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# Water Policy in California and Israel

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*Water policies throughout the world often avoid market-determined allocations. In this article, we focus on case studies of Israel and California. Despite major cultural and political differences, it is found that water is heavily controlled through similar administrative mechanisms in both areas. Moreover, in both cases, these controls have led to inefficient allocation schemes favoring agriculture at the expense of other uses. This article examines the institutional factors that have led to such controls, and argues that adopting a new regulatory framework similar to that used to regulate electricity can still meet social concerns while dramatically improving economic efficiency.*

Throughout history and in many parts of the world, water has been treated differently from other commodities. In fact, there are many that argue that water is not a commodity, but is special because of the role it plays in human survival and development. Dry areas that have been able to gain access to water have turned from deserts to gardens, while areas that have been deprived of water become wastelands.

Because of water's importance to dry regions, access to water is typically a matter of public policy. As suggested by the old saying in the West, "whiskey is for drinking; water is for fighting over," allocation of the resource tends to be the result of contentious historical experience. Development of water tends to be the outcome of publicly sponsored efforts aimed at achieving larger social aims, and allocation of that resource is closely monitored.

It is the heavy restrictions placed on the allocation of water that make the resource so unusual, particularly in market-driven economies. Other resources have been developed in partnership with the government, and the government often has a say in how that resource is used. But, in most cases, government is concerned with initial allocations, and allows subsequent trading to occur to achieve improved outcomes for the recipients. In the case of water, such trading is restricted to a much greater extent.

This unusual control over allocation and use is especially apparent when viewed across cultures. In this article we examine water allocation and use in two very different political and cultural systems—Israel and California—which, despite major differences in nearly all other social and economic institutions, have remarkably similar policies for allocating water. Furthermore, population pressures have increased sharply in both of these areas, placing increasing stress on available water supplies. Additional insights, therefore, are possible by viewing how the two regions are coping with the growing shortages.

While the focus is on these two very different regions, the lessons are more broadly applicable. For example, most parts of the western United States face similar challenges with water allocation. Details of water administration vary by region, however, putting an exhaustive evaluation of all approaches to water allocation beyond the scope of this paper. Moreover, although there are some differences in practice—for example, Colorado allows some trading in a formal market, while Arizona ties water rights to property

rights in some cases, making it possible to buy agricultural land and transfer the water to the cities—for most dry regions, the same basic problems dominate.

This article compares water policy in Israel and California to the U.S. allocation policy of electricity, another good characterized by increasing returns to scale. As discussed in section II, water shares many physical characteristics with electricity, particularly in the infrastructure and institutions needed to develop and get the product to consumers.

The major finding is that water policy differs from electricity policy in one key respect: After the initial allocation, water is much more controlled than electricity, with significant limitations on trading. Thus, it is allocated by quantity rationing. Electricity allocation, on the other hand, has some aspects of social allocation, but, ultimately, prices are used to ration demand (even if they are subsidized prices for some users).

Because of this administrative control, we argue that high efficiency costs are observed in the water delivery systems of the two regions—costs that are directly attributed to the restrictions on trading. In both regions, water is used in ways that force the development of inefficient, high-cost alternatives.

The purpose of such public micromanagement is apparently to control more fully the pattern of economic development in the region. Reform efforts in the two regions provide a useful contrast in this respect. In California, economic forces have become increasingly important in pushing for water allocation reform. Major efforts are underway to change the allocation mechanism to increase the role of market forces—that is, to allow trading. And one factor contributing to the success of those efforts is the declining relative importance of the state's primary water user—agriculture—and the growing political and economic power of cities and industries. In Israel, however, such reform efforts remain weak, and the government's need to control the use of water—for strategic and political purposes—continues to dominate the economic factors that are pushing for reform.

This article is organized as follows. Section I presents institutional details on current water allocation systems in the two regions, including both the physical structure of the water delivery systems and the economic and political infrastructures used to allocate the water. Section II compares those allocation mechanisms to the relatively more market-oriented mechanisms used to allocate electricity in the United States. We look at the reasons for government involvement in developing and allocating a resource like water, and we examine the extent to which the regulation of electric utilities provides a viable alternative model for water allocation. Section III discusses the costs of not using an electric utility-style allocation scheme, pointing out the inefficiencies resulting from the implicit ban on exchange. Section IV discusses traditional responses to rising shortages, and indicates the problems that have arisen in continuing "business as usual" in the two regions' water policies. Section V discusses some of the reform efforts underway in California, and Section VI presents conclusions.

## I. Water Institutions and Policy in California and Israel

California and Israel share a number of similarities in water policy, despite other cultural and economic differences. Both have large semi-arid areas, mountain ranges, and mild, wet winters (except in extreme elevations) combined with dry rainless summers. Both regions experience rainfall that is concentrated in the north, and which then must be transported and pumped to drier southern regions. Both use extensive networks of aqueducts, pipelines, and pumping stations, and both have extensive experience with "high-tech" irrigation technology and biogenetic engineering in agriculture. Moreover, despite very different political cultures, both regions rely extensively on political and not economic policies for water allocation.

### *Israel*

In an average year, Israel draws 1.2 to 1.3 million acre feet (MAF) of fresh water; 60 to 75 percent is consumed by agriculture (depending on supply conditions each year) and the residual goes to urban and industrial consumers. This water is obtained from several sources. The main body of fresh water in Israel is the Kinneret, or Sea of Galilee, which provides about half of the total supplies. It is located in the Jordan rift and sits well below sea level. This means that expensive pumping and transport is required to move water from the Sea to the country's farming areas, most of which are above sea level. The Sea is fed by the Jordan river and also empties into the same Jordan river, which then flows south into the Dead Sea. The latter is even further below sea level; indeed, it is the lowest point on earth and resembles somewhat California's Mono Lake. Water is conveyed from the Jordan River to the southern part of Israel through the National Water Carrier (a pipeline and aqueduct system), which was completed in 1964.

In addition to the Jordan river and the Sea of Galilee, there are two large underground aquifers, the Coastal and the Mountain aquifers, the latter encompassing central Israel and much of the West Bank. Water drawn from these sources accounts for the bulk of the remaining supplies. A variety of wells, oases, and dams capture water from

additional sources, but provide relatively small quantities.

Israel also makes considerable use of recycled waste water, particularly for irrigation purposes, as well as some brackish water from wells near the seacoast and near Eilat. Desalination of sea water has been used only on a limited or experimental basis.

Proposals for new sources of water that have been considered include large-scale desalination, water imports from Turkey, and even a canal from the Mediterranean to the Dead Sea, that would allow complete diversion of the Jordan river for commercial purposes. Other possibilities include new ground water discoveries, and diversions from the Litani River (Wolf and Ross 1992). In all of these cases, however, the projects may not be commercially viable and there are fears that they could cause extensive environmental damage.[1]

Under Israeli law, water is a nationalized public good. As specified in the 1959 Water Law, all water is the property of the state, including waste, sewer, and runoff water that can be commercially used. An owner of land does not own water under the land, and there are no riparian rights.[2] This legal status of water continues practices incorporated into the Fundamental Law defining the rules of government in 1949, and those embedded in the British Mandatory laws. The 1959 law essentially perpetuated the then-existing water allocation pattern, with water set aside for planned future settlements and activities. Water is supplied by Mekorot, Ltd., a public corporation that pumps and supplies about 60 percent of the nation's water, and by small private suppliers.

The Minister of Agriculture is the supreme statutory authority charged with formulation of water policy—including consumption, pricing, and allocation—subject to oversight by a Knesset water committee that must approve water pricing changes. The Minister appoints the Water Commissioner and an advisory Water Commission, and also the directors of other public sector agencies that play a role in water development, pricing, and supply.[3]

Some analysts have argued that this arrangement has fostered an automatic conflict of interest in water allocation. Because the natural tendency of the Ministry of Agriculture is to work as an advocate on behalf of farm interests, water policies also tend to be formed by agricultural interest groups (Galnoor 1978). In part because of this tendency, water policy in recent drought years has allowed substantial over-consumption of water supplies by agriculture, even though these actions have polluted and damaged the structure of the underground aquifers.

Even when cuts are made in supplies, the policies appear to be crafted with farm welfare in mind. For example, in 1991, the Minister of Agriculture implemented across-the-board cuts of 25 percent in agricultural water allocations since the Sea of Galilee's surface level had dropped below its "red line," a somewhat arbitrary level selected as the minimum allowable level.[4] Farmers whose allocations were cut were eligible for compensation from taxpayers for lost revenues that would have been generated with the water.

In Israel, water allocations tend to be political. Historical allocation is one guiding principle, with water users generally able to receive the same allotment in future years if they use the supplies they are granted in the current period. Apportionment of additional water often takes place subject to political pressure.

Once granted, water allocations in Israel are extremely inflexible. Farmers are allocated water to grow specific crops. If a farmer wants to change his crop mix, he must apply to the Ministry for permission to apply the water to that different crop. Allotted water not used cannot be sold—it is explicitly illegal to sell water or water rights in Israel. Violators are subject to criminal prosecution. Moreover, farmers who temporarily consume less than their full allotments may find their future allotments cut in subsequent years, creating the incentive for farmers to use all of their allocation of water to preserve future deliveries, even if the use is wasteful. Finally, a farmer who sells his land cannot sell his water allotment with the land, and must include a clause in the contract where the buyer attests to having been forewarned of this.

### *California*

Water allocation in California is similar to that in Israel. On average, 80 to 85 percent of net water consumption occurs in the agricultural sector. Urban users consume 10 percent, with the residual allocated to industry.

California has one of the most intricate water supply systems in the world. Most of the rainfall and snow

1. According to a feasibility study by the Israeli government in 1983, additional use of water from the Dead Sea could cause minerals to cake on the surface. (The Dead Sea has salt concentrations 55 times that of the Pacific Ocean.) In addition to environmental damage, they concluded that such efforts would damage the tourist trade and mineral extraction processes in the vicinity.

2. Riparian rights are based on English law, and grant a landowner the right to use water that passes through his or her property. In most Middle East countries, mineral and water rights under one's land belong to the state.

3. At the present time, the powers of the water committee are being transferred to the Finance Committee of the Knesset.

4. Despite its designation as a minimum, the Ministry approved even further pumping below the "red line" in 1990 and 1991 because of low rain levels.

accumulate in the northern and eastern parts of the state, while most of the population is in the western and southern, semi-arid regions. A series of dams and reservoirs capture and store water in the Sierra Nevada and the northern part of the state for transport in a vast system of canals and aqueducts to the populated coastal and central agricultural regions.

California's water is developed and supplied by a variety of different agents. The two largest projects, the Central Valley Project (CVP) and the State Water Project (SWP), provide 27.5 percent of the net water supplied in the state in an average year. The CVP was developed and is operated by the federal government, while the SWP was developed and is operated by the state. The two systems provided 7.0 and 2.4 MAF of water, respectively, in 1985, the last year of relatively normal supplies.

In addition to those projects, individual cities have developed reservoirs and delivery systems, such as the Hetch Hetchy reservoir for San Francisco and the Lake Cachuma and Gibralter reservoirs for Santa Barbara. Los Angeles also has aggressively redirected water from other sources. Los Angeles receives water from the Owens Valley and Mono Lake through the Los Angeles Aqueduct, as well as some water from the Colorado River. Recent court decisions, however, have reduced future deliveries from these sources. Total withdrawals from the Colorado River were around 5 MAF in 1985; that total is expected to drop to 4.2 MAF by 2010.

Finally, complementing these surface water sources is an extensive supply of ground water in aquifers. In 1985, sustainable ground water supplies were estimated to be around 6 MAF of the state's total of 32.2 MAF. An additional 2 MAF was overdrafted in that year, to yield total supplies of 34.2 MAF. During drought years, ground water is drawn more heavily, smoothing supplies from year to year.

Several new sources of supply are under consideration. According to the California Department of Water Resources (Department of Water Resources 1987), an additional 1.4 MAF will be needed by the year 2010 to meet existing and projected needs of an additional 6.5 million people. Most of that gain depends on further development of the state and federal water systems, including the Kern water bank, construction of the Auburn dam, and completion of Los Banos Grandes reservoir. Other potential sources include further conservation efforts, development of waste water re-use, and desalination plants.

California's water resources are administered by a large number of overlapping state and federal agencies. CVP water is federally administered by the U.S. Bureau of Reclamation, with water delivered to CVP contractors. SWP water is administered by the state. The state's Water Resources Control Board is the agency most directly involved in determining possible shifts of water from one user to another, but the Department of Fish and Wildlife and the federal Environmental Protection Agency, among others, also have critical input into the process. At the local level, water districts have the power to reallocate water within a district and often have veto power over shipments out of the district.

Rights are an accumulation of historical precedents. Riparian rights, establishing the right to use water that passes through one's land, apply to many of the water resources claimed early in California's development. Appropriative rights apply to most of the state's water, although the rules governing those rights differ depending on the date granted. Appropriative rights allow the user to divert water for "beneficial use," with rights sequentially based on when the right was granted. These rights were designed to protect early developers located downstream from losing water because of newer upstream diversions.

As in Israel, however, rights do not include automatic ownership. Water is deemed a public good owned by the people of the state. The "Public Trust Doctrine" is frequently cited by the courts in water disputes. With roots in Roman law, the doctrine of public trust holds that certain resources are the property of all. In a 1983 decision (National Audubon Society vs. Superior Court), the California Supreme Court held that the state has a duty to consider public trust values before it approves water rights applications or adjustments. This doctrine has been used most recently to guarantee water for in-stream, environmental uses.

Appropriative rights allow users to apply the water for beneficial purposes, but do not allow the rights holders to treat the resource as an asset. Thus, most water supplies cannot be sold or traded to other users without explicit approval of a variety of agencies, including the local water district, the Bureau of Reclamation, the state Water Resource Control Board, and possibly the EPA, U.S. Department of Fish and Game, and the state's Department of Fish and Wildlife. Moreover, water that is not used by a rights holder may be interpreted as surplus water that is not beneficially used. Like Israel, therefore, California's incentives are structured to "use it or lose it," with users that use less than their full allotment potentially losing that surplus in future years.[5]

5. Recent examples of this interpretation have emerged in California. Some rice farmers that idled fields and sold their water to the state's Emergency Water Bank in 1991 are reporting efforts by the state to reduce their allocation on these grounds.

## II. IS WATER SPECIAL?

As discussed above, water allocation is highly controlled in Israel and California. Water is allocated according to historical precedent, with modifications to reflect changes in available supplies or competing uses made by administrative fiat. In drought years, for example, some users are given only partial allotments, with cutbacks either across the board or applied sequentially across classes of users.

Economic forces are largely ignored. Water transfers are difficult, even when they are arranged to the mutual benefit of both parties. Prices do not change to reflect growing scarcity, and hence, prices are not used as a tool to encourage conservation or as a mechanism to evaluate new infrastructures.[6] Differences in prices across regions and users are not used as signals to encourage transfers of water from low-priced to high-priced regions. In fact, those facing limited supplies are encouraged to develop new (usually higher cost) sources, rather than to purchase supplies from existing users, even when both parties could gain from the exchange.[7]

This treatment of water, which differs significantly from the way other resources are allocated in market-oriented economies, is typically justified on the grounds that water is special. In this section, we examine two related issues. First, we discuss the reasons that government typically intervenes in water delivery, drawing parallels with other regulated natural monopolies—particularly electricity. Second, we examine the differences between the allocation of water and of electricity and identify the root difference between regulation of those industries.

### *Arguments for a Governmental Role in Water Delivery*

Several arguments are put forth in favor of involving government in the allocation of water in dry regions. Three issues typically are cited: the cost structure of water investments, other noneconomic public policy goals, such as encouraging migration and directing land use decisions, and concerns about equity and economic disruptions ("third party effects"). As we argue, however, each of these arguments also could be—and is—applied to electricity allocation, and the more successful experience of that industry in adjusting to growing and competing needs appears to offer a useful guideline to improving the current system.

*Water Investment Costs.* Public investment in new water facilities often is justified on the grounds of increasing returns to scale. Typically, the infrastructures needed to store and deliver new water supplies—dams, pumps, and canals—are governed by decreasing marginal cost structures. Slightly increasing the size of a dam or a canal can cause a large increase in capabilities since, in general, volume does not increase linearly with increased investment, but roughly geometrically. Consequently, marginal costs tend to fall with increasing project size up to some point.

Often the point of minimum marginal cost requires an investment too large for an individual or group of individuals to coordinate.[8] In those cases, the government often is asked to step in on behalf of its constituents.[9] For example, after considerable lobbying, the California Legislature authorized the Central Valley Project as a state water project in 1933, which the federal government eventually built and operated. The other major water projects in California also are the result of state or local government efforts, including the SWP.

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6. In fact, prices are used in what appears to be a punitive fashion by many water districts. During the height of the drought in California, for example, moral suasion (rather than price increases) and threats of restricted service caused urban users to reduce consumption sharply. Water districts then were faced with revenue shortfalls, since prices had not adjusted. They then had to raise rates to consumers. Thus, water districts were in the awkward position of penalizing consumers for doing what the water districts had requested. Obviously, if the districts had instead used higher prices to discourage water consumption, this problem would have been avoided.

7. Interestingly, while lack of transfers often forces urban areas to consider more exotic technologies, pricing policies make those investments appear unreasonable. For example, Israel recently decided against a major water resource development project in the southern port city of Eilat because it was not viable at current water prices. However, since prices often are based on pumping and transportation costs, and ignore the social opportunity costs and scarcity value of the resource, those prices may understate the value of a new facility. Consequently, this project might have been viable with proper pricing.

8. According to Reisner and Bates (1990), the federal government tried to encourage private water development in the nineteenth century by offering free or highly subsidized land to those that would undertake such development. However, because of the large costs involved, private efforts were largely unsuccessful. "At the eighth National Irrigation Congress in 1898, one speaker compared the western landscape to a graveyard, littered by the 'crushed and mangled skeletons of defunct irrigation companies . . . which suddenly disappeared at the end of brief careers, leaving only a few defaulted obligations to indicate the route by which they departed' " (p. 13).

9. Work by Buchanan and Tullock (1962) and Olson (1982) has argued that the process by which projects such as these are developed can be explained by special interest group models. Concentrated single-issue interest groups often are able to obtain political support and sufficient votes to pass legislation favorable to that group because the costs imposed on the non-beneficiaries are spread thin, making political opposition weak. The beneficiaries of new water projects typically are relatively concentrated. In California, for example, the CVP delivers

In Israel, the government also has been the principal agent of water development. Galnoor (1978, p.343) characterized the rationale for government involvement as follows:

> Divergences between the private side and the public side of water costs and/or benefits, as well as the need for high initial investments and the characteristics of a natural monopoly, contribute to the necessity of some form of public intervention in the management of water resources. In Israel, government intervention is also required because water is a part of the infrastructure for (a) the ideology of nation building based on farming and new settlements and (b) economic development.

The Israeli government, therefore, has taken upon itself the responsibility for planning, constructing, and maintaining new facilities. Through 1970, gross investment in water projects by the government was estimated to be equal to between 3 and 5 percent of total gross capital investment in the country. Costs of new supplies were so high that expansion plans involving the United States as a partner in a joint venture to build large desalination plants were developed in the mid-1960s, although the plans were never implemented (Tahal 1972).

*Development Tool.* A second motivation for government control over water allocation is water's power as a tool to influence migration and land use. In Israel and the western United States, pro-growth forces were very strong during the periods of water development. Often one of the most powerful inducements to potential migrants was access to cheap land in peripheral areas. In much of California and Israel, the available peripheral land was not particularly attractive to settlers unless water could be provided to irrigate crops. Thus, in both regions, policies often were designed to create large supplies of dependable water for agricultural purposes.[10]

In Israel, strong priority was given to encouraging immigration and population dispersal. Development of available agricultural land has been an important goal (Galnoor 1987, p. 345):

> In the context of Zionist ideological objectives, water has never been regarded as merely another economic resource, but as a prerequisite to efforts to create a new society in the (cultivated and redeveloped) Land of Israel. The selection of one water project over another was not determined on the basis of relative economic returns. This ideology stressed a "productive occupational pyramid" based mainly on farming in the collective Kibbutzim and in the smallholders' communal settlements.

As discussed by Plaut (1992, p. 16), Israeli policy also has sought to encourage active cultivation and occupation of its lands for national security reasons:

> There is an ancient and broad consensus in Israel that survival of the state requires "settlement" of the land by Jews. In many cases, "settlement" is taken to mean farming. The origins of the doctrine go back to the early phases of the Zionist movement, when the boundaries of "settlement" were believed to establish the geographic-political blueprint for a later state.
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> Once Israel came into being, its borders were determined by either diplomacy or force of arms, but no longer by farm settlement. Nevertheless, the belief that land settlement provides political and strategic control of territory has survived. It is closely linked with the ideological consensus in favor of population dispersal policies.
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> Initially, dispersal of farm settlements along frontiers played a strategic role, making border patrol and surveillance easier. Later, it was argued that these settlements could provide support and services for army units stationed near the frontiers. After 1967, agricultural settlements were established in the Territories for the express purpose of creating political "facts" and new strategic realities. In any case, it is widely believed that an absence of Jewish settlement in any part of the country may lead to loss of that region through international pressure and/or Arab insurgency.

More recently in California, water policy has been used in the reverse direction—preventing growth. Barriers are raised to converting agricultural water use to urban use, in part to prevent conversion of agricultural land to urban and industrial purposes. Opposition to water markets in California's Central Valley, for example, is driven by fears that water markets would encourage the transition away from agriculture and bring major changes in the industrial and social fabric of the valley communities. In other cases, such as in Santa Barbara, the city council chose in the early 1970s not to hook up to the State Water Project, arguing that access to additional sources of water would allow more

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water primarily to agricultural users. Similarly, in Israel, farmers consume three-fourths of the total supply. The water is subsidized by other sectors of the economy, which bear the residual cost of operating and constructing supply facilities. Additional federal projects continue to be proposed and constructed, where the costs are borne nationally and the benefits are concentrated in specific regions and groups of consumers. Thus, according to this theory, projects can be approved that provide subsidized water for some users that would be prohibitively expensive to the beneficiaries if they were developed privately by those beneficiaries.

10. According to Reisner and Bates (1990), part of Theodore Roosevelt's motivation for developing water projects in the west was to build up "America's weak western flank" (p. 14).

people to move to the area and create excessive growth.[11]

*Fairness.* A third argument for government allocation of water is concern over fairness and the potential costs of changing existing allocations. Fairness issues arise whenever reforms are considered. Since current policies explicitly state that water is a public good, held in trust by the State and is not owned by any individual, any change whereby an individual gained legal title to the water would involve a change in the distribution of wealth and income. In such cases, it becomes possible to ask whether current subsidized water recipients "should be" entitled to those resources, or whether another allocation is more fair.

Fairness also appears in the debate because of fears that pricing the resource would make water unavailable or too costly to low-income persons and farmers. Some interest groups voice concerns that market prices would be too high for many consumers, so only the wealthy would be able to afford the resource.

More generally, pricing policies of many projects explicitly recognize other social goals relating to fairness. For example, prices of CVP water are heavily subsidized. Most contracts called for fees that often were designed to pay the nominal cost of the construction over time. While initially designed as a 10-year repayment period, most Bureau of Reclamation projects eventually extended terms for as much as 80 years. Moreover, interest costs, under the Reclamation Act of 1902, were not charged (Reisner and Bates 1990).

In Israel, water "doctrine" has always been based on pricing formulas that reflect the farmer's "ability to pay" and not the scarcity value of water as a resource. Under this doctrine, a drought that reduced a farmer's ability to pay should produce lower water prices, not higher prices to farmers, whereas in a market system the price would rise due to the reduction in supply. Hence, "fairness" to farmers, rather than efficient use of the water, appears to be the predominant sentiment guiding water policy in Israel.

A related issue involves potential disruptions that any change in allocation might create, or "third party effects." Policymakers predict that the use of water markets would decimate agriculture and the agricultural communities by encouraging farmers to sell all of their supplies (causing large third party effects on other rural businesses). Large differentials in prices between cities and agricultural water districts are taken as evidence that markets would lead to large diversions between farms and cities, with water costs pricing agriculture out of water. And experience in Owens Valley, where Los Angeles acquired rights to water from the valley and transferred it to the city at the expense of the local economy, is frequently cited as a warning for the potentially negative effects of allowing transfers.

### *Water vs. Electricity*

While these arguments have been powerful justifications for current allocation policies—and may argue for some governmental involvement in the system—they are not unique to water. In fact, these same arguments can be applied to electricity and other utilities, and yet those industries appear to be more adaptable and efficient than the water delivery system. In many instances, water appears to share more similarities than dissimilarities with electricity; the major exception is the way it is controlled after the initial allocation.

*Natural Monopoly.* Water and electricity have similar physical and technical characteristics. Indeed, they often are joint products of large dams constructed along rivers. Water and electricity both flow in complicated grids over long distances, and are delivered to municipal customers through a centralized utility. Technical characteristics are similar: Storage (dams and reservoirs), transportation (canals and pipelines), and distribution networks all exhibit economies of scale that lend themselves to the creation of natural monopolies. Marginal costs tend to fall over a large range, often making it inefficient to promote competition in many parts of the system.

But in the case of electricity, considerable work has gone into designing regulations that maximize the efficiency of the utility while recognizing these scale economies. Utilities that build generating plants are allowed to add costs of approved facilities into the rate base, and owners of the utilities are granted a rate of return on that capital.

Nonetheless, while highly regulated, electricity demand is rationed by price—except in the rare instance of power failures and shortages. Users are charged in ways to generate the necessary rate of return, cost of maintaining the facilities, and costs of inputs. Pricing schemes typically rely on average cost of delivery. Moreover, reforms are constantly being evaluated. For example, time-of-day pricing has been tested in several sites to match marginal costs more closely to prices charged for the resource.[12]

11. This policy has changed as a result of the recent drought. Extreme reductions imposed on homeowners led to political pressure to add new supplies. Santa Barbara did connect a small pipeline to southern California in 1991 to purchase water from the Metropolitan Water District, and it is exploring desalination options.

12. The key advantage of using prices with subsidies to ration demand, as opposed to direct allocation, is that in a pricing environment trading occurs. Even though a system with subsidies results in a distorted use pattern, it is still the case that recipients of the resource balance their valuation of the water against that of all other potential users. In direct quantity rationing without trading, mutually welfare-enhancing improvements from the initial distribution are not allowed.

Major reforms also have been suggested (and elements tested) to introduce more market forces into electricity distribution. As reviewed by Schmidt (1987), increasing interlinkages between power grids have made bulk power sales among utilities at market prices a least-cost mechanism to avoid unnecessary construction of costly new facilities. Other parts of the system also have the potential for injecting additional market forces to improve the operating efficiency of the system.

In many ways, the regulatory structure used for electricity appears applicable to allocating water. A regulated monopoly could be granted to the producers, transmitters, and distributors of the water. In principle, rate of return compensation could be arranged (paid to the government in the case of state or federal projects), with the price to consumers ultimately serving to ration supplies among consumers. Moreover, like bulk power, water could be sold among primary owners of water at market prices, and moved (analogous to "wheeling" in the electric utility industry) along the canal network to its final destination.

*Development Tool.* Water allocation often is intended to guide economic development. Prices are established to subsidize and encourage use in particular areas. The power of water has been readily apparent in both California and Israel.

Electricity has been used for similar purposes. The Tennessee Valley Authority was created in the United States to generate low-cost power to a large underdeveloped rural area. Similarly, the Rural Electrification program has the objective of bringing low-cost power to rural areas to help speed development in those areas.

Electricity, like water, is viewed by many governments as one of the basic infrastructure ingredients necessary to promote economic growth. Encouraging access to electricity networks has been a central part of many economic development programs. Thus, the electricity model of allocation appears rich enough to encompass these additional goals of water development.

*Fairness.* Concerns about social equity often work through water pricing policies. Prices for water generally are tied to historical construction costs—costs that are typically well below the economic value of the resource.[13] In Israel, even this tenuous link to construction costs is missing. The Water Law requires that "in spite of differential costs, water prices in the various regions be equalized. In practice, water charges have been relatively uniform and quite often nominal" (Sadan and Ben-Zvi 1987, p. 3).

In electricity allocation, similar goals exist and are accommodated through pricing policies. The same concerns often are voiced about low-income consumers. In many states, electric utilities are prohibited from cutting off service to low-income consumers during the winter if they are unable to pay. Similarly, lifeline rates are offered to low-income, elderly, and handicapped individuals to assure their access to the resource. Finally, prices charged to industrial, commercial, and residential consumers are allowed to be structured in different ways to encourage certain uses.

In periods of temporary shortages, electricity policy also is designed to recognize social objectives. Since prices cannot be instantly adjusted and communicated to users, temporary surges in demand are met by graduated cutbacks to particular users. Heavy industrial users are cut back first, with critical needs (for example, hospitals) the last to be curtailed. Contingency plans for "brown-outs" and similar emergencies are established by utilities and approved by regulators to be consistent with social policy.

## III. Implications of Trading

Water policy and electricity policy, therefore, share many of the same objectives and characteristics. Both often rely on government investment policies, seek to direct the pattern of economic development, and seek to redress social inequities by designing pricing and access policies to protect certain interests.

The key institutional difference between water and electricity results from the assignment of ownership rights. In the case of electricity, the units are clearly owned by some entity, and that entity has the right to distribute units to any customer or other utility. Even in the case of a publicly constructed facility, such as the Tennessee Valley Authority or Bonneville Power Administration, a public entity has clear ownership of the electricity, which it sells to utilities—sometimes subsidized, and sometimes according to allocation formulas. But there is no requirement that the receiving party must use that electricity, and thereby prevent the utility from transferring the power elsewhere.

In the case of water, transferability is severely restricted. As noted earlier, allocations are determined administratively, for the most part, and those allocations then are fixed. Contractors must use the water, or lose the rights to it.

Consider how such a policy would work in the electricity industry. Customers would receive a given supply of electricity at a particular time. If the customers did not use

13. A report by the Western Governor's Association (1987, p. iii) concluded: "The structure of the West's water system at federal, state, and local levels was designed to promote economic development through assuring a secure supply of water and to protect property rights in water once they were established. Laws, policies, and practices are largely silent on increasing efficiency of use."

that electricity, they would forfeit future rights to that resource. Such a system would lead to inefficient optimizing behavior on the part of consumers similar to that observed in the former Soviet bloc. In Poland, for example, heat was supplied at very low cost at specified times. The incentives built into the system, therefore, led to a practice of regulating temperatures by opening windows, rather than adjusting heat consumption. In other words, the incentives will lead consumers to use all of the subsidized electricity made available, since the alternative is to lose access to the power in the future.

The regulation applied to electric utilities demonstrates the potential to separate efficiency concerns—how the resource is used—from equity concerns. This separability is well-developed in the economics literature. This latter point is attributed to Coase (1960), who examined the importance of initial endowments in determining the final consumption distribution of a given resource. He demonstrated that if trading were allowed and transactions costs were small, the final allocation of a resource would be efficient regardless of the initial distribution of rights. This efficiency would be achieved through trading among potential consumers until the resource was finally used in its highest valued uses.

The "Coase Theorem" predicts that if trading were allowed, the assignment of ownership rights to water would have little effect on how it ultimately would be used (although that outcome could be considerably different from the current mix of production resulting from inefficient allocation of the resource). Whether farmers were granted ownership and allowed to sell to cities, or vice versa, the ultimate outcome in water use would be approximately the same. Clearly, wealth would be distributed differently under the two cases, but the Coase theorem argues that such ownership assignment only affects how the final basket of goods is distributed among consumers, not what or how much is in the basket.[14] Thus, it is possible to allocate rights in the interest of boosting equity, with the recognition that trading will promote efficient use of the resource.

In the case of electricity, initial allocations often are granted with redistribution as a goal, and limits are placed on trading to ensure that those goals are not circumvented. For instance, utilities can sell trade surplus power, but they must first satisfy local demand. However, utilities also have incentives to make local demand more efficient by subsidizing insulation and energy conservation efforts.

In the case of water, similar limitations could be put in place. But if the water districts had ownership rights to the water, they would have more incentives to encourage water conservation to make additional water available to sell outside the district.

The principal benefit of assigning ownership rights to water is to permit exchange. After choosing an allocation scheme that satisfies desires for fairness, individuals can collectively be made better off by allowing them to engage in mutually beneficial trade. Even with regulatory restrictions in place to favor particular uses, the ability to trade encourages all parties to recognize the opportunity cost embedded in any given use of the water.

The cost of not allowing trading is well-documented (Reisner and Bates 1990, Schmidt and Cannon 1991). Agricultural water is heavily subsidized in California, with the price of water to urban users on the order of 10 to 20 times that of most agricultural users—even accounting for differences in transportation costs and processing facilities.

These apparent inefficiencies are illustrated by use patterns in both regions. In Israel, cotton uses a major portion of the country's water supply. Yet, according to some analysts, cotton generates negative value-added in Israel, with the implicit subsidies granted to the sector exceeding the revenues from selling the crop. In California, 40 percent of the state's water is used to grow rice, alfalfa, cotton, and pasture, even though these crops altogether account for only 0.2 percent of total state income.

Moreover, lack of transferability has made it necessary for cities to plan construction of desalination plants. Such plants would yield water at a cost in excess of $2,000 per acre foot at the same time that water used for some low-value crops is priced at $8. Since costs of transportation are on the order of $100 per acre foot between many potential transfer sites, this price differential suggests that both parties could be made better off by trading. The cities could forgo constructing expensive new facilities, while the agricultural sector would be encouraged to increase its efficiency in water use to free up the resource to sell to the cities.

Potential gains from trading water have been demonstrated in several recent cases. A classic example of the gains to be made from trading is the 1988 agreement between the Metropolitan Water District of Southern California (MWD) and the Imperial Irrigation District (IID). In that arrangement, MWD agreed to pay the cost of lining irrigation ditches in the Imperial Valley in exchange for the right to buy the saved water.

14. Some researchers have disputed this claim, arguing that different initial assignments of rights would lead to different final consumption bundles. In particular, if there is a difference between the amount a farmer would pay to get a unit of water ("willingness to pay") and the amount she would accept to sell a unit to another person ("willingness to accept compensation"), the outcome would depend on whether she had the initial right to the resource or whether she had to purchase that right from another.

Interestingly, this case provides strong evidence of the magnitude of inefficiency that resides in the current administrative system. Both parties were made better off by the transaction. Indeed, it was sufficiently in MWD's interest to make the trade that they were willing to pay for the infrastructure improvements as well as pay for the water. Clearly, IID also gained in the process, since they were faced with no additional cost, yet gained a windfall profit from selling water that would otherwise have been lost to the district. But the incentives in the current system—including uncertainty about future rights to water—prevented this transaction from occurring automatically.[15]

Similarly, in the recent drought, California experimented with an Emergency Water Bank, where water districts could sell water to a state body, which then could resell the water to other districts with shortages. According to work by Howitt (1991), the effect of the Water Bank was to idle some acreage of rice and pasture, while permanent crops and high-value crops continued to receive sufficient water. Such transfers were voluntary, and resulted in farmers receiving compensation automatically from urban water districts.

In sum, the key difference between allocation schemes for water and electricity—and the cause of the high level of inefficiency in water use—is the result of failure to assign ownership rights to water users, and hence, to allow trading of those rights. Granting water rights holders the ability to engage in mutually beneficial trades would put in place incentives to increase efficiency in use.

## IV. Rising Shortages: Failures of Traditional Remedies

Drought conditions in the 1980s and early 1990s revealed serious deficiencies in the water delivery systems of both Israel and California. Both regions experienced extended droughts that stressed the available supplies beyond normal experience. Large cutbacks in water deliveries to farmers were required, and extensive conservation and rationing schemes were imposed on urban and industrial users.

In both cases rains finally arrived and eased short-term conditions, but the public in both Israel and California have become increasingly sensitized to the inefficiencies and costs associated with centrally planned and allocated water. Water policy in both regions, therefore, is facing intense public scrutiny, with the public less willing to leave decisions to the "experts." Moreover, the droughts also highlighted the increasing scarcity of existing supplies over the long term, with growing populations likely to make responses to future droughts even more difficult and costly. Both Israel and California expect growing populations, while few new sources of supply are scheduled to come on line without further investments.

Traditionally, the response to shortages has been to locate and develop new supplies. California's Department of Water Resources, for example, projects the need for 1.4 MAF of new water by the year 2010, based on the assumption that the needs of a growing population are met by new sources, rather than through reallocation of existing supplies. Estimates in Israel in the mid-1970s called for a shortfall of about 0.25 MAF developing by 1985, again to accommodate new uses, not to reallocate existing supplies. Projections of population growth imply that by the early twenty-first century water may suffice for urban users only, with no agricultural water in Israel.

The traditional response—to meet growing demand by adding capacity—has faced resistance in recent years, however. Three related reasons have combined to make new facilities increasingly difficult to undertake.

First, the environmental movements in California, and to a lesser extent in Israel, have challenged additional water development by focusing attention on the previously ignored environmental consequences of water projects. In California, current water use patterns have caused widespread damage to the San Francisco Bay Estuary (the Delta). Agricultural runoff has degraded water quality by increasing the nitrogen content of the water. Low flow conditions caused by excessive pumping of water through the Delta to the southern portion of the state have caused periods of reverse flow, where salt water is pulled into the Delta. Moreover, periods of low flow have raised water temperatures in the rivers, a development that has been linked to a sharp decline in the number of salmon that spawn in the Sacramento River. Finally, past development policies have reduced wetlands areas, destroying the habitat of a wide variety of fish and migratory wildlife.

Changes in operating practices in the Delta, which are likely to be mandated by the EPA and the federal Department of Fish and Game, may have a profound impact on California's water supply. Currently, over half of the state's fresh water passes through the Delta. Improved environmental quality is likely to result in reduced shipments of

15. For a description of the events in this case, see Reisner and Bates (1990). While heralded as a success by those advocating increased use of voluntary transfers, this agreement also highlighted the problems with the current system of regulation. Rather than happening voluntarily in response to recognition of the mutually beneficial trade possibilities, the agreement was triggered by a legal challenge by one of the farmers and an order by the State Water Resources Control Board. The process took over eight years to complete.

water to the southern portion of the state.[16] As much as 1.1 MAF of the state's water may be removed from consumption and applied for environmental purposes.[17]

In Israel the main ecological policy issue has been the destruction of its aquifers. Overconsumption of water from those underground resources has begun to damage the geological structures of the aquifers, threatening to destroy future water supplies. Moreover, additional use of water from the Dead Sea could cause further environmental damage to that body of water.

Second, new supplies are expensive. The relatively inexpensive projects have already come on line. Currently, planners are considering new dams in California (although with little likelihood of success given environmental opposition), water banking in ground water basins, and the development of some new facilities to store water south of the Delta. But most plans for new supplies also involve desalination plants that can cost in excess of $2,000 an acre foot, and waste water treatment facilities that also yield high-cost water. Other choices involve forced rationing in urban settings, particularly in new construction (limits on landscaping, plumbing requirements, and so forth).

Israel faces similar choices, although options are more limited because of its geography. Desalination plants can be constructed, but they yield water at very high costs. Moreover, desalination plants also increase dependence on oil, which is needed to operate the facilities. Wastewater treatment facilities are already used and others are under consideration to recycle some water, but demand management to reduce water use remains the primary tool for meeting projected shortfalls.[18]

Water rights are now a major issue in the Israeli-Arab dialogue. A separate panel is working exclusively on the issue of water and important issues remain unresolved. Until those issues are resolved, options involving transfers from outside Israel also are unlikely until Israel's international situation changes.

Third, complementing the other two factors, is the fact that the urban populations in the two regions have become better educated about water policy trade-offs. Urban users have been forced to examine the system in light of the high costs that resulted from rationing during the recent droughts. As a result of that examination, there is widespread understanding that most water is applied to agriculture, with much of it going to field crops that are relatively low-value crops.

In California, early water politics led to an alliance between agricultural interests in southern California against interests in northern California. Most battles for changing water allocations were between the north and the south. Recently, though, the alliances have changed. Increasingly, the political conflict has shifted to agricultural versus urban uses, with cities pointing to the rising relative value created by water in industrial uses compared to that in agriculture. Similarly in Israel, the political power of the agricultural interests has found increasing opposition among other groups in the matter of water policy.

These factors have made it increasingly difficult to meet growing demands for water through the addition of capacity. Moreover, the increased political power of the environmental groups in California already has forced reallocations of water to the environment that will reduce available supplies.

## V. Reform Efforts

Because these problems cannot be answered with traditional solutions, interest has emerged in determining new allocative mechanisms to improve the use of the water that currently is available. Public awareness of the inefficiencies of the current system have bred a large number of groups to reform water policy in the state.[19] Most proposals seek to achieve consensus between agricultural, urban, industrial, and environmental interests. Typically, these consensus approaches call for a mixture of new facilities, conservation ("Best Management Practices"), waste water recycling, increased allocations for environmental protection, and some transfers of water.

16. Total shipments through the Delta need not necessarily be affected by new practices, although the timing of shipments probably will be. Two alternatives that have been considered are (1) a peripheral canal to divert water around the Delta, and (2) storage facilities south of the Delta to bank increased shipments in the wetter winter months to use in the summer months when demands on the system are greater. Both projects face strong political opposition, particularly in the northern part of the state where residents fear that the new facilities would make it possible for increased transfers from the north to the south at the expense of consumers and the environment in the north.

17. Congressional bill H.R. 429, signed into law in October 1992, sets aside 800,000 acre feet for environmental purposes from the CVP, while a proposed ruling by the State Water Resources Control Board (to comply with EPA rulings) may take an additional 300,000 acre feet from other sources.

18. There have been reports that Israel and Jordan currently are considering a new canal from the Red Sea to funnel water to the Dead Sea and generate electricity, but this is viewed largely as a political gesture promoting peace efforts, rather than as a major effort to increase water supplies.

19. In California, these groups include The Three-Way Process, Californians for Water, Committee for Water Policy Consensus, Southern California Water Committee, Farm Water Coalition, and the Bay Delta Oversight Committee, among others.

In most cases, "transfers" are treated as only part of the solution, but water marketing has been rising rapidly to the front of the list of alternatives. Some environmental groups and business groups (such as the Environmental Defense Fund, the Bay Area Economic Forum, the Bay Area Council, and the California Business Roundtable), as well as some of the more prominent urban water districts (most noticeably MWD), pushed hard to bring market forces into water allocation, arguing that the resale of water offers the potential for greater efficiency, with the prospect that nearly all agents can be made better off (Schmidt and Cannon 1991, Mitchell 1993).[20]

These interest groups, were instrumental in obtaining passage of recent federal legislation (H.R. 429), frequently known as the "Bradley-Miller bill," which has strongly embraced the market point of view. The bill, signed into law on October 30, 1992 by President Bush, allows individual contractors to sell up to 20 percent of their allocations without approval by water districts, along with other provisions that allocate water to environmental purposes, create a fund for environmental restoration, and shorten contract periods.

In Israel some steps toward water reform were begun in 1991. These efforts, however, were halted after the change in government following the 1992 election. At present, no significant reforms are under consideration.

This lack of reform efforts in Israel reflects the different social and political interests in the two regions. In California, water policy is increasingly addressed as an economic issue. While arguments still are voiced about the importance of maintaining agriculture in the state, increasingly the discussion has migrated toward economic issues. Arguments opposed to trading emphasize economic dislocations and third party effects, rather than simply relying on statements about the importance of maintaining a way of life for those in the agricultural communities.

In Israel, on the other hand, water remains a strategic resource and the state is vitally concerned with its allocation. As discussed by Wolf and Ross (1992), water policy has been an important consideration in Israel's dealings with its neighbors. For example, according to their analysis, water complicates resolution of the West Bank dispute. The West Bank sits above the Mountain aquifer, and pumping in that region affects supplies to much of central Israel. Under current policies, the Israeli government must approve all pumping from the West Bank. Clearly, should that area no longer fall under Israeli jurisdiction, such control would be jeopardized. Diversions from the Litani River in southern Lebanon also involve strategic interests.

While such strategic considerations do not preclude permission to trade water, they tend to increase the government's interest in monitoring the uses of the resource. Moreover, the kibbutz system has a strong place in the cultural and political structure of Israel. Changes in water policies that might lead to a shift away from agriculture to industrial uses could pose a threat to that system.

*Cost of reforms.* The speed with which reforms are adopted depends critically on the transitional costs that arise in implementing new policies. Experimentation with additional transfers under the Bradley-Miller legislation should provide strong evidence of the potential gains and disruptions that can result from limited resale of water. By allowing resale of water by CVP contractors, the bill converts water rights into marketable assets, much like electricity from federal projects. Thus, as with electricity, the new structure of rights should encourage marginal transfers among water districts, which may be sufficient to eliminate the need for major new water storage facilities. A key question facing potential reform options is the magnitude of disruptions that such reforms might generate. Would market forces lead to large shifts in water use and to large changes in prices?

Research on California's water system suggests that the quantity of water transferred would be relatively small and the effect on prices to agriculture relatively minor. Howitt, Watson, and Adams (1980) found estimated elasticities of demand for agriculture that were well above those of urban users. Agricultural demand elasticities for water prices in the range of $62 to $87 per acre foot (in 1992 dollars) ranged from $-0.98$ to $-1.5$, and prices below this level had even larger elasticities. In contrast, urban users were estimated to have price elasticities close to $-0.4$ (Vaux and Howitt 1984). Given that agriculture currently consumes somewhere in the range of 80 to 85 percent of the water in California, relatively small percentage reductions in agricultural use resulting from small increases in average water prices would relatively quickly satisfy urban demand: Even a doubling of urban water consumption would reduce agricultural water by only around a fifth from current levels.

In a simulation model embedding these statistics, Vaux and Howitt (1984) estimated that price effects on agriculture and the magnitude of water transferred in California would be relatively small. Using updated figures from Vaux and Howitt's article, Schmidt and Cannon (1991) found that *average* agricultural prices might increase as little as $2.60 per acre foot—from $54.61 to $57.23. Less

20. The extended drought led to the establishment of an emergency water bank in California in 1991. While not a pure market, the bank did provide a mechanism to facilitate transfers from agricultural to urban users, demonstrating the potential for mutually advantageous trade. The water bank, however, is viewed as an emergency measure, and is not generally perceived as a model for marketing water permanently.

than one MAF moved from agriculture to other uses in the simulations. Obviously, some farmers receiving water at well below that price would face a larger increase, but even in those cases, that suggests that those farmers may have the potential to profit from selling more water. These elasticities also are short-run elasticities. Over the longer run, elasticities are likely to be significantly larger as farmers install new technologies that save water.

More recent evidence from Howitt (1991) provides further arguments supporting the low-price impact of a market. According to this research, rice farmers in California could make the same income from selling water at a price of $58 per acre foot (including avoiding production costs), while the break-even price for alfalfa was $114 per acre foot. Given that these commodities, along with irrigated pasture, account for about a third of California's total water use, those prices put a ceiling on the likely level to which prices would rise, since demand by urban areas would be expected to be satisfied well before all of that water would be purchased. Moreover, Howitt found that relatively little water was transferred from agricultural producers of high-value and permanent crops.

Similarly, in Israel, a study by Sadan and Ben-Zvi (1987) examined the implications of allowing water to be traded. They found significant changes occurring in water use across regions, with less used in the northeastern end of the system, and more used in the south. Nevertheless, their study concluded (p.8):

> The findings presented demonstrate the low economic cost of the institutional alternative relative to that provided through new resource development. In the case of Israel, the cost of a given quantity of irrigation water reallocated through institutional change appears to be only half as expensive as that same quantity provided through the implementation of projects for sewage water treatment and recycling, flood control, etc.

While allowing trading would result in some reallocation of resources, and hence some "third party effects" on agricultural communities, concern about such effects must be placed in perspective. Some changes in production and consumption practices would occur, but the indirect effects of those actions on others are likely to be small relative to others that occur regularly in agriculture. For example, the introduction of mechanical tomato harvesters sharply reduced the demand for labor, thus generating third party effects well in excess of those likely to be generated by introduction of a water market (Mitchell 1993).

## VI. CONCLUSIONS

Israel and California share similarities not only in their water delivery systems and their institutions, but in their public attitudes. In both cases, water infrastructures have relied heavily on public investments, where costs have been spread widely. Moreover, in both regions political involvement has expanded beyond the construction of facilities to include close controls on allocation and use of the resource. Agriculture has been the biggest beneficiary of past institutional arrangements, typically receiving the bulk of the water and paying lower unit prices for that water.

In both states, serious reform of water policy has proven very difficult. Among the reasons for this difficulty is the ingrained public attitude that because water is "important" it should be allocated administratively. The public seems to believe that this is "more fair" even though actual allocations seem to belie this fairness concept. Despite water's importance in semi-arid areas, policy has opted for this "fairness" over efficiency.

We have argued, however, that concerns over fairness need not preclude trading. As demonstrated in the electric utility industry, it is possible to achieve social policies through differential pricing and through government development of new facilities. Yet, efficiency can be boosted in that system by allowing trading to take place. Fairness can be handled by choosing how to allocate the rights to the resource; efficiency is achieved by granting those rights holders the right to sell to others.

Examination of Israel and California suggests that the willingness to experiment with water reforms—specifically to allow trading—may be increasing in California, while little momentum is apparent in Israel. In part, this may be the result of the trade-off that exists in control of water markets. Direct allocation of water gives tremendous control over development to governmental agencies. The cost of such control, however, is to increase drastically the efficiency losses and encourage poor resource allocation.

In the case of California, momentum is building for increased decentralization of control. This momentum results, in part, from the declining *relative* economic importance of the primary user—agriculture—and the growing importance of environmental values. Since the latter have had the effect of reducing available supplies and making new supplies more difficult to acquire, the efficiency costs implicit in administrative control over water use have risen to the point that other industries and consumers have been forced to address the issue. Moreover, at least in California, evidence suggests that the cost and

disruptions resulting from water trading are not likely to be that large.

In Israel, while economic costs of administrative water allocation also are high, strategic concerns and the political strength of the agricultural sector continue to make reform options politically unpalatable. However, as demand for the water continues to rise with Israel's population, and as other industries become increasingly important relative to agriculture, it is possible that reforms will become more attractive there as well.

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