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Planning and Financing Water Resource Development in the United States: *A Review and Policy Perspective*

By P. K. RAO*

ABSTRACT. Since the beginning of the 80s, there has been a discernible decline in *federal spending* for *water resource development*. The methods of *financing* project development at the state level exhibit diverse characteristics across different states. The state and sub-state level agencies and users will have to find and develop additional *resources*. This might also call for reduction in subsidies in *water pricing* which might give a greater role to market factors in *conservation* efforts. The present differentiated cost-sharing formula for different uses on the basis of the federal agency involved in the project development contributes to inefficient allocation of the resource. There is urgent need for *financial and water management reform* in order to avert a potential water crisis. Use, efficiency and equity considerations need to play a greater role in the distribution of the resource than in the past.

I

Introduction

“THE COUNTRY IS FACING a water management crisis that is being perpetuated by outdated financial and management practices,” according to a recent Special Study by the U.S. Congressional Budget Office, (July 1983, p. xvi). Historically, the preservation and development of water resources has always been a critical issue in the socioeconomic, cultural and political development of any region in the world. Civilizations grew and flourished thousands of years ago because of economic use (especially for irrigation-based agriculture) of water resources wherever available in a natural manner. There are several examples across the world that demonstrate the serious adverse consequences of misuse of water resources with little consideration for environmental consequences. In the U.S. the earliest water developers were the Hohokam Indians who built extensive irrigation canals for surface irrigation in the region now called Arizona. The civilization vanished as the exploitation of water resources contributed to the rise and fall of the comprehensive structural foundations of the development process.

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The major use of water is in irrigation. Irrigated agriculture is an extremely inefficient water consumer in the current system of application of water in most countries. Often, the possibility of saving large quantities of water (and of finances) for small investments in irrigation technology and management is not explored in practice (Rogers, 1985, p. 294). Related to this aspect is the fact that in most countries (including the U.S.) the real costs of projects aimed at water resource development are constantly on the rise as relatively more favorable sources are increasingly exhausted. The ever increasing financial burden is only a minor part of the problem; the main issue is the physical (often, irreversible) consequence of resource exploitation beyond critical limits. The latter phenomenon tends to take place when the resource use is accelerated by various fiscal and institutional mechanisms that act as incentives towards over-exploitation of the resource. To the extent that water pricing subsumes very heavy subsidy (as is the case in most countries, especially when it comes to the major usage—irrigated agriculture), the resource use inefficiencies and consequent long-term physical (and economic) consequences cannot be ignored.

This paper, after a brief review of historical developments (especially legislative measures) of the post-World War II era, examines the current trends in water resource development in terms of the evolutionary process governing fiscal structures with emphasis on the roles of federal and non-federal institutions affecting project financing and cost-sharing. An analysis of irrigation water pricing and subsidies is also briefly included, along with expressed concerns of some of the governmental institutions and forums. Issues relating to alternative methods of financing water resource development at the state and sub-state levels are examined. Clearly, many of the issues that are addressed here have been engaging attention in different professional debates but it appears there is need to articulate and sharpen the focus of the debate further, much beyond the scope of this paper. After all, public policy decisions do not emerge from any single academic discipline but have to be brewed from a judicious mix.

II

Emerging Trends

ALTHOUGH THE U.S. IS BLESSED with abundant water resources, the task of rational utilization and of achieving some element of cost-effectiveness in resource development is bound to be met with limited success because of the complexity of institutions, conflicting interests and differential pattern of spatial distribution of surface and groundwaters. Trends in consumptive use of water for different purposes indicate that irrigation for agriculture continues to be the major user

(accounting for about 80 percent of total consumptive use of water in the U.S.). Projections of water use by the turn of the century indicate relatively higher consumptive water use by nonirrigation users, although the scenario still indicates a substantial proportion (around 70 percent) will continue to be used for the purpose of irrigation.

Currently, the U.S. has nearly 422 million acres of cropland. Of the 51 million acres of agricultural land under irrigation, about 40 million acres is cropland. About 90 percent of this irrigated harvested area is located in 17 western states (which irrigate at least half their harvested cropland). The Federal Government is directly involved in about 20 percent (*i.e.*, about 10 million acres) of the total irrigation water supply. California, the major irrigation water user state of the west, has about a third of the irrigation water supply developed by federal water projects; the state, local agencies and significantly, private individuals developed the remaining water supply projects.

Out of 25 federal agencies concerned with water projects, four account for about 70 percent of all federal expenditures on water resources, and about 40 percent of all federal water resources and water quality expenditures combined. These four agencies are: the U.S. Army Corps of Engineers, the Bureau of Reclamation, the Tennessee Valley Authority and the Soil Conservation Service.

Beginning in the 80s, federal spending for water resource development showed declining trends. During 1980–85 the spending dropped from \$11.6 billion to \$6.5 billion per year (*i.e.*, a decline of about 44 percent). As a natural reaction, perhaps, the aggregate spending by state and local authorities went up from \$25 billion to \$29 billion per year during the same period (*i.e.*, an increase of about 17 percent). However, there appears a net decline in spending. This pattern should be viewed along with other salient features of the water resource system in order to interpret possible implications.

The Clean Water Act of 1972 targeted that the main rivers and inland waters be “fishable and swimmable by 1983.” The terminal year was later extended to 1984 but the objective could not be attained. There is still need for considerable investment and attention to achieve desired goals. Also, the imperative role of state, regional and local authorities in this context is clear in view of the expressed intention of the federal government to eliminate grants for wastewater treatment by 1990. The lack of comparable comprehensive protection (similar to the Clean Water Act of 1972) for groundwater poses certain problems in resource development and quality control in respect of groundwater. It is useful to recall that about 50 percent of all drinking water comes from groundwater wells. The nationwide planning for water quality control was mandated by the Congress in 1973 (by section 208 of Public Law 92500). Lack of adequate data on the

economic costs of water pollution, among other issues, is a barrier to proper economic evaluation of investment proposals or possibilities. The brief narration of the evolutionary process of financing and cost-sharing in the water resource development system is presented to clarify some of the operational issues concerning recent trends.

III

Financing and Cost-Sharing

THE PROBLEM OF FINANCING may not be entirely resolved by analyzing the issue of cost-sharing. If we subdivide the categories of agencies and organizations as the bodies responsible for financing and sharing costs of water development, these would appear relevant: federal, state, regional and local agencies and authorities, and public and private water users and water user organizations. It was pointed out by the National Water Commission in its final report (1973, p. 485) that because of varying vintage origins, the present policies governing federal and non-federal cost-sharing arrangements are "inconsistent among programs, among purposes, and among agencies." Part of the implied cost is possibly worth incurring in order to encourage democratic institutions and their interplay.

Beginning in the 60s there was federal legislation authorizing cost-sharing in various projects. The Water Resources Planning Act of 1965 (passed after 4 years of congressional negotiations) included a program of grants to states for comprehensive water resources planning so as to enable the states to have an equal role in the establishment and functioning of water basin commissions.

The Clean River Restoration Act of 1966 authorized federal grants to state and interstate agencies for basin planning. It also raised the federal treatment facility grants from 30 to 50 percent of estimated construction costs, in cases where the state agreed both to contribute to the construction costs and to set enforceable water quality standards for the water into which the treatment facilities discharged.

It is useful to recall that the Reclamation Act of 1902 established a revolving fund from the sale of public lands to provide financing for western irrigation projects. The Reclamation Act of 1939 provided that project costs allotted to irrigation be repaid by users only to the extent that they were able to pay. These provisions still apply. The Bureau's figures on "ability to pay" or repayment capacity on project farms represent the maximum residual available for payment of all water charges after deducting a modest family living allowance from budget

from net farm income. With regard to capital costs, the basis of cost-sharing of bureau projects by appropriate agencies for non-irrigation water uses are as follows: 100 percent for hydroelectric power, municipal and industrial water supply; 50 percent for recreation; and 25 percent for fish and wildlife and water quality. Operation and maintenance costs in all cases are supposed to be met by the users (including irrigation).

For most water projects with federal involvement, nominal cost-sharing (specified by legislation) differs from the proportion of total project costs actually paid by the user categories over the project life when summed in constant dollars. The latter feature is referred to as an effective cost share. The Congressional Budget Office (hereafter CBO) study (1983a, p. 22) found that the effective non-federal cost shares differ significantly across projects implemented by different federal agencies. To illustrate, let us take irrigation water use. The effective non-federal share is around 18 percent for the projects under the Bureau of Reclamation and 54 percent for those under the Soil Conservation Service. The corresponding percentages for municipal and industrial water use are 71 and 100. Thus, there appears a good deal of discrepancy between planned and actual levels of cost-sharing, leading to unintended (and often unjustifiable) subsidies and income distribution policies.

In May 1977, President Carter called for the establishment of a national water policy and a year later the President communicated a water reform policy message wherein he stated (see *e.g.* Wilson, 1978, p. 33–34) “States must be the focal point for water resource management.” It was also stated: “Across the nation there is remarkable diversity in the role water plays. Over most of the west, water is scarce and must be managed carefully. . . . Given this diversity, federal water policy cannot attempt to prescribe water use patterns for the country. Nor should the federal government preempt the primary responsibility of the states for water management and allocation.”

The Council of State Governments (COSG) in 1978 adopted a set of 11 principles for guiding national water policy. The first principle maintained that: “Water management activities relating to water qualities, water supply, ground-water, wetlands protection, coastal zone management, and soil conservation should be clearly delineated by Congress as the primary responsibility of the states and their delegated interstate agencies.” Until 1978 various federal agencies used different non-federal cost-sharing rules for structural and non-structural plans. Since 1978, there have been two main ingredients in the cost-sharing initiative:

- i) States would provide a commitment to contribute up-front cash for projects within their borders: 10 percent of construction costs for projects that had vendible outputs (5 percent for other categories).

- ii) Present cost-sharing conventions of all agencies involved in flood control or flood damage reduction would be amended to require a standard 20 percent of non-federal contribution both for structural and non-structural measures.

The financing and cost-sharing guidelines suggested in the summer of 1982 and abandoned later by the Administration are given below. The non-federal cost-sharing and financing, expressed as a percentage, for five different user categories, were suggested: a) Hydropower—100; b) Municipal and Industrial Water—100; c) Flood-Control—35; d) Separable Recreation—50; e) Agricultural Water Supply—35.

The aggregative specifications above indicate the implications of these specifications in terms of improved resource use efficiency and regional as well as economic equity in public expenditure. Whereas there is increasing responsibility for cost-sharing and financing water resource development at the state level (often, perhaps, necessitated by gradual decline of federal provision of financial resources in recent years), it is rather surprising that a clear statement (even if heterogeneous across regions/states or implementing federal agencies) is not available for practical purposes. The states may have to continue to “shop around” among different federal agencies in order to obtain the best deal in this regard. Such a flexible arrangement has its own merits. But the implications for the resource’s use efficiency and regional equity dimensions are not likely to be favorable to optimal development as they may not transmit desirable signals for optimal resource use and investment.

Based on the following extract from President Reagan’s letter in 1984 in response to a letter from Senator Laxalt and 14 colleagues, Waelti (1985, p. 156) concluded that cost-sharing policies are less clear than in the past and that non-federal cost-sharing is unlikely to increase much. It is, however, doubtful if the letter is likely to have an impact on significant acceleration of state level initiatives on water resource development. That is, if the increase in non-federal public expenditures in this regard in recent years is any indication of emerging trends. The letter included the following:

All federal water development agencies will continue to seek out new partnership arrangements with the states and other non-federal interests in the financing and cost-sharing of all proposed projects. Each such agency will negotiate reasonable financing arrangements for every project within its respective area of responsibility.

IV

State Level Financing

WATER RESOURCE DEVELOPMENT PROGRAMS reflect the diverse roles of states. The development may be a totally local responsibility as in Delaware and Iowa. A

state may take a very active role in funding water development, as do New Jersey and Texas. Revolving or special funds earmarked for state water development projects exist in 27 states. Innovative methods of financing or local financing and water management examples are found in Arizona, Florida, Nebraska and Montana. Tax revenues from energy development or mineral mining are emerging as an important new source for supporting water development in states like Alabama, Colorado, Mexico, Montana, New Mexico and Wyoming. Other natural resource user fees and revenues from timber sales, grazing rights or municipal water sales partially aid new water development projects in California, Rhode Island, South Dakota and Utah.

Reforms in state financing or cost-sharing provisions could interact with water law in two ways; i) new development could not impair existing water rights and long-term contracts that have been entered into for the sale of water in the Bureau of Reclamation projects; ii) if new water rights from state-financed storage projects were allocated according to user's willingness to pay for water, legal conflicts could arise with both the prior appropriation and riparian doctrines.¹

Other legal impediments include limited legal authority to levy user fees, statutory or constitutional prohibition against debt financing, and statutory ceilings on state bonded indebtedness or on interest rates allowable on state bonds. Appropriate legislative modifications would be necessary to raise financial resources for water resource development.²

According to a CBO study (1983a, p. 67), “. . . , neither western nor eastern states currently have institutions or water laws that are well-suited to purely market-oriented allocations. But states would play a major role in fostering such policies; and if new water development was conditioned by users' willingness to pay for investments made on their behalf, a market-based allocation might be the only way to meet future water needs”.

Another CBO study (1983b, p. 45) suggested three alternatives for carrying out cost-effective projects with non-federal involvement (“local initiative”):

- i) establishing a self-sustaining federal loan fund to replace annual appropriations for local water resource projects;
- ii) replacing federal grants for projects of local interest with block grants to states, allowing greater local choice of investments;
- iii) targeting the remaining federal project grants toward water projects that are national in character.

Some of these issues need to be examined in greater detail. It is relevant to recall the observations of the National Water Commission (1973, p. 525) (Recommendation 16.1):

Table 1

Projections of Capital Investment Costs for U.S. Water Development
(Based on Extrapolations of 'Needs' in Water Resources Council Framework)
(Billions of 1972 Dollars)

Category	1970-1980 Non-Federal			Percent of Total	1970-1980 Non-Federal			Percent of Total
	Federal	Federal	Total		Federal	Federal	Total	
Municipal and Industrial Water Supply	0.4	13.7	14.1	7	6.7	32.2	38.9	7
Irrigation and Drainage	3.0	12.0	15.0	7	9.6	27.8	37.4	7
Power ¹	6.9	12.9	19.8	10	6.7	35.1	41.8	8
Flood Control	8.9	10.4	18.9	9	22.3	25.0	47.3	9
Recreation	9.4	9.3	18.7	9	24.4	24.4	48.8	9
Fish and Wildlife	2.4	1.8	4.2	2	6.9	5.2	12.1	2
Water Quality	31.0	50.5	81.5	40	116.0	111.0	227.0	42
Land Management	6.7	6.7	13.4	6	15.3	15.3	30.6	6
Navigation	10.8	3.1	13.9	6	25.5	7.6	33.1	6
Shoreline Protection	2.8	2.8	5.6	3	7.8	7.9	15.7	3
Other	1.3	1.3	2.6	1	2.6	2.7	5.3	1
	83.2	124.5	207.7	100	243.8	294.2	538.0	100

¹Primarily hydroelectric although cooling water facilities were included in some studies.

Source: National Water Commission (1973, p. 507).

Since continued heavy reliance must be placed on debt financing of water resource projects of all types at the state and local levels, unrealistic legal barriers to efficient debt acquisition and management should be removed in state and local constitutions, statutes, ordinances and charters. These restrictions include debt and interest rate limitations that place local governments at a long-run cost and interest rate disadvantage and that ignore the fact that the bond markets themselves will reflect debt repayment capacity of local and state governments.

A CBO survey for the year 1981-82 indicated that the following components of resource mobilization contributed in different states towards water resource development: i) appropriations from general revenues, ii) general obligations bonds, iii) revenue bonds, iv) special taxes and user fees, v) special or revolving funds, and vi) loans and grants. Of these, the bonds (ii) and (iii) tend to have

greatest revenue potential for some of the states. However, in some of the states there are statutory and legal obstacles to raising any financial resources under these potential instruments. The states in this category include: Arizona, Colorado, Indiana and Nebraska. The following states realized finances exceeding \$400 million by floating General Obligation Bonds in 1981–82: New Jersey, Texas and California (which raised up to \$1.75 billion). The corresponding group of states that raised revenues exceeding the above magnitude from Revenue Bonds were only two: Alabama and California. Special or revolving funds were created in about 20 states, but only five of them created funds in the range \$100 million to \$1 billion: Massachusetts, Minnesota, Pennsylvania, Texas and Wyoming. Two of these, *viz.* Minnesota and Wyoming, and California are the states which earmark funds exceeding \$100 million under the category (vi) above for the purpose of water resource development.

Amongst the impediments to tap potential financial resources required for optimal water resource development in most of the states are: lack of statutory or legal provisions for market-based resource mobilization (under bonds (ii) and (iii)), limited attempts to utilize leverage under other instruments in majority of the states and subsidies in water pricing (especially irrigation water pricing). Some of the states that attempt to raise bonds for finances have additional constraints like interest rate ceilings which limit the potential.³ It is also useful to note that only in about 10 states are appropriations from general revenues used for water resource development, and that even in these cases the financial amounts involved were very meager (around \$5 to \$10 million in the majority of the cases).

It may also be noted that there are 24 states where General Obligation Bonds make little or no contributions towards the public finance needs for water resource development. The corresponding numbers for other sources of potential for finance with zero or near zero contribution are: Revenue Bonds—32 states, Special Taxes and User Fees—25 states, Special or Revolving Funds—23 states, and Appropriations from General Revenues—15 states.

V

Subsidy and Water Pricing

THE MAGNITUDE of capital investment requirements for different sectors of water users in various time-intervals including projections till 2020 is shown in Table 1. It would be realistic to make an upward revision for the non-federal components and an opposite adjustment for the federal component for future periods.

From the order of magnitude of required investments, it appears that water quality, rather than water supply, seems to require highest attention. This is indicative of the highlights: i) relatively diminished need for accelerating irrigated agriculture and other major users of freshwater; ii) increased burden on proper water management, *i.e.* preventive rather than curative needs of water resource use and disposal. Thus there are more costs to be incurred in water disposal than in water withdrawal in some uses (especially when it comes to industrial and urban uses and also when water is not used rationally in agriculture). Hence the need for rational consumptive use of water. Since pricing is one of the most effective methods of affecting water consumption, it is useful to pay greater attention to the issue (which is often viewed mainly as an instrument for achieving financial objectives).

There appears evidence of "over-investment" in the water supply industry in the developed as well as developing countries contributed by heavy subsidies in water pricing (see *e.g.* Warford, 1966, and Rao, 1986, p. 73). Rogers and Rubin (1985, pp. 3, 27) pointed out that federally supplied irrigation water resulted in wasteful irrigation practices primarily because of heavy subsidy (about 90 percent of the cost being incurred by the federal agencies). The National Water Commission (NWC) Report dealt with several relevant issues relating to U.S. water resources including the role of proper pricing. The Report stated (p. 257):

The central objective of the federal reclamation program has been the promotion of irrigation-based agricultural communities, not the efficient use of water. This policy is reflected in the ability-to-pay criterion for the pricing of water to irrigation districts (p. 257).

The strongest argument [the report said] in support of cost-based pricing and user charges is that by encouraging efficiency in use they improve resource allocation and prevent premature investment for expansion of facilities. The entire society is made better off (p. 258).

The two major weaknesses of federal water resource programs identified by the NWC are:

- a) heavy subsidy—water users on some modern reclamation projects repay no more than 10 percent of the construction costs attributable to irrigation;
- b) defective project evaluation methods leading to overestimation of benefits (without adjusting for farm incomes attributed by price support schemes).

The major disadvantages of subsidization of new irrigation water projects are: i) inefficient use of water resources leading to generation of negative physical and economic externalities; ii) expansion of the productive capacity of an agricultural system beyond the optimum levels, resulting in the possibility that taxpayers pay for bringing new land into production, pay for price-support schemes for the produce and also for adverse physical consequences of over-irrigation. Let us look at some of the estimates of subsidies.

According to Frederick (1982) the range of water subsidies per acre varies from \$58 to \$1787 for the life of the projects implemented by the Bureau of Reclamation; the average farmer pays 19 percent of the actual supply costs. The proportion of allocated irrigation construction costs designed for repayment by irrigators, on the basis of their capacity to pay, varies greatly among projects and project units. Among 21 units in the Missouri Basin Project, the range was from zero to 72 percent; in only two projects the number exceeded 40 percent (NWC, p. 486). However, in irrigation projects built by the Corps of Engineers in the eastern states, cost-sharing policy varies from project to project, with the irrigators generally paying about 50 percent of the construction costs allocated to irrigation.

Franklin and Hageman (1984, p. 1047), using financial data relating to 19 projects implemented by the Bureau of Reclamation, argued that agricultural water users do not pay 100 percent of their allocated share of operation, maintenance and replacement (OM & R) costs. It is concluded that irrigated agriculture has been and continues to be heavily subsidized not only with respect to capital costs but also with respect to OM & R costs. The 19 projects of the BOR indicated that irrigation was allocated 73.2 percent of total capital costs but is ultimately expected to repay 3.8 percent of capital costs allocated to irrigated agriculture, *i.e.* the capital cost subsidy to irrigated agriculture is in excess of 96 percent. Of the OM & R costs projected in the feasibility reports, 69 percent were projected to be reimbursable (*i.e.* to be paid by private users) by irrigated agriculture and 8 percent were projected to be nonreimbursable. However, in terms of agricultural performance in 1979, only 7 percent of ex-post OM & R costs are reimbursed by irrigated agriculture and 64 percent are allocated to nonreimbursable categories. This was suggested to be a "political accounting" technique (Franklin and Hageman, 1984, p. 1050).

In the areas covered by 18 projects studied by the Department of Interior in 1980, the largest 5 percent of farmers with operations of 1280 acres or more, received 50 percent of the total subsidy. Also, the largest 1 percent category farmers get 21 percent of the subsidy. The smallest 60 percent of farmers with holdings of 160 acres or less for whom the benefits of the Bureau projects were intended, get only 11 percent of the total subsidy. It is also useful to note the limited productivity, mainly because of supply of highly subsidized water, from the fact that about 30 percent of the area under the Bureau projects is in low value crops: alfalfa, irrigated pasture and hay.

The U.S. General Accounting Office stated ". . . the large subsidy given to irrigators is based on goals of home building and settling the west. These goals were established at the beginning of the 20th century and were considered

important enough for the Federal Government to step into what had been primarily private enterprise. The original rationale for subsidized irrigation projects is probably no longer applicable.”

A study (quoted in *The Economist*, 1983, p. 45) by an economist at the San Francisco Federal Reserve Bank reported that in 1981 the average price paid by farmers in California's Central Valley for federal water was \$5 an acre-foot. This compares with the \$325 an acre-foot they would pay if price equalled marginal cost, \$48 an acre-foot for replacement average cost, and \$24 an acre-foot for historical average cost. The annual subsidy (at the 1985 rates) currently works out to more than one billion dollars for the areas covered by the Bureau of Reclamation.

A study by Heady *et al.* (1971) indicated that increasing the price of water for irrigation in the 17 western states would create the potential for release of substantial quantities of water from agriculture for uses in other sectors and locations without putting pressure on the nation's food supplies or export potentialities. The NWC recommended that subsidization of new irrigation projects should be discontinued. The recent U.S. Department of Agriculture model on agriculture implies that even substantial shifts in water costs and availabilities would have small aggregate impacts on farm incomes, prices and outputs, due to various modes of adjustment. This indicates considerable scope for reduction of irrigation water subsidies.

Levy argued, based on an empirical study (1982, p. 50), that the U.S. “Congress logically should give more attention to the role of the price mechanism in reducing the projected growth of irrigation water demand, not only in California but throughout the west.” More recently, LeVeen and King (1985, p. 156), who studied in detail the federal water subsidies in the Central Valley Project in California, suggested that Congress should enact a prohibition against use of subsidized water to grow surplus crops.

LeVeen and King (p. 8) estimated that the total subsidy in the Central Valley Project amounts to \$3.5 billion, or about \$286 million a year (in 1985 dollars), and argued that cheap reclamation water is not correlated with family farms or rural prosperity in California. Rogers and Rubin (1985, p. 20) estimated that the subsidies to the large farms in the western states could lie in the range \$480,000 to \$1,715,500 over the life of the project. The question that naturally arises in this context is: Is this a desirable feature of income redistribution in the society, and if so, what are the objectives of the income transfer policy? A clear statement does not seem to emerge from the official documents of the Bureau of Reclamation to answer this question. It appears that the rest of the society pays to subsidize water use in the farms in the western states in return for greater agri-

cultural prosperity of the nation resulting in lower consumer prices for agricultural products. But this premise can only be partially valid, when additional federal expenditure is incurred to protect farm incomes through measures like price support schemes for surplus crops grown in these areas with large water subsidies.

Whereas the reports of the Bureau of Reclamation favored subsidies to irrigation in the western states, these were working at cross purposes with the programs and objectives of the USDA's price support and acreage control programs (see *e.g.* Tolley, 1959, p. 180). The Rural Poverty Commission (1967, p. 138) was critical of the Bureau's irrigation program and saw this as subsidizing the development of prosperous new irrigated cotton and vegetable economies in the southwest, at the expense of displaced farm workers and impoverished rural communities in the southwest. The Bureau of Reclamation in its 1980 "Interim Report on Acreage Limitation" showed that 48 percent of reclamation land is controlled by 9 percent of the landowners. The implications of subsidies on income distribution are rather obvious. As Smith (1985, p. 117), based on a detailed study of western states, pointed out, user-fee schedules can become complex as they reflect treatment costs, water reuse opportunities, and scale economies. Their potential for effective financing of water investments has not been exploited fully. In agriculture, the fiscal conjunctive use of dedicated groundwater tax revenues for financing surface water development has yet to be adopted widely. In municipal settings, effluent charges have not been levied on discharges of industrial wastes into the water supply.

VI

Concluding Observations

HARRISON (1981) IDENTIFIED seven institutional conflicts to be resolved in order to develop an integrated water policy planning process: "the public interest versus the existing institutional structures, man vs. nature, individual vs. collective local interest, management agencies vs. constituencies, higher vs. lower levels of government, region vs. region, and water vs. other public priorities." An important additional dimension that runs through all the above is that of time: now vs. later. A rational policy for water resource development needs to incorporate the implications of varying specifications of water resource use on intergenerational distribution of water, land and related resource base, its productive potential and long-term environmental (and hence economic) impact of alternative patterns of resource development. The mechanics of financing

water resource development, in a broader and long-term perspective, should fit into such a framework.

There is a growing need for more active multi-level cooperation among national, regional, state and local agencies for rational use of water resources and for enhancing complementary roles of the public and private sectors in resource development and optimal utilization. The direct and indirect income redistribution policies effected by methods of financial resource mobilization for water resource development by various public agencies, along with their policies governing water pricing and subsidies for alternate users require critical review in order to enhance productivity and equity of water resource use. Equitable sharing of costs and benefits of water resource development should be an integral part of this exercise.

Some of the specific observations relevant in the current context are the following:

a) The methods of financing cost-sharing, in respect of water resource development are complex and varied to such an extent that the system lends itself to unintended or intended but not entirely justifiable subsidies on some user categories (and regions), resulting in resource use inefficiencies and adversely affecting income distribution in some cases.

b) The bases for cost-sharing under different federal agencies involved in water resource development might require some uniformity with respect to user categories, although exceptions on justifiable grounds can always be granted.

c) The states may have to either be assigned by a federal policy or assume on their own greater responsibility in evolving optimal water resource policy (taking quantity and quality aspects into consideration in an integrated framework) and conduct more active mechanisms of implementation of such policies directly or catalytically.

d) The potential for financial resource mobilization at the state and lower levels needs to be tapped in many states in order to develop resource use in an optimal manner; the possibility of raising more funds under bonds and of encouraging a greater private role in water development projects needs to be explored with greater emphasis.

e) The pricing mechanisms for federally supplied water (especially for irrigation projects) require reform so as to make these reflective of costs of provision of resources and make the programs and schemes self-sustaining.

f) Reduction in planned and unplanned subsidies in some of the water projects might pave the way for a greater role of private ownership in resource development, reduce physical and economic inefficiencies in resource use and encourage greater interplay of forces relevant under efficient water markets in many regions.

Notes

1. Under the riparian water rights, owners of land contiguous to a watercourse have a legal right to direct and beneficially use that water. They do not forfeit the right to water by not using it. The law applies in some western and most eastern states. Prior appropriation or appropriative water rights were developed in most western states to permit water to be used on productive land not contiguous to a watercourse. This system ranks rights by the order of filing the claim to the water. The junior appropriator must reduce use of water first in times of shortage. The appropriative right can be lost if it is not used. Source: C. Edwards, "U.S. Agriculture's Potential to Supply World Food Markets," USDA-ERS-Agricultural Economics Report 539, August 1985, p. 27.

2. As argued by Anderson (1983, pp. 42, 45): "Some elements of the riparian doctrine led directly to more public control of water allocation. First, with riparian ownership the resource is held in common, requiring regulations on open access. Second, since uses that were prejudicial to other owners required 'license, grant or prescription,' users naturally sought and obtained these preferences through legislation." "Instead of relying on markets, we have turned water allocation over to a rent-seeking process that uses valuable resources without guaranteeing efficiency or equity."

3. The changes federally proposed to be effective during 1986 or later in tax-exempt financing via municipal bonds triggered the scramble by state and local borrowers to raise the bonds and this pushed up the volume in 1985 to \$196 billion, an 87% increase over that of 1984. The new terminology in the House Bill combines the General Obligation Bonds and Revenue Bonds, under the name of Governmental Bonds. The House bill envisaged higher yields for investors in new issues called Nongovernmental Bonds; these were to be issued to finance housing projects, many water and sewage systems and nonprofit hospitals. These are expected to be taxable whereas those in the other category—constituting roughly half of the total—will continue to be tax-exempt. Clearly, the potential for mobilizing resources under bonds is likely to be restricted and thus can contribute to aggravate the problems of financing water resource development at the state level.

References

- Anderson, T. L. *Water Crisis—Ending the Policy Drought*, Cato Institute, Washington, D.C., 1983.
- The Economist*, American Survey—"Water in the West: The Well Runs Dry," May 14, 1983, pp. 41–50.
- Franklin, D. R. and R. K. Hageman. "Cost Sharing With Irrigated Agriculture: Promise Versus Performance," *Water Resources Research*, 20.8, August 1984, pp. 1047–1051.
- Frederick, K. D. "Water for Western Agriculture," *Resources for the Future*, Washington, D.C., 1982.
- Harrison, D. "Do We Need a National Water Policy Process?" U.S. Department of Interior, 1981 (quoted by M. Hrezo, and W. E. Hrezo (1985)).
- Heady, E. O. *et al.* "Agricultural Water Demands," Report PB206790, National Water Commission, 1972.
- Hrezo, M. and W. I. Herzo. "From Antagonistic to Cooperative Federalism on Water Resources Development," *American Journal of Economics and Sociology*, 44.2, April 1985, pp. 199–214.
- Levy, Y. "Pricing Federal Irrigation Water—A California Case Study," *Economic Review* of Federal Reserve Bank of San Francisco, Spring, 1982, pp. 35–53.

- National Advisory Commission on Rural Poverty. *The People Left Behind*, Washington, D.C., 1967, pp. 134–38.
- National Water Commission. "Water Policies for the Future," Water Information Center Inc., New York, 1973.
- Rao, P. K. "Cost Recovery and Irrigation Water Pricing—India," Study Report prepared for the World Resources Institute, Washington, D.C., 1986.
- Rogers, P. "Fresh Water," in *Resources, Development and the New Century*, ed. by R. Repetto, New Haven: Yale Univ. Press, 1985.
- Rogers, P. and K. Rubin. "Management of Water Resources in the U.S.: Current Context and Future Strategies," 5th International Seminar of the Institute of Public Administration of Canada, Vancouver, B.C., April 1985.
- Smith, R. T. "Troubled Waters—Financing Water in the West," Council of State Planning Agencies, Washington, D.C. 1984.
- Tolley, G. S. "Reclamation's Influence on the Rest of Agriculture," *Land Economics*, 25, May 1959, pp. 176–180.
- United States Congressional Budget Office (CBO). "Current Cost-Sharing and Financing Policies for Federal and State Water Resources Development," Special Study, Washington, D.C., July 1983.
- United States Congressional Budget Office (CBO). "Efficient Investments in Water Resources—Issues and Options," Washington, D.C., August 1983.
- Waelti, J. J. "Cost-Sharing for Federal Water Projects—Trends and Implications," *Water Resources Research*, 21.2, February 1985, pp. 153–58.
- Warford, J. J. "Water Requirements—The Investment Decision in the Water Supply Industry," *Manchester School of Economics*, 34, January 1966.
- Wilson, L. U. "State Water Policy Issues," The Council of State Governments, Lexington, Kentucky, 1978.

The Influence of Exchange Rates on Trade

DR. ARTHUR B. LAFFER, Distinguished Professor of Economics at Pepperdine University and member of the President's Economic Policy Advisory Board, reports on his recent research on international trade in "Minding Our Ps and Qs: Exchange Rates and Foreign Trade," published in the Fall, 1986 number of *International Trade*, Laredo State University's new scientific quarterly.

An examination of interest rate patterns internationally suggests that the dollar's decline is not inflation induced, Dr. Laffer reports. Detailing the evidence, he finds that Europe and Japan have had supply-side revolutions of their own. The fall in the U.S. dollar appears to be the consequence of improved foreign economies and so the situation will result in improvements to the U.S. economy. "The rich will get richer," he says, "and so will the poor." W.L.