doctrine.

The aridity of much of the West was a primary concern for settlers who wanted to establish agricultural operations. The notion that the “rain follows the plow” was an oft-repeated theme among early settlers and was based on expert advice. Samuel Aughey Jr., appointed the first professor of natural science at the University of Nebraska in 1871, published articles, pamphlets, and a book arguing that rain did indeed follow the plow: that is, once the soil was broken by a plow, it would absorb more moisture. This moisture would be given back slowly to the atmosphere through evapora-

tion, causing rainfall to increase. He predicted that as more and more of the Great Plains was plowed, rainfall would increase to the point that crops could be grown on a regular basis without irrigation.²³ Others publicized the argument through books and public lectures. “Rain follows the plow” was the major thesis of a popular book by Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, published in 1881. Orange Judd, publisher of the *Prairie Farmer*, and Frank Snow, chancellor the University of Kansas, were other prominent exponents of the idea.²⁴ The theory was a primary justification for the original Homestead Act of 1862, which limited settlers to 160-acre land claims that were later viewed as too small for the arid conditions of the West. At the time, it was thought that acreage limitations would be overcome by intensive plowing.

Another theory, later discredited, suggested that increasing forestation would increase rainfall through increased humidity. Again, the aridity of much of the West meant that there were extensive efforts to discover what worked and what did not work in terms of rainfall and agriculture. Among the prominent advocates of planting trees to increase precipitation were Frederick Olmsted, the famous landscape architect, and Ferdinand Hayden, one of the foremost explorers and surveyors of the West. Professors at land-grant universities and forestry officials lent additional support to the idea.²⁵ In 1873, tree planting became official federal policy with the passage of the Timber Culture Act, which modified the original Homestead Act to allow claimants to receive an extra 160 acres of land if they planted 40 acres of trees.

Another expert-driven solution to aridity was the dry farming doctrine that dominated discussion of appropriate farming techniques from 1905 until 1917.²⁶ Deep cultivation, packing the sub-surface soil, and harrowing after every rain were techniques that supposedly would allow farming to succeed in areas of low rainfall. Agricultural experiment stations, created by Congress in 1887

and attached to land-grant colleges, were major advocates of dry farming techniques. Years with higher-than-normal rainfall gave credence to the theory, but the 1917–1921 drought in eastern Montana was the death knell of the idea that dry farming techniques could compensate for low and variable precipitation.

These varied attempts to discover how to interact with the aridity of the American West provide ample evidence for Ostrom’s insights about the importance of communication among those with local knowledge and those directly involved in a particular resource issue. Walter Prescott Webb, for example, describes how such local knowledge and trial-and-error experimentation radically transformed many of the longstanding institutions and practices that were familiar to Euro-Americans as they advanced across the western frontier. Webb describes the frontier as “a modifier of institutions” on the basis of local adaptation and innovation.²⁷ The frontier, he writes, “acted as a force in modifying old institutions or displacing them with new ones better fitted to the needs of a frontier culture.”²⁸ These modifications took on many forms in response to local conditions on the frontier, such as changes in the way water rights were allocated, the development of new fence-building techniques, and even the adoption of new weaponry.

In the context of the American West, Gary Libecap explains how assigning property rights to western resources required adaptation from established eastern practices. He notes that “property rights allocations that were based on local conditions and prior use and were unconstrained by outside government mandates were most effective in addressing not only the immediate threat of open-access, but in providing a longer-term basis for production, investment, and trade.”²⁹ Yet Libecap also notes that some of the property institutions developed to govern natural resources were poorly constructed—the result of what he calls “initial faulty property allocations”—and, to the extent that such

institutions were formalized by governments, they created path dependencies today that are difficult to modify. In particular, Li-becap explains that the political transaction costs of reforming faulty property institutions are high, and political constituencies that benefit from the status quo often emerge and create significant barriers to change.

4. Top-Down Governance in the American West

The history of resource governance in the American West is replete with examples of top-down control ill-suited to the physical realities and local knowledge requirements of the western landscape. These institutions created obstacles for appropriate adjustments to the unique conditions of the region.

4.1 Western Settlement

The Land Ordinance of 1785 set in motion the mechanisms for dealing with the vast areas of land that later became part of the United States. One of the most important elements in the ordinance was the relinquishment to the national government of the original thirteen colonies' land claims beyond their borders. Originally, land policy was driven by two primary tenets: first, that federal lands should be transferred to private ownership, and second, that the mechanism of transfer would be sale of land to the highest bidder.³⁰

Early land sales focused on the minimum acres that could be sold at auction, which varied over time from 40 to 640 acres. Many sales were for blocks of land much larger than the minimum; a land speculator would buy a large segment and then divide it over time into appropriate farm-sized units or town sites for subsequent sale. This process was well designed to take account of local knowledge since the purchaser had strong incentives to create parcels that reflected the existing farming technology and local climate conditions. Legal historian Robert Ellickson makes

the case for individual land ownership of a size that takes into account the productive potential of land and the interactions of individuals in using the land.³¹ US land policy before 1862 fit quite well Ellickson's prescription of the optimal design of a land ownership regime.

Since land sales were designed to maximize revenue for the federal government, a minimum price was set that specified the process of land sales. Often, however, settlers pushed into lands available for purchase and settled without following the formal legal process. Congress was reluctant to use force to evict the squatters, and gradually legal rights of preemption were recognized. Again, however, settlers relied heavily on local knowledge in choosing where to settle. Economic rents were dissipated through people racing for the most productive lands, but rent dissipation was mitigated through land claims clubs. These extralegal organizations would claim an area for a group of settlers through preemption and hold it until it became profitable to settle, and then those settlers would bring the land into production.³²

Land privatization changed dramatically with the 1862 Homestead Act. Instead of codifying minimum size allocations, the act specified 160 acres as the maximum homestead size. And rather than being distributed via cash sales, the land was to be "free" to homesteaders who lived on a plot for five years and made appropriate improvements.³³ In reality, however, the land was never free. Settlers dissipated any rents available from land ownership through racing to claim property rights.³⁴ For example, if a 160-acre claim in Wyoming would generate rents in 1900—in other words, if it would generate some return above the opportunity cost of settlement—settlers would not wait until 1900 to move to the land and bring it into production. Instead, they would compete for the rents by settling the land as soon as the discounted present value of the stream of future rents was positive.

The move from allowing privatization to occur gradually through preemption and land purchases to forcing races for maximum-size units was especially inappropriate because the Homestead Act applied primarily to poorly understood western lands. A farm of 160 acres was quite feasible in Ohio, but was poorly suited to the semi-arid conditions in Kansas. And for land that was not suitable for tillage but instead was used for livestock grazing, acreage limits were even more constraining.

The costs were large, both in terms of loss of production and in terms of human suffering as settlers tried to claim land too early and in plots that were too small for them to set up a profitable operation. Dan Fulton, a Montana cattle rancher and historian, reports that, by 1922, 88 percent of homesteaders who entered claims in Montana between 1909 and 1918 “had starved out or given up.”³⁵ Fewer than half of the homestead claims in Wyoming between 1910 and 1934 were completed.³⁶ By 1905, there were still 450,000 acres that had yet to be claimed,³⁷ further evidence of the difficulty of establishing viable agricultural operations on 160 acres. Zeynep Hansen and Gary Libecap argue that homesteading was a major contributor to the dust bowl conditions of the 1930s.³⁸ Small farm size meant it was more difficult to use fallow methods that limited soil erosion.

Given that such small homestead sizes were decidedly unworkable for agricultural operations in the West, why did the policy persist for as long as it did?³⁹ Two forces were at work. The idea of free land continued to have political appeal in the US Congress, but there was also a strong desire for that land to go to small-scale yeoman farmers. Despite numerous attempts to revise the Homestead Acts, Congress refused to budge from granting supposed privileges to small farmers. Also, as discussed above, there was scientific evidence (although it turned out to be flawed) that plowing the land and planting trees would increase precipitation and make small farms economically viable.⁴⁰

Texas provides an interesting contrast to federal homestead policy. Because Texas entered the United States as a sovereign nation, the Homestead Acts did not apply there. As a result, land disposition policy there was much more rational and led to a wide variety of farm sizes. The Texas Constitution of 1836 granted a league of land (4,428 acres) to household heads, and single men received one-third of a league (1,476 acres).⁴¹ Over time more such “headright” grants were made, and as the arid lands of the Texas Panhandle were settled, the state used land trades to fund projects.⁴² Throughout the nineteenth century, state lands were available for purchase, leading to ownership of property for cattle raising on a more appropriate economic scale. As a result of these land disposal policies, most of the land in Texas was privatized, and only a small portion of the state (just 1.8 percent) remains in public ownership today. This stands in sharp contrast to most of the American West, where large amounts of land were ultimately retained by the federal government—a topic we turn to next.

4.2 Federal Land Retention and Management

The other major change in land policy was the move away from privatization to retention by the federal government. Even though the Homestead Acts imposed high transaction costs on establishing private rights, those rights could later be organized into efficiently sized units. The costs of top-down governance became even higher, however, once policy changes cemented the federal government as a permanent, large-scale landowner in the West. Today, nearly half of the land in western states is owned and managed by federal agencies, primarily the US Forest Service and the Bureau of Land Management.

The move to retention rather than sale began with the General Revision Act of 1891, which allowed the president to set aside, or reserve, public lands bearing forests. President Benjamin Harrison made the first such withdrawal, setting aside fourteen million

acres.⁴³ In 1897, Congress passed the Forest Service Organic Administration Act, which strengthened the federal government's ability to reserve and manage forest lands.

The move from privatization to retention was driven by the dominant Progressive Era ideology of the late nineteenth and early twentieth centuries. The Progressive Era embodied a strong commitment to the idea that scientific management could replace market forces. Progressives at the time favored centralized control of the nation's natural resources on the basis that management by experts would be superior to management by local communities left to the whims of the market. President Theodore Roosevelt, along with Gifford Pinchot, the first chief of the US Forest Service, advocated what historian Samuel Hays calls "the gospel of efficiency," which Hays describes as the belief that "experts, using technical and scientific methods, should decide all matters of development and utilization of resources."⁴⁴ This Progressive Era ideology favors large-scale federal ownership of natural resources, federal bureaus devoted to efficient management, and formal comprehensive land-use planning, all of which remain hallmarks of federal land policy today.

This Progressive Era thinking, which has been widely criticized for its failures,⁴⁵ captures well Ostrom's concern that centralized control will often be seen as a panacea for resource governance problems. Such top-down solutions may well crowd out more responsive and incentive-compatible local institutional innovations.

As forest lands were being set aside for government management, and with homestead claims limited to small sizes, massive amounts of arid land not suitable for farming were not being claimed by homesteaders. Congress eventually attempted to create better incentives for stock raising with the Enlarged Homestead Act of 1909 and the Stock-Raising Homestead Act of 1916. The 1909 act doubled the maximum size of a land claim, bringing it to 320 acres, and the 1916 act increased it again, to 640 acres.

Yet both acts still imposed size limitations that made cattle ranching unprofitable in much of the West. On the Great Plains' prairie land, stocking rates are between 20 and 30 acres per cow per year, so—even with the increases—the herd size enabled by a single land claim was far below what was necessary for a sustainable grazing operation.

With much of the arid western land unclaimed, ranchers knew there was little chance for complete privatization, so they argued for leasing arrangements that would give them legal use and management opportunities on the unclaimed open range. In 1934, the Taylor Grazing Act was passed, which allowed the Department of the Interior to actively manage unclaimed rangelands. The legislation specified that 80 million acres could be withdrawn from the unreserved public land and placed in grazing districts. Such a designation closed those lands to homesteading. The 80-million-acre limitation was subsequently removed, and 162 million acres were eventually allocated for federally managed livestock grazing. These lands are now administered by the Bureau of Land Management.

4.3 Irrigation

Another major top-down institutional structure in the West is the provision of irrigation water through the Bureau of Reclamation. Rather than relying on the private provision of irrigation or Ostrom-style local collective action, the federal government has enabled the bureau to be a dominant force in bringing western lands under irrigation. Federal irrigation was promoted starting in the 1870s, but it was not until 1902, when Congress passed the Reclamation Act with the enthusiastic support of Theodore Roosevelt, that irrigation became a function of the federal government. Since financing was originally predicated on the sale of federal lands, thirteen western states were covered, with Texas excluded because it had no federal lands.

Despite the claims that federal support of irrigation was necessary to foster the development of western land for agriculture, there were already 8.9 million acres of private irrigated land when the Reclamation Act passed in 1902.⁴⁶ Thus, it was not the case that federal involvement was necessary for irrigation to occur. Once the federal government got involved, the necessity of carefully calculating benefits and costs ended, and the Bureau of Reclamation became a source of massive subsidies and unnecessary projects. The bureau has aggressively attempted to dam every major river at multiple locations. Furthermore, the requirement that irrigation project costs should be repaid by users went by the wayside, and soon most projects suffered from cost overruns and little attention was given to payback obligations. On the whole, less than 15 percent of project costs were paid back by 1980. Since present payments from users focus on operating costs, the large-scale subsidies continue.⁴⁷

Reclamation projects have continued to the present day, with political considerations overriding efficiency concerns. The Central Arizona Project was authorized in 1968 and was completed in 1987 with a loss of \$1 billion.⁴⁸ The official in charge of providing benefit-cost analysis for that project has been quoted as saying, "I had to fly all the way out to Denver and jerk around the benefit-cost numbers to make the thing look sound."⁴⁹

5. Institutional Evolution from the Bottom

Despite the top-down institutions discussed above, in some cases settlers developed bottom-up institutions for natural resource governance similar to those Ostrom described in her numerous works. The process of land privatization was slow and incomplete, but there were several situations that afforded opportunities for institutional innovation. Settlers sought to find ways to allow resources to be claimed and moved to their highest-valued uses, as well as to develop rules that reduced waste and mini-

mized conflict. Many of these innovations were extralegal, and some were eventually incorporated into state law, while others were negated by state or federal action.

5.1 Varying Forms of Agriculture

An early issue that required entrepreneurial insight and innovation was the challenge of putting western land to its highest and best use.⁵⁰ Many settlers tried growing row crops, and dry farming was successful in certain areas. In other places, settlers quickly developed irrigation. Often, however, cattle grazing was more economical. The search for optimal use was an ongoing process, in which local information was vital. Family farms dominated agricultural production, but those farms used a wide variety of contractual forms to organize inputs and to sell outputs.⁵¹ There was substantial leasing of land between farmers and from outside owners, and there was a wide range of lease contracts. In many cases, crop type and risk preferences led to crop-share arrangements, but in others cash leases dominated.⁵²

As with any attempt to adapt to new conditions, there were costly mistakes. Early cattle grazing on the Northern Plains was done by absentee owners who turned livestock loose to graze with minimal supervision. It was thought that cattle could survive without extra care or feeding. The winter of 1886/87 was disastrous, with immense livestock loss. Owner-operators who put up hay for the winter and who provided much more supervision eventually became the main livestock producers.⁵³

5.2 Water Rights

For allocating water, the common law historically relied on the riparian doctrine, which gave streambank landowners a right to undiminished quantity and quality of water. In the mining camps of the American West, it became clear that diversion of water from streams was important for sluicing gravel to find gold. But since

the riparian doctrine did not provide for any diversion, a brand-new doctrine known as prior appropriation emerged as an alternative rights structure. The prior appropriation doctrine granted exclusive rights to the first person to divert water. The timing of the appropriation became a determinant of the quality of the right, because subsequent diverters held their rights conditional on the use of the prior appropriator. The quantity of the diversion was limited to the amount of water that could be put to beneficial use, defined as use in mining claims or to irrigate farm lands. Water could be diverted to nonriparian lands, and the rights to water could be transferred.

The prior appropriation doctrine was crucial to mining and the development of agricultural production in the American West. It was adopted in its purest form in the most arid states, with some modifications in western states that had higher rainfall.⁵⁴ The benefits of the new rights structure were large. Economists Bryan Leonard and Gary Libecap estimate that by 1930 the benefits of irrigated agriculture were 3.5 percent to 20 percent of state income, and that most of these benefits existed thanks to the prior appropriation doctrine.⁵⁵

5.3 Irrigation

There was rapid development of irrigation in many areas in the West. By the time of the Reclamation Act in 1902, there were 8.9 million acres of land irrigated by private water.⁵⁶ Some stream diversion was carried out by individual operators, but most irrigation involved collective action. Many mutual ditch companies were created, with farmer-users owning the corporations that provided irrigation infrastructure. These companies were effective in organizing capital for irrigation development, and farmer ownership avoided the monopoly problem.⁵⁷

States also created the opportunity for local groups to form a legal organization that could tax land to support diversion struc-

tures, pumping facilities, and canals. In 1887 California became the first state to pass such enabling legislation. It allowed a group of fifty or more farmers to petition the county board of supervisors to create a taxation district. A two-thirds majority of voters in the designated area was required for approval.⁵⁸ California irrigation districts received a 90 percent approval rate, a strong indication that these small-scale collective organizations had widespread community approval.⁵⁹ Other states followed California's lead: Washington's legislature passed enabling legislation in 1890; Kansas and Nevada in 1891; Idaho, Nebraska, and Oregon in 1895; and Colorado in 1901.⁶⁰

Irrigation projects depended heavily on trust relationships. Mormons arrived in the Salt Lake Valley in 1847, and by 1848 they had irrigated 5,000 acres. Irrigation spread rapidly, with 150,000 acres growing irrigated crops by 1865.⁶¹ The church provided the infrastructure for building canals and diverting water. Canal governance was also carried out by community religious-based organizations.⁶²

5.4 Mining

The discovery of gold at Sutter's Mill in California in 1848 and silver in the Comstock Lode in Nevada in 1859 led to a rapid evolution of rights to mining claims. There was almost no federal presence in those areas and no clear rules for establishing mining claims. Therefore, the rules for mining claims grew organically and were time- and place-specific. Mining camps developed clear rules for establishing and maintaining claims, and those rules differed depending on the value of the claims and whether the precious metals were located in surface gravel, streams, or underground veins.

The rapid influx of miners from different backgrounds to claim a valuable resource would seem to be a sure recipe for violence. The mining camps were surprisingly orderly, however,

because the miners found violence to be negative-sum in nature. Settling on rules provided prospectors with the opportunity to produce wealth rather than fight over ownership.⁶³ States gradually codified the rules that had evolved in mining camps, and the federal government accepted the principle of entry and patenting of claims in 1866.

Gold mining was based on the alluvial deposits in stream beds, and early prospectors were able to pan to extract the precious mineral. It became evident that using water in sluice boxes was more efficient, and this required different forms of organization in order to divert water and to provide labor for the sluices. Some efforts required new forms of ownership, and others involved the collective efforts of owners and nonowners.⁶⁴

5.5 Grazing

By limiting the size of land claims, the Homestead Acts severely constrained cattle ranching on the frontier, but there were still strong incentives to develop rules to solve coordination problems on the open range. Since much of the range was unappropriated, there was potential for a tragedy of the commons to develop. Yet ranchers discovered innovative ways to establish extralegal rights to the open range by the rule of first possession and to limit new entrants through local norms and through restricting access to bi-annual community roundups. With the invention of barbed wire in 1873, fencing was used to prevent overgrazing on the common pastures. The fences, which followed locally-agreed-upon boundaries, did interfere with legal claims under the Homestead Acts, so in 1885, Congress passed an anti-fencing act that forced the removal of fences from more than a million acres.⁶⁵

Local norms continued to dominate the legal framework for much of the cattle industry. The rules for claiming maverick calves and for organizing roundups were enforced by cattleman associations.⁶⁶ Likewise, Robert Ellickson finds that in Shasta Coun-

ty, California, the rules governing grazing land were bottom-up norms that ignored the top-down legal rules.⁶⁷

6. Changing Demands in a Top-Down World

The institutional innovations discussed above provide a helpful case study in the use of time- and place-specific information to solve coordination issues. The bottom-up evolution of norms and rules ameliorated some of the heavy-handed, top-down governance of land and water during the first century and a half of western settlement. Another problem with top-down rules, however, emerged in the twentieth century: some resources became more valuable for producing nonconsumptive amenity and environmental goods than for commercial production of timber, crops, and cattle. Over the past half-century, these new amenity and environmental demands have often encountered natural resource governance institutions that were designed for the extraction-based demands of an earlier era. In many cases, these institutions have proved ill equipped to address these new resource demands.⁶⁸ Many of the top-down institutions governing natural resources in the West are rigid and favor traditional extraction-based demands, resulting in high transaction costs, legal disputes, and political controversy in the face of new conservation-oriented demands. Several examples illustrate these challenges.

These examples illustrate the challenges of institutional path dependence,⁶⁹ which tends to lock in suboptimal institutional arrangements, and also demonstrate the importance of the initial allocations of property rights in the presence of transaction costs, a point emphasized in the work of Ronald Coase.⁷⁰ Once a certain institution is established to allocate natural resources, it tends to prevail even in the face of changing demands. This helps explain why institutional reform has been so challenging in the American West. Because of the “stickiness” of top-down western resource institutions, new environmental and amenity demands have of-

ten resulted in the creation of even more top-down regulatory policies or political mandates. That is, because the existing governance institutions are unable to reconcile new demands with traditional resource uses, separate laws, regulations, and mandates are often created to address environmental and amenity concerns.

The dispute between the “Old West” and the “New West” is illustrative of these challenges. The Old West is characterized by traditional extractive uses of the western landscape, such as agricultural development, grazing, timber harvesting, and mining. The New West represents the emerging recreational, conservation, and environmental interests on the western landscape. These two visions are often incompatible. That is, the emerging demands for recreation and conservation often conflict with the demands of traditional extractive resources users. How these competing demands can be reconciled is one of the central challenges of western natural resource management today, and it is the source of much modern political debate.

6.1 Environmental Water Markets

The evolution of western water law demonstrates these challenges. As described above, the traditional rules established to govern water in the West, which were codified in the nineteenth century by state legislatures, were created for the unique needs of the arid West’s agricultural economy. The prior appropriation doctrine provided usage rights on a first-come, first-served basis for settlers who put the water to “beneficial use.”⁷¹ This beneficial-use requirement was incorporated into state law, meaning that water rights were valid as long as the water was physically diverted from a stream and used in a manner determined to be “beneficial” by the state, primarily for crop irrigation.

Yet as new environmental and conservation demands emerged in the latter part of the twentieth century, the prior appropriation doctrine was unable to resolve conflicts over these new, compet-

ing demands for water use. The beneficial-use requirement precluded the possibility of water rights being acquired and used for instream flows to improve fish and wildlife habitat or for recreational or amenity purposes. Initially, courts denied voluntary trades to transfer water rights from an agricultural use to an environmental use, such as for instream flows, on the basis that such uses (or non-uses, as it were) were not a legally accepted form of “beneficial use.”⁷² The institutions governing water, which were conceived in an earlier era, simply did not allow for such voluntary transactions to occur. As a result, early efforts to promote instream flows relied on state regulations and restrictions on water use.

Over the past three decades, however, many western states have begun to gradually expand the legal systems governing water rights to recognize instream flows as a beneficial use and to allow voluntary trades to occur for the purpose of enhancing such flows.⁷³ This change has required amending the definition of a beneficial use. Today, as a result of this institutional change, a considerable number of water trades result in the transfer of water from agricultural uses to environmental purposes such as instream flows.⁷⁴ Nonetheless, despite these recent developments, considerable legal and institutional barriers still exist that complicate environmental water markets and make it difficult for new environmental demands to be expressed through the prior appropriation system of western water allocation. Reforms that lower the transaction costs of market exchanges and clarify rights to instream environmental flows could further enhance environmental water markets.⁷⁵

6.2 Conflicts over Public Land Use

Other western resource governance institutions, however, have not been as flexible as state water law in accommodating new environmental and amenity demands. Consider livestock grazing

on federal rangelands in the West. The Taylor Grazing Act of 1934 established federal control over grazing on the unclaimed public domain lands that composed the open range. The act created grazing districts on unclaimed public lands, established a permit system to manage grazing on these lands, and allowed grazing fees to be charged for use of the public rangeland. Under this system, ranchers were eligible to receive grazing permits if they owned a nearby qualifying “base property,” which could serve as a base for the rancher’s livestock operation, and if they could demonstrate a recent history of grazing on the open range. This system remains in place today. Grazing permits cannot be transferred to groups or individuals that do not hold a qualifying base property. Permits are issued for ten-year periods, and permit holders have priority over others to renew the permit for additional ten-year periods without competition.

The Taylor Grazing Act also gives preference to ranchers who operate within or near a grazing district and who are “engaged in the livestock business, bona fide occupants or settlers, or owners of water or water rights.” Moreover, it establishes a use-it-or-lose-it permit requirement to ensure that federal grazing permits are actively used for grazing purposes: if they are not being used, they can be revoked and transferred to other ranchers. This requirement, like the traditional beneficial-use requirement in western water law, poses important challenges in the face of new environmental and recreational demands over the western rangelands.⁷⁶ The use-it-or-lose-it requirement, in addition to the base property requirement, significantly raises the costs of acquiring grazing permits for “non-use” conservation, environmental, or recreational purposes—and in some cases entirely precludes the possibility of acquiring grazing permits for such purposes. In short, permittees are required to graze livestock on their public grazing allotments, or the federal government could transfer the grazing privileges to another rancher who will use them.⁷⁷

Unlike western water law, however, no meaningful institutional reforms have been implemented to modify these rigid grazing provisions, which complicate the ways in which federal rangeland policy can accommodate new environmental demands. In other words, no evolution has occurred in federal rangeland management whereby environmental use (or non-use) is recognized as a legally valid or “beneficial” use that could facilitate voluntary transactions of rangeland usage rights from grazing uses to environmental, recreational, or amenity uses.

The inability of federal rangeland policy to accommodate these new, competing environmental demands has important implications. In particular, one significant result is that federal rangelands are the source of immense political and legal controversy in the American West, as evidenced by several near-violent, high-profile conflicts over grazing rights in recent years.⁷⁸ Because there are significant obstacles to resolving competing demands through voluntary transactions, competing groups have instead resorted to political or legal channels to influence the management of federal rangelands. Over the years, this has resulted in various federal environmental regulations and mandates that restrict grazing through political means. Litigation is also often used by environmental groups in an attempt to force federal agencies to reduce grazing on certain public lands for the purposes of endangered species protection, water quality conservation, and mitigation of other environmental concerns.⁷⁹

Federal rangeland policies have largely proved incapable of resolving new conflicting demands through negotiation rather than conflict. This institutional path dependence has thwarted mutually beneficial exchanges of grazing rights and contributed to political and legal disputes over western land use.⁸⁰ As a result, the western range is more often the subject of conflict, litigation, and regulation rather than of exchange and cooperation.

The story is much the same for other federally managed natural resources in the American West.⁸¹ The top-down institutions governing resource use are largely ill equipped to effectively resolve new conflicting demands over resource use, resulting in the creation of other political or legal strategies to influence resource use. For example, the institutions governing timber management on federal lands do not allow use (or non-use) rights to be directly allocated to environmental or recreational groups.⁸² Rather, the interests of such groups are expressed through a myriad of environmental laws and regulations that require, among other things, environmental assessments, lengthy public comment periods on proposed agency actions, or endangered species habitat protections, or that impose top-down restrictions on where certain management actions can and cannot occur.

Likewise, public land policies restrict market-based approaches to resolving disputes over energy development on federal lands.⁸³ For instance, the institutions governing oil and gas leasing prevent recreational, environmental, or conservation interests from holding leases. Lease terms require that leaseholders must intend to develop their energy leases.⁸⁴ This “diligent development requirement” dates back to the Mineral Leasing Act of 1920 and states that “lessees must exercise reasonable diligence in developing and producing” leased energy resources. The predictable result is that, to the extent that environmental or amenity values are represented in the political process governing federal energy development, they are expressed through regulations, mandates, and moratoriums, rather than directly through the institutions allocating the use of energy resources on federal lands.⁸⁵

7. Conclusion

The settlement of the American West is a strange chapter in the history of institutions and institutional change in the United States that in some ways has ignored many of the insights of Eli-

nor Ostrom's work on appropriate governance institutions. As settlement increased in the West, where the climate and topography varied much more than in the East, one might expect that a greater reliance on local knowledge would produce a variety of bottom-up institutional forms to govern resource use. Initially, for some resource uses such as water allocation, mining, and grazing on the open range, this was indeed the case. But over time top-down governance became the dominant theme of natural resource policy in the West. While in some cases there was enough latitude under government policy for bottom-up innovations to ameliorate the problems of top-down governance, the changing resource demands of the twentieth century have imposed additional burdens and politicized the adaptation process. Therefore, resource management in the American West has been more conflict-ridden than necessary, and inefficiencies in resource use have been a significant part of the region's history.

