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FINANCIAL AND ECONOMIC ANALYSIS OF WATER PROJECTS

By

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## Financial and Economic Analysis of Water Projects

by

David J. Allee<sup>1,2</sup>

I will describe some of the basic differences between financial and economic analysis. While complementary, they perform different functions and are thus quite different in the concepts that stand behind them and in the data used. Many of the calculations and terms are similar, giving the impression that they are more alike than is true, or at least than should be true. Many refer to financial analysis as being economic analysis -- it's a loose language we use.

But perhaps the more important objective here is to identify some of the ways these differences may affect the planning process for water projects. Nonfederal participants and co-sponsors are being asked to assume a larger share of the costs of both planning and project development. For some purposes such as fish and wildlife enhancement, some have felt the federal contribution too low; for others such as flood control, too high. At least since the "Section 80" study of 1974 there has been increasing interest in overhauling "cost-sharing" (WRC, Allee, Ingram and Allee, W. Hunt, et al.). Deficits, high interest rates, inflation, tax changes that have opened new tax shelter possibilities, and more, have combined to put the focus of reform on the financing and on the related organizing needed to pay a larger local share. The result will change the mix of participants in project development and thus the outputs of that process.

Organizations at the interlocal level (eg. multi-county) will be facilitated. States will certainly develop more of a role in financing. The federal agencies will have to give up some of their dominance in the planning process and a share of their ownership in projects. In return for this they should receive more net support for their programs than otherwise.

If all this really happens, the planning process should be characterized by more intergovernmental negotiations and should put more emphasis on local capacity building. More than the addition of financial analysis skills to the process will be required. But then these are changes that water planners have been facing for many years (Hunt, et al.). But perhaps

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  2. Remarks presented at the conference on Water Project Financing Workshops, sponsored by the U.S. Army Corps of Engineers and Interstate Conference on Water Problems at Seattle, Washington on December 6-7, 1984.

the pace of change will pick up under the pressure of declining budgets. After all, what this amounts to is more aggressive market development and more intensive competition between agencies and levels of government to be responsive to the needs of the American people. Surely in principle that is as desirable in the public sector as it is in the private. The difference between public and private is the public obligation to consider rule making and the protection of public values that fall outside the incentives working in organizations -- public or private.

### The Questions are Different, and So are the Answers

Why should we construct a project? How shall we pay for it? In both questions, the word "we" has to be defined. The "how" may be more dependent on the "why" than in the past. But these are quite different questions, even in the private sector.

Economic analysis is used in the politics of project development to provide legitimacy and control. An efficiency criterion (eg. maximize net present value or the weaker B/C 1) serves as a screen to limit governmental largesse to otherwise deserving recipients (Ingram, 1972; Shabman, 1983). It helps limit technical efficiency standards (eg. safety of a dam) or the esthetics of engineering and science (which sometimes translates to if we know how, we should), or for wasting public resources inefficiently favoring a particular interest. A solid net benefit helps to justify to those less interested in water that the projects proposed are worthy of the mutual support crucial to decision. It is part of the technical basis for allocation that government provision of services requires. Economic analysis makes a convenient target for opponents and provides a framework for the debate. It sorts out the worst projects, but often a more significant way to increase overall social efficiency of programs is to change the mix of projects that enter the inventory. That appears to be more of an institutional challenge than just policing the application of evaluation rules.

Financial analysis, on the other hand, is concerned with how much of those estimated benefits can be turned into revenue to match that part of the costs that must be met in cash. The timing of money costs and money revenues for investment projects means that someone's savings must be invested to create the opportunity for the stream of revenues. Whose savings? What will they cost? And how is that cost influenced by the variability and uncertainty (i.e. risk) of the revenues? These questions are what financial analysis is about.

Obviously, financial factors affect politics. A federal appropriation involves different players and rules than creating a tax district on a flood plain or pledging water service revenues. Financial considerations also screen projects, limit engineers, convey legitimacy and provide an incentive to change the mix of projects in the inventory. The point is that a change in finance rules gives you a different mix, one you may or may not prefer, to that produced by a change in economic evaluation rules.

Principles that follow from financial analysis affect organizational arrangements. They include beneficiaries should pay; amortization should be for the life of the investment and maintenance should not be deferred and should be a component of the financing agreement; responsibility for

the project should be limited to those jurisdictions where the impacts are felt (Vaughan).

Principles that follow from economic analysis move in different directions. Benefits and costs should be defined in terms of opportunities -- ie., what else would an input earn -- not what you have to pay for an input. The prices can be wrong, indeed there may not be a cash price to be paid. Yet there is still a cost, extra-market, but still real. Only consider costs and benefits that are at stake with the decision, with vs. without, not before and after. Be sure to include all associated costs and benefit reductions regardless of who pays them. A cost should be incurred only if the benefit it creates is greater, ie., maximizing net present value. Indirect effects that would be the same if the savings were used some other way are irrelevant. Sunk costs, even though not paid for yet, are not relevant. Who pays and who gains, compensation for losers, are beside the point. What counts in the analysis is if the gainers could compensate the losers, not that they do pay them off. Using benefits to compensate losers is a poorly developed institutional role.

#### Dollars, Risk and Interest

Much of this follows from the way in which the two approaches treat monetization or appropriability, cash flow, risk and interest or discount rates.

To turn a benefit into a revenue, either a price or a tax has to be collected. In estimating a benefit for a directly consumed amenity, it is reasonable to take most of the area under the demand curve. Recreation is an example. But only fees collected -- a smaller value -- can pay off bonds. Losses of property to floods provide a guess at what people should be willing to pay to avoid them, perhaps with additions for wages lost and the trauma of some flood events, but it is unlikely that the land market works well enough to always fully reflect those costs of flooding. People don't perceive the risks accurately, and individually use different discount rates than those used for evaluation. This is some evidence that when people agree to tax themselves directly for flood control they will agree to recapture of only a fraction of the benefit. Similarly, it is clear that politicians can only increase taxes slowly -- the '70s saw unprecedented rates of tax increase and a significant backlash. Incremental benefits from a water service often are not easily linked to the incremental effect on taxes. Taxpayers do tend to want more services and lower taxes -- only logical when values get lost in the aggregation process.

Economic evaluation should be concerned with estimates of whether associated investments will in fact happen. They are usually needed to complement project investments. Will the port facilities occur along the waterway? Will the farmers put in the field drainage to use the new outlets? Will the supplemental water supply induce more intensive cropping? Such sources of variability in outcome are often studied without the perception that risk is a stake. Financial analysis, on the other hand, must deal with sources of risk explicitly.

As the history of irrigation organizations in the West testifies, the variability of such results is at the heart of financial risk. Investor

owned and financed water companies started irrigation in the West. When farm prices fell, they failed, often to be bought up at bargain prices by mutual companies organized by their customers. When these defaulted, they were apt to be replaced by public districts that could use taxing powers to secure debt. Institutional changes were spurred on by the financial market and its demand for lower risk.

Economic evaluation uses a discount rate to deal with the problem of time preference. Costs and benefits have different time patterns. How to deal with that is debated. Should the rate reflect social time preference for the benefits and costs in question, or the opportunity cost of savings or some combination? Some suggest differences in risk should be explicitly examined, not lumped into the discount rate. Risk that may affect repayment of savings is obviously a component of this interest, i.e., the price paid for savings -- as is taxation and inflation -- both usually ignored in economic evaluation.

The time pattern of fund flows is all important to finance -- outflows must be matched by accumulated inflows at each step. The patterns chosen will change in response to the price of funds. Long term payouts look less desirable in financial analysis, particularly to the lender with alternative uses for the funds.

Usually, inflation in economic analysis is assumed to affect benefits and costs equally and thus not to be a factor, but in financial analysis it may allow increases in revenue at a time when most costs are sunk. This has been more favorable than the negative effect of expected inflation on the price paid for money. But the one is a factor in hand while the other is a conjecture about the future.

#### Need to Do Regional Income Analysis

Table I (from Mugler, 1984) displays the elements in the National Economic Development Analysis (NED) version of economic analysis (Mugler, 1984). NED plans to have a variety of components and related costs that are incurred to produce intangible and nonrecoverable values (eg., a dam to withstand the Maximum Probable Flood) as long as measured benefits exceed measured costs. Labor costs are reduced for idle workers put to work. Omitted associated costs and excess benefits are a favorite target of project opponents as are discount rates that are less than the current cost of borrowing. But then adjustments for income constraints and other benefits not captured by current procedures would increase benefits. Conventional wisdom among planners has it that benefits are left on the table when the BCR is likely to be large enough to attract attention.

Regional income analysis is called for under present rules, but has not been formally accepted as an objective for plan formulation. Of course, regional income effects are often linked to political support. Components are listed in Table I. Less energy has been put toward developing policy, procedures and reliability in project level estimates for regional effects. There has been little use for them, except to discourage excessive overstatement by project supporters. But fiscal impact analysis could put them to use. And fiscal impact analysis is the basis of two important steps -- first, the identification of who locally has a stake in the project. And, with some imagination and experience, the second step is to suggest how

TABLE I

## TREATMENT OF ECONOMIC AND FINANCIAL EFFECTS

NED ANALYSIS	REGIONAL INCOME ANALYSIS	FISCAL IMPACT ANALYSIS	FINANCIAL ANALYSIS
+net increase in value of goods and services	+regional net increase in value of goods and services	+changes in sponsor revenue from increased goods and services	+changes in sponsor revenue from increased goods and services
+underemployed labor	+regional net income from implementa- tion outlays	+changes in sponsor revenue from implemen- tation outlays	-sponsor share of implementa- tion outlays, associated costs (and other
-implementa- tion outlays	+regional share of other direct benefits	-sponsor share of implementa- tion outlays	
-associated costs	-regional share of implementa- tion outlays, associated costs and other direct costs	+/-changes in sponsor revenue from associated costs, other direct costs and benefits and changes in transfer payments	
+/-other direct costs and benefits	+/-changes in transfer payments		
	+/-changes in regional net income from transfers of basic economic activity	+/-changes in sponsor revenue from transfers of economic activity, in- direct effects and induced effects	
	+/-changes in regional net income from indirect effects		
	+/-changes in regional net income from induced effects		



that stake might be translated into the revenues for the project. Regional income analysis is needed for the financial analysis.

Obviously, the planning challenge in the translation of regional income into revenue is to foster an organizational and institutional capacity building process. Agreement to tax or to change prices and estimates of how much revenue those will produce must be backed up by agreements, commitments and a higher degree of ratification and documentation. The demands upon the planning process beyond estimation and calculation are considerable.<sup>3</sup>

But these are not demands that are so unusual in the history of federal water development projects. Many regional and local sponsors have faced these kinds of problems before, if not as often and as intensively as in the foreseeable future. The point is that now the Corps, at least among the federal agencies, is faced with the choice of providing assistance to its sponsors in dealing with the financial side of their role through the addition of analytical (and organizational?) capability in its staff. The Bureau of Reclamation and the Soil Conservation Service probably have more experience at such assistance because of a rather different historical relationship to project sponsors.

This means more identification of beneficiaries and more vigorous recruitment of those beneficiaries to consent to revenue production measures. This should also mean better support for the resulting project. But it will also mean more leverage on the part of beneficiaries in the planning and operating, indeed, in the ownership of the project. Again, this is a change in degree, not kind, for the federal agencies.

If financing is to be more important, financial analysis must come with the reconnaissance stage for that stage to be a meaningful screen of feasible projects.

#### New Clients and Related Changes

Does this mean that there will be incentive to seek new clients? I suspect it may. Two examples come to mind that suggest some of the kinds of difficulties likely. Fish and wildlife enhancement is now cost-shared at 100 percent nonfederal. In other words, a project may leave net habitat values unaffected with the use of mitigation, but not enhanced unless it is 100 percent paid for by a nonfederal sponsor. Presumably, the Fish and Wildlife Service could seek separate appropriations if economies of joint development were attractive to them. But in some eastern situations, joint enhancement of drainage and wetland values may be necessary to get support for any project at all. Will the present apparent rigidities in that policy area inhibit the development of environmentally sound as well as financially feasible projects? Or will we see some attempts to loosen up the situation faced by the planning project manager? If changes are to simply reduce the requirement for mitigation, it may be counter-productive. If

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3. The reader is referred to Mark Mugler's Non-Federal Cost Recovery and Financing for Water Projects, Report Number 84-R-1, U.S. Army Engineer Institute for Water Resources, Ft. Belvoir, Virginia, 22060, for examples of the calculations for benefits and costs, revenues and expenditures for a hypothetical flood control project and for a water supply project with a variety of different financing arrangements. These should be included in the Appendix to these proceedings and this paper.

changes are to provide for some enhancement at federal expense, a truly different bargaining situation may have been achieved. Obviously, if the funds for wildlife enhancement come at the further expense of federal cost sharing for fungible benefits, it will cause sponsors to pause. The point is that this dimension in getting agreement is not automatically settled by greater local cost sharing and financial analysis.

Is rural domestic water supply a new client for this process? Small towns in some states can't obtain credit for water projects at any interest rate except from the Farmer's Home Administration whose funds have been curtailed and rates limited. There never has been substantial outreach or planning capability to meet the needs of this group. Even where they can obtain funds, the infrastructure problem -- deferred maintenance -- is substantial. There is some evidence that rural water supplies are in worse shape and more vulnerable than those in urban areas (Francis, et al.). Could the capability on the staffs of federal agencies, now that projects are fewer, make a dent in this need? But even a small start might pave the way later. The point is that some new clients and some new client relationships may increase rather than decrease the need for agency capacity.

Should there be more use of the basin account concept, i.e., funding of nonfungible or nonvendable benefits with surpluses from those features that can raise revenue (North, 1984)? It could help on the kinds of problems cited above. And who will control those accounts? If the sponsors are to pay more, they will want more control. More consultation and negotiation in the planning process!

Will the states help with all this new activity? Some feel they can do the reconnaissance stage planning more effectively now and would certainly have more effect on the final project mix if they did it. Indeed, some may be as able and perhaps more willing than the local units of federal agencies to carry out financial analysis.

Sponsors will have to have a large role if not all of the task of dealing with the investment counsellor/banker community. After all, we are talking about their obligations and -- what will become in more cases than in the past -- their project. But the federal agency as the design agency and as the guardian for the federal contribution obviously has a stake in seeing that it is done well and will be called upon to help in the beneficiary identification step.

Better handling of beneficiaries in the planning process has been a need for many years. In several reviews of projects that were never built, I came to the conclusion that if agency planners could take a page out of the book of the community organizers, more projects would be built. I suspect that is even more true now. Too many projects are designed in the district offices and not enough in city hall (Libby, Shabman b, et al). Given the limited capacity of many city halls, this also means a need for more state involvement.

In any case, state involvement will be needed to help in the lobbying needed to get the federal agencies to change their rules to facilitate more local sponsor participation. This means lobbying in the agency hierarchy -- a process that was easier when the Water Resources Council was available to provide its ombudsman role. And, of course, states can be helpful in assisting Congressional modification of rules.

Rigidities such as the "Maximum Probable Flood" design criterion will only give way if the process by which responsibility is shared facilitates it. Professional standards of the federal agencies must be maintained. A new final status for projects and process for arriving at them will probably have to evolve.

Agency planners are in a position to help states move into new roles in public works development. For example, the State of Washington has recently completed a new inventory of infrastructure needs. It includes two necessary components; reasonable technical comparability and standards and a political component to apply values to the technical alternatives. See Rutledge's paper in this same proceedings. Inventories that lack both technical and political components are not useful planning documents. They stay on the shelf. But many small jurisdictions cannot respond successfully at all without outside technical assistance. The potential role of consulting engineers is substantial since often they already serve these clients. And there is a role for federal agency assistance. New York has made good use of the Corps of Engineers in a similar inventory. Such inventories would seem to be an essential step in the full development of state arrangements for credit enhancement in support of local sponsors. In many states, credit enhancement and/or participation by the states is critical to greater nonfederal cost sharing.

Finally, the pressure for more sponsor cost sharing and the resulting emphasis on improved financial analysis suggests we are in a period where we can improve the fit of federal programs to the needs of the nation. Perhaps we can more effectively apply the traditional rationales for federal involvement:

a) The Commons problem -- federal funding should be a more effective bribe to improve behavior -- ie., induce action and investment that adds and does not merely replace what sponsors would have done anyway.

b) Scale of investment may not be as important an argument as it once was. The big projects are built. But improving organizational capacity to manage on a larger scale is the modern version of the scale argument for federal participation.

Management capacity building, particularly at the interlocal level, can substitute for some of the increase in investment capacity needed. This seems a well suited corollary objective to enhancing sponsor financial participation. The Miami Conservancy District showed the way on that as long ago as 1913 (see Shabman's paper in this same series).

c) Risk taking is more than reducing the risk for the bond holders. It is the will to try solutions that are the best of a hard lot that no banker would fund. The Federal Government will still be expected to deal with depressed regions and distressed people through public works projects. Perhaps an emphasis on financial analysis and greater nonfederal cost sharing will cause that objective to be more explicit and overt.

APPENDIX

Pro Forma Financial Analyses<sup>4</sup>

Tables II to IX provide sample financial analyses. The tables are intended to show in part the effects of project purpose, of sponsor capabilities and objectives and of financing technique on the financial feasibility of projects.<sup>5</sup> The reader is referred to Chapter IV, particularly the discussions of "Revenue Sources and Bond Security" and of "Leasing and Contracts," for descriptions of the financing techniques discussed herein.

Table II presents the economic analysis for a flood control project with deferred special assessments as the revenue source. A sponsor evaluating the financial feasibility of a flood control project in an inflationary environment should regard the inflated benefit stream as the upper limit of potential revenues.

As shown in Table III, the particular sponsor of this project can obtain 20 year special assessment bond financing. Wishing to reduce the debt load, the sponsor determines that a portion of the financing can be realized through up-front assessments. A bond anticipation note is to be used to finance construction, and interest is to be capitalized into the SA bond.

The objective of the sponsor in Table III is to minimize assessments each year, subject to the constraints that assessments increase at the rate of inflation (five percent), that cash flow be positive and that debt be paid off within 20 years.<sup>6</sup>

To achieve this objective the sponsor makes two decisions. First, it decides to use serial compound coupon SA bonds so that debt service may be matched to anticipated net revenues. (Compound coupon SSA bonds should also be considered if within the sponsor's authority.) Since the bonds in this example are special-special bonds -- a form of limited obligation -- a reserve balance is required to cover cash flow emergencies.

Second, the sponsor decides to set the level of debt such that the assessment is minimized. This level of debt may be found by successive appropriations and is shown in Table III. Were debt to be increased, assessments would need to be increased to cover out-year debt service. Were debt to be reduced, assessments would also need to be increased, in this case to assure an adequate reserve balance in the early years. (Of course, by adopting a different level of assessments during the construction period, the sponsor could affect later assessment levels.)

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4. From Mark Mugler, op. cit.

5. The tables were prepared by the author using a Visicalc (R) program on the IBM personal computer. Details are available from the author.

6. For all the examples in this section, a 50-year financial planning horizon is most appropriate. However, for the sake of simplicity, the 20-year criterion is used.

Many lenders cast a justifiably jaundiced eye on revenue projections of borrowers which are highly dependent on or sensitive to inflation. Also, the sponsor may have political difficulty adjusting assessments in increments to meet cash requirements. For these reasons, the sponsor may wish to establish an assessment and debt service schedule that is more or less constant (in nominal dollars) through time. This may be achieved through a number of techniques other than compound coupon bonds.

If the sponsor wishes to refund (refinance) the bonds after 20 years, debt service requirements and revenue requirements may be reduced and techniques other than compound coupon bonds are appropriate.

Tables IV through IX are concerned with various aspects of a water supply project. Table IV displays undiscounted, discounted and inflated costs and benefits. The inflated benefits represent the upper limit on the revenues which can be obtained by the sponsor under optimal pricing involving fixed charges, multipart variable charges and peak use surcharges.

Table V displays financial analysis of the project from the standpoint of a public sponsor (general purpose, special purpose or authority). In this example, the sponsor's objective is to minimize the revenues required for debt service, subject to the constraints that rates rise at the rate of inflation (five percent), that cash flow be positive and that debt be paid off within 20 years. The use of compound coupon bonds facilitates those objectives, and the sponsor decides to float serial compound coupon revenue bonds maturing within the 20-year period. As in the case of flood control, were the objectives and constraints to be modified, different approaches to financing would also be appropriate.

As shown in Table V, water rates which average 63 percent of the benefit to the user are sufficient to pay recurrent expenses and debt service on the bonds and to maintain an adequate reserve balance. Were the bonds to be refunded, the "benefit capture rate" could be reduced. In Table V the level of debt is set to minimize average rates; heavier borrowing would increase out-year expenses while less borrowing would result in short-term shortfalls in the reserve.

As shown in Table VI, an unregulated water company needs only a 54 percent benefit capture rate to achieve a 12 percent internal rate of return, due largely to the five-year ACRS deduction period and the ITC. (The benefit capture rate, of course, would be higher to achieve higher rates of return.)

Since the water company or its investors may have other income it wishes to shelter, it desires to bring forward in time deductions from income and to push back in time tax liabilities, even to the extent of incurring a negative cash flow for a number of years. For this reason the company decides to take out "mortgage-style" debt with high interest payments in the early years. Cash flow remains negative until the ninth year of operation, but after-tax return is very healthy the first five years due to the ACRS deductions. (The company may structure its debt in other ways to provide marginal improvements in its rate of return.)

The public sponsor in Table V, seeing that the private company can charge less and still earn a reasonable return, decides to investigate various leasing and contracting options to determine whether its rates can be reduced under those options.

Under the terms of a finance lease option (Table VII), the sponsor would pay as lease payments a predetermined series of annual payments computed to equal the revenues net of OM&R. The private company, in turn, has a mortgage-style debenture. However, under this option, the company's rate of return is only 11 percent while the sponsor is unable to reduce its rates. This option is rejected.

Under the conditional sale option shown in Table VIII, the sponsor loses the ACRS deductions but gains tax exemption for the income attributable to interest. Accordingly, the payments by the sponsor are increased in the early years to a level equal to the company's own debt obligations (the computed interest being equal to the company's explicit interest payment) and the shortfall is covered by a series of revenue anticipation notes. However, this option also yields insufficient return to the company with no reduction in rates.

The option which the public sponsor selects is to enter into a service contract with the company. Obligations for water delivery by the company are set at a level equal to anticipated use, and obligations for payment by the sponsor are set at a level equal to anticipated revenues from users. The rates may be set at some level in relation to benefits between 54 percent (the point at which it becomes worthwhile for the company -- see Table VI) and 63 percent (the point at which it is no longer worthwhile to the sponsor -- see Table V). This option eliminates the sponsor's borrowing requirements and reduces rates. Its disadvantages may be reduced through contractual provisions providing renewal options for the sponsor and a non-substitution clause for the company if a fiscal funding out clause is required.

Table IX shows the same project from the standpoint of a utility. The utility's objectives in this example are to minimize rates subject to an annual five percent inflationary rate increase, positive cash flow and retirement of debt within 20 years. Because its accounting practices differ from those of the public sponsor and the project is part of a system, the utility decides to float term bonds with level coupon payments and to establish a sinking fund for debt retirement at the end of the 20-year period. Largely due to tax factors, the interest rate it pays on debt is greater than for the public sponsor, but its front-end borrowing requirements are less. As shown in Table IX, a 59 percent benefit capture rate is sufficient to cover expenses and provide a 12 percent return.

TABLE II  
ECONOMIC ANALYSIS OF FLOOD CONTROL PROJECT

YEAR	UNDISCOUNTED:		DISCOUNTED @ 8%:		INFLATED @5%:	
	COSTS	BENEFITS	COSTS	BENEFITS	COSTS	BENEFITS
-2	20.00		23.32		20.00	
-1	15.00		16.20		15.75	
0	15.00		15.00		16.55	
1	1.00	10.00	0.93	9.26	1.16	11.58
2	1.00	10.00	0.86	8.57	1.22	12.16
3	1.00	10.00	0.79	7.94	1.28	12.76
4	1.00	10.00	0.74	7.35	1.34	13.40
5	1.00	10.00	0.68	6.81	1.41	14.07
6	1.00	10.00	0.63	6.30	1.48	14.77
7	1.00	10.00	0.58	5.83	1.55	15.51
8	1.00	10.00	0.54	5.40	1.63	16.29
9	1.00	10.00	0.50	5.00	1.71	17.10
10	1.00	10.00	0.46	4.63	1.80	17.96
11	1.00	10.00	0.43	4.29	1.89	18.86
12	1.00	10.00	0.40	3.97	1.98	19.80
13	1.00	10.00	0.37	3.68	2.08	20.79
14	1.00	10.00	0.34	3.40	2.18	21.83
15	1.00	10.00	0.32	3.15	2.29	22.92
16	1.00	10.00	0.29	2.92	2.41	24.07
17	1.00	10.00	0.27	2.70	2.53	25.27
18	1.00	10.00	0.25	2.50	2.65	26.53
19	1.00	10.00	0.23	2.32	2.79	27.86
20	1.00	10.00	0.21	2.15	2.93	29.25
SUM:	70.00	200.00	64.34	98.18	90.57	382.78
BCR:		2.86		1.53		

TABLE III  
PUBLIC FINANCIAL ANALYSIS OF FLOOD CONTROL

YEAR	B.A.N.	C.C. BONDS	CONST&FIN REVENUES COST	OM&R	PRNCPL RETIRED	COMPOUND COUPON	PRNCPL OUTSTDG	INITIAL BALANCE	INTEREST @10%	RESERVE BALANCE
-2	38.92		4.43	-20.50			38.92	22.85	2.28	25.13
-1			4.65	-15.75			38.92	14.03	1.40	15.43
0		51.80	4.88	-16.54	-38.92	-12.88	51.80	3.77	0.38	4.15
1			5.12		-1.16	-3.51	48.29	4.25	0.42	4.67
2			5.38		-1.22	-3.74	44.55	4.31	0.43	4.74
3			5.65		-1.28	-3.57	40.98	4.36	0.44	4.80
4			5.93		-1.34	-3.41	37.57	4.40	0.44	4.84
5			6.23		-1.41	-3.25	34.32	4.42	0.44	4.86
6			6.54		-1.48	-3.11	31.21	4.42	0.44	4.87
7			6.87		-1.55	-2.96	28.25	4.40	0.44	4.84
8			7.21		-1.63	-2.83	25.42	4.36	0.44	4.79
9			7.57		-1.71	-2.70	22.71	4.28	0.43	4.71
10			7.95		-1.80	-2.58	20.14	4.18	0.42	4.60
11			8.35		-1.89	-2.46	17.68	4.03	0.40	4.44
12			8.76		-1.98	-2.35	15.33	3.85	0.38	4.23
13			9.20		-2.08	-2.24	13.08	3.61	0.36	3.97
14			9.66		-2.18	-2.14	10.94	3.32	0.33	3.66
15			10.14		-2.29	-2.04	8.90	2.97	0.30	3.27
16			10.65		-2.41	-1.95	6.95	2.55	0.26	2.81
17			11.18		-2.53	-1.86	5.09	2.06	0.21	2.26
18			11.74		-2.65	-1.78	3.31	1.47	0.15	1.62
19			12.33		-2.79	-1.70	1.61	0.79	0.08	0.87
20			12.95		-2.93	-1.62	0.00	0.00	0.00	0.00



TABLE IV  
ECONOMIC ANALYSIS OF WATER SUPPLY PROJECT

YEAR	UNDISCOUNTED:		DISCOUNTED @ 8%:		INFLATED @ 5%:	
	COSTS	BENEFITS	COSTS	BENEFITS	COSTS	BENEFITS
-2	20.00		23.32		20.00	
-1	15.00		16.20		15.75	
0	15.00		15.00		16.55	
1	3.00	10.00	2.78	9.26	3.47	11.58
2	3.10	10.50	2.66	9.00	3.77	12.77
3	3.20	11.00	2.54	8.73	4.08	14.04
4	3.30	11.50	2.43	8.45	4.42	15.41
5	3.40	12.00	2.31	8.17	4.78	16.88
6	3.50	12.50	2.21	7.88	5.17	18.46
7	3.60	13.00	2.10	7.59	5.58	20.16
8	3.70	13.50	2.00	7.29	6.03	21.99
9	3.80	14.00	1.90	7.00	6.50	23.94
10	3.90	14.50	1.81	6.72	7.00	26.04
11	4.00	15.00	1.72	6.43	7.54	28.29
12	4.10	15.10	1.63	6.00	8.12	29.90
13	4.20	15.20	1.54	5.59	8.73	31.60
14	4.30	15.30	1.46	5.21	9.39	33.40
15	4.40	15.40	1.39	4.85	10.08	35.30
16	4.50	15.50	1.31	4.52	10.83	37.31
17	4.60	15.60	1.24	4.22	11.62	39.42
18	4.70	15.70	1.18	3.93	12.47	41.65
19	4.80	15.80	1.11	3.66	13.37	44.02
20	4.90	15.90	1.05	3.41	14.33	46.51
SUM:	129.00	277.00	90.88	127.91	209.61	548.67
BCR:		2.15		1.41		

TABLE V  
PUBLIC FINANCIAL ANALYSIS OF WATER SUPPLY

YEAR	B.A.W.	C.C. BONDS	CONST&FIN REVENUES COST	OM&R	PRNCPL RETIRE	COMPOUND COUPON	PRNCPL OUTSTDG	INITIAL BALANCE	INTEREST @10%	RESERVE BALANCE
-2	52.70		-20.50				52.70	32.20	3.22	35.42
-1			-15.75				52.70	19.67	1.97	21.64
0	-70.14	70.14	-16.54				70.14	5.10	0.51	5.61
1			7.31	-3.47	-3.24	-0.32	66.91	5.89	0.59	6.48
2			8.06	-3.77	-3.86	-0.81	63.05	6.10	0.61	6.71
3			8.87	-4.08	-3.91	-1.29	59.14	6.30	0.63	6.93
4			9.74	-4.42	-3.95	-1.83	55.19	6.46	0.65	7.11
5			10.67	-4.78	-3.97	-2.42	51.22	6.60	0.66	7.26
6			11.67	-5.17	-3.99	-3.08	47.23	6.69	0.67	7.36
7			12.74	-5.58	-3.99	-3.79	43.24	6.74	0.67	7.42
8			13.89	-6.03	-3.99	-4.56	39.25	6.73	0.67	7.40
9			15.13	-6.50	-3.98	-5.40	35.27	6.65	0.67	7.32
10			16.45	-7.00	-3.96	-6.31	31.31	6.50	0.65	7.15
11			17.87	-7.54	-3.94	-7.29	27.38	6.25	0.62	6.87
12			18.89	-8.12	-3.73	-7.98	23.65	5.94	0.59	6.53
13			19.97	-8.73	-3.54	-8.67	20.11	5.55	0.56	6.11
14			21.10	-9.39	-3.35	-9.38	16.75	5.09	0.51	5.60
15			22.30	-10.08	-3.18	-10.10	13.57	4.54	0.45	4.99
16			23.57	-10.83	-3.01	-10.83	10.56	3.88	0.39	4.27
17			24.91	-11.62	-2.86	-11.58	7.70	3.12	0.31	3.43
18			26.32	-12.47	-2.71	-12.35	5.00	2.22	0.22	2.44
19			27.81	-13.37	-2.57	-13.13	2.43	1.19	0.12	1.31
20			29.39	-14.33	-2.43	-13.93	0.00	0.00	0.00	0.00
			346.69		-70.15	-135.08				

(63% BENEFIT CAPTURE RATE)

TABLE VI

FINANCIAL ANALYSIS OF WATER SUPPLY FEATURES FOR AN UNREGULATED WATER COMPANY

YEAR	REVENUES	CONSTN COST	DMAR	PROP. TAX	INTEREST ON DEBT	PRNCPL PMTS	CASH FLOW	NEW DEBT	NET CASHFLOW	DEBT PRNCPL	A.C.R.S.	DEDUCTIBLES	TAXABLE INCOME	TAX CREDIT	TAX	AFTER TAX RETURN	P.V. A.T.R.
-2		-20.50					-20.50	-16.40	-4.10	-16.40		0.00	0.00	2.05	2.05	-2.05	-2.05
-1		-15.75		-0.21	-1.97		-17.93	-12.60	-5.33	-29.00		-2.18	-2.18	1.58	2.98	-2.75	-2.46
0		-16.54		-0.38	-3.48		-20.40	-13.23	-7.17	-42.23		-3.86	-3.86	1.65	3.43	-3.74	-2.98
1	6.26		-3.47	-0.53	-5.07	-0.59	-3.39	-3.05	-3.39	-41.65	-7.92	-16.99	-10.73		4.93	1.54	1.10
2	6.91		-3.77	-0.53	-5.00	-0.66	-3.05	-3.05	-3.05	-40.99	-11.61	-20.91	-14.00		6.44	3.40	2.16
3	7.59		-4.08	-0.53	-4.92	-0.74	-2.67	-2.67	-2.67	-40.25	-11.09	-20.62	-13.02		5.99	3.32	1.98
4	8.34		-4.42	-0.53	-4.83	-0.82	-2.27	-2.27	-2.27	-39.43	-11.09	-20.87	-12.53		5.76	3.50	1.77
5	9.13		-4.78	-0.53	-4.73	-0.92	-1.83	-1.83	-1.83	-38.51	-11.09	-21.13	-12.00		5.52	3.69	1.67
6	9.99		-5.17	-0.53	-4.62	-1.03	-1.37	-1.37	-1.37	-37.48		-10.32	-0.33		0.15	-1.21	-0.49
7	10.91		-5.58	-0.53	-4.50	-1.16	-0.86	-0.86	-0.86	-36.32		-10.61	0.30		-0.14	-1.00	-0.36
8	11.90		-6.03	-0.53	-4.36	-1.30	-0.31	-0.31	-0.31	-35.02		-10.92	0.98		-0.45	-0.77	-0.25
9	12.95		-6.50	-0.53	-4.20	-1.45	0.27	0.27	0.27	-33.57		-11.23	1.72		-0.79	-0.52	-0.15
10	14.09		-7.00	-0.53	-4.03	-1.63	0.90	0.90	0.90	-31.95		-11.56	2.53		-1.16	-0.26	-0.07
11	15.30		-7.54	-0.53	-3.83	-1.82	1.58	1.58	1.58	-30.12		-11.91	3.40		-1.56	0.01	0.00
12	16.17		-8.12	-0.53	-3.61	-2.04	1.87	1.87	1.87	-28.09		-12.26	4.46		-1.80	0.07	0.02
13	17.10		-8.73	-0.53	-3.37	-2.28	2.18	2.18	2.18	-25.80		-12.63	5.06		-2.05	0.13	0.02
14	18.07		-9.39	-0.53	-3.10	-2.56	2.50	2.50	2.50	-23.24		-13.01	5.69		-2.33	0.17	0.03
15	19.10		-10.08	-0.53	-2.79	-2.86	2.83	2.83	2.83	-20.38		-13.40	6.38		-2.62	0.21	0.03
16	20.18		-10.83	-0.53	-2.45	-3.21	3.17	3.17	3.17	-17.17		-13.81	7.11		-2.93	0.24	0.03
17	21.33		-11.62	-0.53	-2.06	-3.59	3.52	3.52	3.52	-13.58		-14.21	7.91		-3.27	0.25	0.03
18	22.53		-12.47	-0.53	-1.63	-4.02	3.88	3.88	3.88	-9.55		-14.63	8.77		-3.64	0.24	0.03
19	23.81		-13.37	-0.53	-1.15	-4.51	4.26	4.26	4.26	-5.04		-15.05	9.69		-4.03	0.23	0.02
20	25.16		-14.33	-0.53	-0.61	-5.05	4.64	4.64	4.64	0.00		-15.47	9.69		-4.46	0.19	0.02

INTERNAL RATE OF RETURN: 0.12

SUM: 296.83 (54% BENEFIT CAPTURE RATE) -76.29 -42.24

TABLE VII  
FINANCIAL ANALYSIS OF WATER SUPPLY FEATURES FOR A FINANCE LEASE

YEAR	PUBLIC LESSEE:				PRIVATE LESSOR:				DEDUC- TIONS	TAXABLE INCOME	AFTER TAX RETURN	P.V. A.I.R.					
	REVENUES	OMR	PURCHASE PMTS	LEASE & SALE REVENUES	CNST&IN COST	PROPERTY TAX	INTEREST ON DEBT	PRNCPL PMTS					CASH FLOW	NEW DEBT CASHFLOW	NET DEBT	PRNCPL A.C.R.S.	
-2																	
-1																	
0					-20.50	-0.21	-1.97		-20.71	-16.40	-4.31	-16.40	-0.21	-0.21	0.10	-4.21	-4.21
1	7.31	-3.47	-3.84	3.84	-15.75	-0.38	-3.48		-18.10	-29.00	-5.50	-29.00	-2.35	-2.35	1.08	-4.42	-3.89
2	8.06	-3.77	-4.30	4.30	-16.54	-0.53	-5.07	-0.59	-20.55	-42.23	-7.32	-42.23	-4.01	-4.01	1.84	-5.47	-4.25
3	8.87	-4.08	-4.79	4.79		-0.53	-5.00	-0.66	-2.34	-41.65	-2.34	-41.65	-13.52	-9.68	4.45	2.11	1.44
4	9.74	-4.42	-5.31	5.31		-0.53	-4.92	-0.74	-1.89	-40.99	-1.89	-40.99	-17.14	-12.85	5.91	4.02	2.42
5	10.67	-4.78	-5.88	5.88		-0.53	-4.83	-0.82	-1.40	-40.25	-1.40	-40.25	-11.09	-11.75	5.40	4.01	2.13
6	11.67	-5.17	-6.50	6.50		-0.53	-4.73	-0.92	-0.87	-39.43	-0.87	-39.43	-11.09	-11.13	5.12	4.25	1.99
7	12.74	-5.58	-7.16	7.16		-0.53	-4.62	-1.03	-0.30	-38.51	-0.30	-38.51	-11.09	-10.46	4.81	4.51	1.86
8	13.89	-6.03	-7.87	7.87		-0.53	-4.50	-1.16	0.31	-37.48	0.31	-37.48	-5.15	1.35	-0.62	-0.31	-0.11
9	15.13	-6.50	-8.63	8.63		-0.53	-4.36	-1.30	0.97	-36.32	0.97	-36.32	-5.03	2.13	-0.98	-0.01	0.00
10	16.45	-7.00	-9.45	9.45		-0.53	-4.20	-1.45	1.68	-35.02	1.68	-35.02	-4.89	2.98	-1.37	0.31	0.09
11	17.87	-7.54	-10.33	10.33		-0.53	-4.03	-1.63	2.45	-33.57	2.45	-33.57	-4.73	3.90	-1.79	0.65	0.16
12	18.89	-8.12	-10.77	10.77		-0.53	-3.83	-1.82	3.26	-31.95	3.26	-31.95	-4.55	4.89	-2.25	1.02	0.22
13	19.97	-8.73	-11.23	11.23		-0.53	-3.61	-2.04	4.14	-30.12	4.14	-30.12	-4.36	5.96	-2.74	1.40	0.27
14	21.10	-9.39	-11.71	11.71		-0.53	-3.37	-2.28	4.59	-28.09	4.59	-28.09	-4.14	6.63	-3.05	1.54	0.26
15	22.30	-10.08	-12.22	12.22		-0.53	-3.10	-2.56	5.05	-25.80	5.05	-25.80	-3.90	7.33	-3.37	1.68	0.25
16	23.57	-10.83	-12.74	12.74		-0.53	-2.79	-2.86	5.53	-23.24	5.53	-23.24	-3.63	8.09	-3.72	1.81	0.24
17	24.91	-11.62	-13.28	13.28		-0.53	-2.45	-3.21	6.03	-20.38	6.03	-20.38	-3.32	8.90	-4.09	1.94	0.23
18	26.32	-12.47	-13.85	13.85		-0.53	-2.06	-3.59	6.55	-17.17	6.55	-17.17	-2.98	9.76	-4.49	2.06	0.21
19	27.81	-13.37	-14.44	14.44		-0.53	-1.63	-4.02	7.10	-13.58	7.10	-13.58	-2.59	10.69	-4.92	2.18	0.20
20	29.39	-14.33	-15.05	15.05		-0.53	-1.15	-4.51	7.66	-9.55	7.66	-9.55	-2.16	11.69	-5.38	2.29	0.18
						-0.53	-0.61	-5.05	8.25	-5.04	8.25	-5.04	-1.68	12.76	-5.87	2.33	0.17
									8.87	0.00	8.87	0.00	-1.14	13.92	-6.40	2.47	0.15

INTERNAL RATE OF RETURN: 0.11

TABLE VIII

FINANCIAL ANALYSIS OF WATER SUPPLY FEATURES FOR A CONDITIONAL SALE LEASE

YEAR	PUBLIC LESSEE:		PRIVATE LESSOR:		PUBLIC LESSEE:		PRIVATE LESSOR:		PUBLIC LESSEE:		PRIVATE LESSOR:		PUBLIC LESSEE:		PRIVATE LESSOR:	
	INTEREST REVENUES	OMR SALE PMTS	LESSEE R.A.N. PRNCL	MONTAGED TAXED REVENUES	CONSTN PROPERTY COST	PROPERTY TAX	INTEREST ON DEBT	PRNCL PMTS	CASH FLOW	NEW DEBT	NET CASHFLOW	DEBT PRNCL	DEDUC-TIONS	TAXABLE INCOME	TAX	AFTER TAX RETURN
1	7.31	-3.47	-5.07	-1.23	-20.50	-0.21	-0.21	-20.71	-16.40	-4.31	-16.40	-0.21	-0.21	0.10	-4.21	
2	8.06	-3.77	-5.00	-2.05	-15.75	-0.38	-1.97	-18.10	-12.60	-5.50	-29.00	-2.35	-2.35	1.08	-4.42	
3	8.87	-4.08	-4.92	-2.39	-16.54	-0.53	-3.48	-20.55	-13.23	-7.32	-42.23	-4.01	-4.01	1.84	-5.47	
4	9.74	-4.45	-4.83	-2.14	0.00	-0.53	-5.07	-1.12	-1.12	-1.12	-41.65	-5.60	-5.60	2.58	1.46	
5	10.67	-4.78	-4.75	-1.21	0.00	-0.53	-5.00	-1.19	-1.19	-1.19	-40.99	-5.53	-5.53	2.54	1.36	
6	11.67	-5.17	-5.17	0.00	0.00	-0.53	-4.92	-1.27	-1.27	-1.27	-40.25	-5.45	-5.45	2.51	1.24	
7	12.74	-5.58	-5.16	0.00	0.00	-0.53	-4.83	-1.35	-1.35	-1.35	-39.43	-5.36	-5.36	2.47	1.11	
8	13.89	-6.05	-7.87	0.00	0.00	-0.53	-4.73	-1.45	-1.45	-1.45	-38.51	-5.26	-5.26	2.42	0.97	
9	15.13	-6.50	-8.63	0.00	0.00	-0.53	-4.62	-1.55	-1.55	-1.55	-37.48	-5.15	-5.15	2.12	1.10	
10	16.45	-7.00	-9.45	0.00	0.00	-0.53	-4.50	-1.68	-1.68	-1.68	-36.32	-5.03	-5.03	2.37	1.09	
11	17.87	-7.54	-10.33	0.00	0.00	-0.53	-4.36	0.97	0.97	0.97	-35.02	-4.89	-4.89	2.32	2.06	
12	19.39	-8.12	-11.25	0.00	0.00	-0.53	-4.20	1.68	1.68	1.68	-33.57	-4.73	-4.73	2.32	2.32	
13	21.10	-8.73	-12.22	0.00	0.00	-0.53	-4.03	2.45	2.45	2.45	-31.95	-4.56	-4.56	2.32	2.59	
14	22.30	-9.39	-13.24	0.00	0.00	-0.53	-3.83	3.26	3.26	3.26	-30.12	-4.36	-4.36	2.13	2.87	
15	23.57	-10.83	-14.28	0.00	0.00	-0.53	-3.61	4.14	4.14	4.14	-28.09	-4.14	-4.14	3.01	3.16	
16	24.91	-11.52	-15.28	0.00	0.00	-0.53	-3.37	4.59	4.59	4.59	-25.80	-3.90	-3.90	3.23	3.20	
17	26.32	-12.47	-16.35	0.00	0.00	-0.53	-3.10	5.05	5.05	5.05	-23.24	-3.63	-3.63	3.23	3.23	
18	27.81	-13.37	-17.44	0.00	0.00	-0.53	-2.79	5.53	5.53	5.53	-20.38	-3.32	-3.32	4.99	3.22	
19	29.35	-14.33	-18.55	0.00	0.00	-0.53	-2.45	6.03	6.03	6.03	-17.17	-2.98	-2.98	6.11	3.19	
20	30.95	-15.05	-19.71	0.00	0.00	-0.53	-2.06	6.55	6.55	6.55	-13.58	-2.59	-2.59	7.32	3.13	
21	32.61	-16.47	-20.92	0.00	0.00	-0.53	-1.63	7.10	7.10	7.10	-9.55	-2.16	-2.16	8.63	3.04	
22	34.34	-17.81	-22.18	0.00	0.00	-0.53	-1.15	7.66	7.66	7.66	-5.04	-1.68	-1.68	10.06	4.63	
23	36.14	-19.13	-23.49	0.00	0.00	-0.53	-0.61	8.25	8.25	8.25	0.00	-1.14	-1.14	11.62	2.91	
24	38.01	-20.35	-24.85	0.00	0.00	-0.53	-0.61	8.87	8.87	8.87	0.00	-1.14	-1.14	13.31	2.75	

INTERNAL RATE OF RETURN: 0.11



References

- Allee, David J. 1977. "Failure of the Public Market -- A Framework for Cost Sharing Policy Research," Water Resources Finance and Cost Sharing Workshop. Institute of Natural Resources, University of Georgia, Athens, Ga.
- Francis, Joseph. 1984. National Statistical Assessment of Rural Water Conditions. U. S. Environmental Protection Agency, Washington, D.C., and Department of Rural Sociology, Cornell University, Ithaca, N. Y.
- Hunt, William, et al. 1976. A Critique of the National Water Commission Analysis of Cost Sharing. Cornell Agricultural Economics Staff Paper No. 76-16, Cornell University, Ithaca, N. Y.
- Ingram, Helen. 1972. "The Changing Decision Rules in the Politics of Water Development," Water Resources Bulletin, Paper No. 72106.
- \_\_\_\_\_ and David J. Allee. 1975. "Equity and Cost Sharing -- A Neglected Opportunity for Improving Water Policy," Eleventh American Water Resources Conference Proceedings, American Water Resources Association, Bethesda, Md.
- Libby, Lawrence W. 1970. The Political Economy of Water Management: Conceptual Model and Decision Strategy for the Susquehanna Basin. Ph.D. Thesis. Cornell University, Ithaca, N. Y.
- Mugler, Mark W. 1984. Non-Federal Cost Recovery and Financing for Water Projects. U. S. Army Engineer Institute for Water Resources, Fort Belvoir, Va.
- North, Ronald M. 1984. "Internal Financing of Water Resources Projects," Proceedings, U. S. Army Corps of Engineers Seminar on Water Project Financing. Institute for Water Resources, Fort Belvoir, Va.
- Shabman, Leonard. 1983. "Non-Market Valuation and Public Policy: Historical Lessons and New Directions," Southern Natural Resource Economics Meetings. Virginia Polytechnic Institute, Blacksburg, Va.
- \_\_\_\_\_. 1973. Decision Making in Water Resource Development and the Potential of Multi-Objective Planning: The Case of the Army Corps of Engineers. Ph.D. Thesis. Cornell University, Ithaca, N. Y.
- U. S. Water Resources Council. 1975. Options for Cost Sharing: Implementation and OM&R Cost Sharing for Federal and Federally Assisted Water and Related Problems. Washington, D. C.
- Vaughn, Robert. 1984. Rebuilding America. Council of State Governments, Lexington, Ky.