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Benefit-Cost Analysis Reconsidered: An Evaluation of the Mid-State Project

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The Bureau of Reclamation has traditionally been accused of distorting benefit-cost analysis to serve political ends. Economists and other critics have usually believed that if only the theoretical tools of benefit-cost were sharpened sufficiently and its logic applied impartially by government analysts, the politics of water resource investment decisions could be neutralized. This study of the controversial Mid-State reclamation project serves both to point out the politically expedient elements of bureau analysis that remain after almost 30 years of refinement and criticism by economists and to act as a lesson to reformers who fail to recognize the limitations on benefit-cost analysis in replacing the inherently political choices of democratic government.

The Bureau of Reclamation has traditionally been accused of using the tools of economic analysis to justify decisions that have been determined politically. Economists have long been critical of the apparent manipulation of benefit-cost analysis in project planning and approval processes [Altouny, 1963; Eckstein, 1958; Freeman, 1965; Hirshleifer *et al.*, 1960; Margolis, 1957; McKean, 1958; Renshaw, 1957]. These studies conclude that the bureau tends to overstate benefits and understate costs and that this policy enables projects to be built that would not be feasible if 'proper' evaluation techniques were employed. The bureau's procedures for benefit-cost analysis are held to be deficient because they (1) omit opportunity costs of the water diverted for project purposes, (2) improperly include secondary benefits, (3) employ low discount rates, and (4) exaggerate primary benefits through the farm budget procedures by valuing farm output on the basis of support prices, by not accounting for the effects of variability in the supply of project water, and by not properly evaluating the opportunity costs of farm investment and owner-operator labor.

Although the critics of the Bureau of Reclamation correctly point out the rather cavalier use of benefit-cost analysis by that agency, they usually do not deal with a more general and important set of issues. They fail to recognize the limits of benefit-cost analysis as a means of making and judging public policy and to locate and critique the economic and political origins of water project proliferation, for which benefit-cost analysis is only a mask.

In this paper our focus is on benefit-cost analysis and its limitations. We have discussed the economic and political origins of water project proliferation elsewhere [Cicchetti *et al.*, 1973; Hanke, 1973; Walker, 1972; see also Ingram, 1971]. To illustrate both the practical application and the inherent problems of benefit-cost analysis, we reevaluate a highly controversial reclamation unit, the proposed Nebraska Mid-State project. Through this process we are able to show how the tools of economics can be used by different analysts to come to widely divergent conclusions and how many of the assump-

tions that are the basis for these differences are fundamentally of a political nature.

The Mid-State project would serve an area of highly productive agricultural land lying along the north side of the Platte River valley in south central Nebraska. It was conceived in 1943 by local farmers who believed that the project could be financed locally. The Mid-State reclamation district, encompassing 550,000 ac, was created in 1948 to carry out this purpose. Local financing was found to be impractical, and in 1954 it was proposed that a federal loan be obtained. In 1958, R. W. Beck and Associates, consulting engineers, prepared a complete project study, which estimated construction costs at \$74 million [Beck, 1958]. Even with a federal loan the project had become unfeasible on a local basis. Therefore the district sought the aid of the Bureau of Reclamation.

The bureau in turn sought financial support for the Mid-State project. The project was made a division of the Missouri Valley project in order that surplus power revenues from other divisions could be used to finance a portion of the project. After a long delay in authorization due to the poor financial status of the Missouri Valley project the repayment status of Mid-State was finally secured, and the project was authorized by Congress in 1967. Funds for construction have not been appropriated yet.

When the Mid-State project was first proposed, there were only 1300 irrigation wells in the district and an abundance of high-quality land remaining to be brought under irrigation. The Mid-State project was originally proposed as a means of finishing the job of irrigation, but this objective has been achieved in the meantime without additional supplies of surface water. While the Mid-State project languished on the drawing boards and in Congress, individual farmers continued to drill wells and irrigate new acreage. Today there are more than 5600 wells, and virtually all land in the district has been developed; it is now questionable whether the bureau will be able to find the required number of farmers to contract for project water on new lands. In the face of this changed situation the primary justification for the Mid-State project has turned from expanding irrigated acreage into a 'rescue' operation.

The Mid-State project is now the subject of heated debate in which (1) the bureau and its supporters claim that existing groundwater supplies are being depleted by excessive pumping by individual farmers and therefore additional water should be diverted from the Platte River and (2) the majority of local farmers now oppose the project, arguing that water from the Platte is not needed to supplement existing groundwater supplies. Recently, a third factor has entered the controversy: the rising sensitivity of the public to the deleterious environmental effects of diverting most of the remaining water in the Platte River. There is little in the private vocabularies of the parties involved to reconcile these three viewpoints. Records from sample wells in the area are mainly over short periods, often contradictory, and generally inconclusive. Local groundwater experts from the U.S. Geological Survey are unwilling to support either side in the dispute. The effects of the project on environmental values are also inconclusive.

It was initially our belief that economic analysis could break the deadlock because the language of economics, as expressed in benefit-cost analysis, can reduce most effects to the common measure of exchange value. What we found, instead, was that although economic analysis focused attention on issues of reclamation policy that had previously been ignored by the antagonists involved in the dispute over this particular project, benefit-cost analysis cannot resolve conflicts between incommensurable values and objectives, such as environmental preservation and irrigation development on the Platte River. Benefit-cost analysis is not a strictly objective method for guiding public policy decisions, one that eliminates the need for the political resolution of social conflicts. It is not, in the metaphor of Richard Hammond, 'a kind of intellectual cake-mix, complete with instructions for use' [Hammond, 1966]. On the contrary, subjective valuations lay the basis of the technical analysis in the form of predictions about the future, evaluations of the performance of markets, beliefs about the economic role of the state, etc. Basic disagreement on these issues cannot be avoided, regardless of the degree of technical refinement.

In the following pages we attempt to illustrate why we believe that benefit-cost analysis is not a purely objective approach to decision making. The reevaluation of the Mid-State project highlights some of the major sources of conflict. From this analysis, conclusions are drawn with regard to the significance of the discrepancy between the bureau's benefit-cost figures and those generated here.

PROJECT EVALUATION

Plan

The authorized plan for Mid-State includes (1) a diversion dam on the Platte River; (2) a main supply canal, which can also carry off flood waters from Buffalo and Stevens creeks; (3) a system of 23 interconnected reservoirs in the ravines along the north side of the valley with a combined irrigation conservation capacity of 289,000 ac ft; (4) four canals, or floodways, for distributing irrigation water and carrying off flood flows from the reservoir system to the Platte River; (5) an irrigation distribution system; (6) large pumps situated along the canals to provide supplemental water at times of peak demands (up to 50% of total); and (7) recreation and fish and wildlife developments, including a federal wildlife refuge on the Platte River [U.S. Congress, 1967].

Much of this plan is no longer current. The bureau has several years following the authorization of a project in which

to produce a definite plan report in which final project plans are presented. However, the bureau is not required to submit a new benefit-cost report, regardless of changes that might be made in the project plans. In the case of Mid-State the plan conceived by Beck [1958] was found to be technically unsound owing to anticipated excess seepage and the structural weakness of the ravines in which the reservoirs were to be built. This disclosure was made after project justification and authorization. The bureau has indicated that the number of reservoirs will be reduced to two, one on the Wood River and another on Prairie Creek.

Benefits and Costs: The Bureau's 1967 Analysis

The tentative nature of the project plan does not necessarily preclude a meaningful reevaluation based on available data on project benefits. The project has been authorized to provide a specific service, the delivery of a given amount of water, regardless of the number of reservoirs. On the cost side of the ledger there are two reasons why the redesigned project will not cost less than the original one: (1) the original plan was presumably selected because it was the least cost system of providing water to the district (this is not to say that the original plan is the least cost solution to the water problems of the Mid-State district but only the cheapest method of providing a diversion of surface water), and (2) the bureau has a record of underestimating costs, as verified by the bureau's own studies made in 1951, 1955, and 1960. The last report included 128 projects initiated between 1935 and 1960. More than 75% of the projects in this group showed cost overruns, and the group as a whole exceeded original cost estimates by 72% [Haveman, 1972]. Inflation increased estimated costs of the Mid-State project from \$72 million to \$112 million between 1958 and 1967 and has undoubtedly taken a further toll since then.

Therefore throughout the analysis we use the 1967 estimate of \$112 million for construction costs and \$863,000 for annual operation, maintenance, and repairs. Similarly, the starting point in evaluating the benefits of the Mid-State project will be the bureau's 1967 analysis.

The 1967 reevaluation statement of the Mid-State project indicates that annual costs of the project are expected to be \$4,543,000, whereas annual benefits are estimated to be \$5,661,000. Since the alleged benefits exceed the costs (a benefit-cost ratio of 1.24 to 1.00), the project has been designated as 'justified.' On the basis of existing data and a less favorable choice of criteria and parameter values the results can be changed substantially. If liberal assumptions regarding economic parameters are made the benefit-cost ratio of the project is 0.87. Under more severe, although not unrealistic, postulates the benefit-cost ratio falls to 0.23.

The Mid-State project proposes to supply an average of 1.66 ac ft of water per acre per year to an area of 140,000 ac. This amount of water is considered adequate to grow a crop based on the Lowry-Johnson method of estimating consumptive use [Beck, 1958]. The 140,000 ac is divided into 44,000 ac of 'new land' (dryland farming converted to irrigation) and 96,000 ac of irrigated land receiving 'supplemental water' (converted from pumping to project water). In addition, another 163,000 ac of previously irrigated land is projected to benefit from stabilized groundwater levels.

The benefit and cost figures for the project are summarized in Table 1. The following is a brief explanation of each entry under benefits and costs:

1. Direct benefits of new lands (44,000 ac) of \$59.86/ac

TABLE 1. 1967 Bureau of Reclamation Benefits and Costs for the Mid-State Nebraska Project

Description	Value, \$
Benefits	
44,000 ac, dry farming to irrigation, direct benefits, \$59.86/ac	2,471,000*
44,000 ac, dry farming to irrigation, secondary benefits, \$12.11/ac	204,000†
96,000 ac, pumping to project water, \$12.17/ac	1,096,000*
163,000 ac, balance of irrigated lands, benefiting from groundwater stabilization, \$5.05/ac	772,000*
Recreation	
General use for 300,000 days	156,000
Boating for 27,000 days	15,000
Camping for 9,000 days	4,500
Total	175,500
Fish and wildlife	
Fishing	306,000
Hunting	24,000
Trapping	12,000
Annual equivalent investment (\$2,540,000) in lands for wildlife refuge	83,000
Total	425,000
Flood control	518,000
Total annual benefits	5,661,500
Costs	
Annual equivalent investment costs (\$112,334,000 at 3½%)	3,680,000
Annual operation, maintenance, and replacement costs	863,000
Total annual costs	4,543,000
Benefit-cost ratio	1.24

Data are taken from *U.S. Congress* [1967].

* Irrigation benefits are discounted by 0.938 to take account of 5-year development lag before full benefits are realized; 5 years is probably an optimistic figure.

† Actual figure for secondary benefits is \$500,000, but the bureau has chosen to subtract disbenefits (primary and secondary) from lands lost to project right-of-ways, reservoirs, etc., rather than show them as a separate figure.

were calculated by the bureau in April 1962 on the basis of new bureau evaluation standards of August 1961. (The new standards allowed an increase of \$38.56/ac from the previous calculation of \$21.30.) This figure represents an increase in net farm income associated with switching from dryland to irrigated farming. It was derived by using modified farm budget studies from the nearby North Loup project.

2. Indirect (secondary) benefits of new lands (44,000 ac) are said to be net profit added to processing, marketing, and farm supply industries by the increased agricultural production in the project area (see section on secondary benefits for the method of calculation). The actual figure for secondary benefits is \$500,000, but the bureau has judiciously chosen to subtract the costs of land lost to project right-of-ways, reservoirs, etc., from secondary benefits rather than show these costs as a separate figure.

3. In the case of land receiving supplemental water (96,000 ac) the bureau predicts a decline in groundwater for the Mid-State district. The estimate of long-run future pumping costs for 1.66 ac ft/ac/yr without the Mid-State project is \$12.17. When the 96,000 ac in this category is shifted from pumping to project water, the amount of \$12.17 is freed for other expenditures, including project water purchase.

4. In the case of land benefiting from groundwater stabilization (163,000 ac) the value of groundwater stabilization is the difference between the estimated long-run costs of pumping 1.66 ac ft/ac/yr with and without the project (stabilized versus declining water levels). The bureau's projections are \$7.15 and \$12.17, and the difference is \$5.05 (sic).

5. Recreation benefits were estimated by the National

Park Service. In the Beck report the amount was \$480,000, but a review by the park service in 1963 lowered it to \$175,000, owing in part to revised standards and procedures for evaluating recreation and also to the increased supply of reservoir recreation developments in central Nebraska.

6. Fish and wildlife benefits were estimated by the Bureau of Sport Fisheries and Wildlife for the Beck report and reviewed in 1963. The subsectors are self-explanatory except for the annual equivalent investment for a proposed wildlife refuge. The benefits of such a refuge were felt to be intangible and at least equal to its cost (capitalized).

7. Flood control benefits were originally estimated by the U.S. Army Corps of Engineers in 1951; they have not been changed substantially since then.

8. Total construction costs are capitalized by using an interest rate of 3.125% for a 100-year period to obtain an annual equivalent investment at year zero. All bureau benefit-cost calculations are done on an annualized basis by abstracting from dynamic changes over time such as price inflation, movements in demand, or technological change.

Reevaluation

The Bureau of Reclamation's analysis of the benefits and costs from the Mid-State project can be altered substantially through a reappraisal of certain economic assumptions and procedures. We have based such a reevaluation upon what we believe to be the dominant opinion of the economics profession and a critical view of certain logical procedures of the bureau's analysis. On the basis of the following three factors one would conclude that the Mid-State project is an unsound

investment: (1) the discount rate used in the analysis is inappropriately low, (2) multipurpose benefits from flood control and fish and wildlife enhancement have been overstated, and (3) 'new lands' do not yield significant net national benefits.

Discount rate. The discount rate to be used in calculating the present values of benefits and costs of federal water resource projects has long been of great concern to federal agencies and their cliental groups [Fox and Herfindahl, 1964]. Given the time stream of benefits and costs of most water projects, this concern is warranted; net-outlays occur early in the life of a project, whereas net benefits start to accrue only after some lapse in time. Therefore the net benefits are extremely sensitive to changes in the rate of discount.

The Mid-State project was last evaluated in 1967 at a discount rate of 3.125%. At that time, discount rates for project analysis by all federal water agencies were derived from the average rate of interest payable by the treasury on outstanding long-term government bonds. This policy was thought to reflect the cost of capital for federal investments. Even granting the validity of a purely financial criterion, one finds that the agencies were able to keep the interest rate artificially low by using the coupon rates on bonds of long maturity rather than using current yields [Krutilla, 1969]. For example, the discount rate used in 1967 was 3.125%, but the current yield that same year was 4.85%. At this latter rate of interest the benefit-cost ratio of Mid-State would have been only 0.89. This situation suggests that a seemingly minor difference in the definition of bond yields may have had a significant effect on the pattern of project approval over the past 2 decades.

Federal policy regarding discount rates has changed considerably since the Mid-State project was authorized. Since the Water Resources Planning Act of 1965 [U.S. Congress, 1965] the Bureau of Reclamation and other water-related agencies have been under the purview of the Water Resources Council (WRC), which is now responsible for setting procedural guidelines for project evaluation. In December 1968 the WRC made the change from long-term averages to current yields on treasury bonds as the relevant interest rate. As of 1971 this method yielded a 5.375% rate. This change in policy contains a grandfather clause that exempts projects already authorized but not constructed from being re-evaluated by using the new discount rate. Mid-State falls into this category of lame duck projects.

In its latest revision of project evaluation procedures [Water Resources Council, 1971] the WRC proposed a further increase in discount rate to 7% based on a belief that the best measure of the cost of federal investment capital is not the cost of federal borrowing but the 'opportunity cost' of resources diverted from use by the private sector. However, many congressmen are balking at approving the new WRC standards; they recognize that a 7% discount rate is likely to cause a significant decrease in the number of acceptable water projects [Walker, 1972].

According to the Office of Management and Budget the opportunity cost of public funds raised through taxation of the private sector is 10%. Most federal agencies must use this rate in project analysis. Although the opportunity cost idea is still open to question on theoretical grounds [Hammond, 1966; Marglin, 1963] and to several interpretations on method of computation [Haveman, 1969; Krutilla and Eckstein, 1958; Baumol, 1969; Stockfish, 1969], it has become a widely accepted guideline for public investments [U.S. Congress, 1968].

We have calculated the effects of several different interest

rates on the benefit-cost ratio of Mid-State (Table 7). In addition, the period of analysis was lowered in the calculations from 100 to 50 years. The bureau is the only water agency still using the longer period, in the belief that 100 years is more nearly the expected life of its projects. This is confusing physical life with economic life. At the current rate of technological change it is doubtful whether projects built according to today's economic criteria can operate efficiently even 50 years hence. Furthermore, prediction of future economic variables is tenuous enough without straining our powers of projection unnecessarily [Hammond, 1966].

At high rates of interest the future is so rapidly discounted that the difference between 50- and 100-year periods of analysis is not too important, but at the low rates traditionally used by the bureau the difference can be quite significant. If 3.125% is used, the Mid-State project has a benefit-cost ratio of 1.24 for 50 years but only 1.07 for 100 years. Whereas the bureau's presentations of the project before Congress in 1962 and 1964 included both 50- and 100-year estimates, the 1967 report omitted the less favorable 50-year figure.

If the Mid-State project were being evaluated by using today's rate of 5.375%, it would fail the test of economic viability for both 50 and 100 years, with a benefit-cost ratio of 0.87 for 50 years. At the higher rates of 7% (WRC recommendation) and 10% (Office of Management and Budget requirement) the project fails by a larger margin, with benefit-cost ratios of 0.63 and 0.46, respectively (Table 7).

It is often argued by Congress and water resource agencies that administrative costs make it unreasonable to expect all projects to be reevaluated constantly as changes occur in economic parameters and evaluation procedures [Walker, 1972]. Yet the bureau was willing to make the necessary changes in parameters for Mid-State when they sought authorization for the project in 1960, 1962, 1964, and 1967. Should the original analysis [Beck, 1958] have been left unaltered because of the administrative costs of revising it? On the contrary, there is no reason why significant changes (such as those that have occurred in the interest rate since 1967) cannot be taken into account by a reevaluation at the time of appropriation hearings when the definite plan report is completed. This is particularly true of irrigation projects because of the time lag between authorization and appropriation. The logic of benefit-cost analysis demands such an updating, regardless of the politics of project authorization.

Multipurpose benefits: flood control, recreation, and fish and wildlife. Federal water resource policy is predicated on the concept of multiple purpose development. This symbolic goal is ambiguous, and hence the calculations attending multipurpose projects are easily distorted to camouflage economically questionable irrigation projects. In this section we will review the three areas of nonirrigation benefits that have been claimed for the Mid-State project: flood control, recreation, and fish and wildlife.

1. Flood control benefits must be reassessed in light of the new Mid-State plan. The flood threat in the Mid-State area is not from the Platte River but from the various creeks and washes coming out of the hills north of the irrigation district. The reduction in the number of dams from 23 to 2 clearly reduces the capacity of the project to check flooding.

Dams will remain on the Wood River and Prairie Creek, and the main diversion canal from the Platte River will still be capable of diverting the flood flows of Buffalo and Spring creeks. We have extracted the relevant damage values from the Beck report, which were provided by the U.S. Army

Corps of Engineers. The remaining flood benefits for the Wood River, Prairie Creek, and Buffalo and Spring creeks amount to \$296,000, \$18,000, and \$27,400, respectively. The total flood control benefits for the new Mid-State project plan will be \$341,400 rather than \$518,000.

2. Recreation benefits are also affected by the new plan. The reduction in amount of surface and shoreline area that will result from fewer reservoirs will eliminate much of the recreation potential. Moreover, the increased severity of water level fluctuations in the storage reservoirs may worsen the quality of recreation. However, since we cannot reconstruct the original analysis, we cannot make an appropriate adjustment for the probable reductions in recreation benefits.

3. Fish and wildlife benefits claimed for the Mid-State project have been overstated. One of the most important objections to the project is its damaging effect on the Platte River wildlife environment. A study by the Bureau of Sport Fisheries and Wildlife shows that if the Mid-State diversions had been attempted over the period of record (1931-1960), the Platte River would have been dried up 184 out of 360 months. In 7 of the 30 years there would be no flow in the river for the entire 12 months. Hence if Mid-State were allowed to divert the proposed amount of water for irrigation, waterfowl habitat would be eliminated from the diversion dam to the confluence of the Loup River, 150 mi downstream. The in-stream fishery would be destroyed, central flyway would be disrupted, and several rare or endangered species, including the whooping crane, the sandhill crane, and the bald eagle, would be jeopardized further.

The water of the Platte River has many demands for its use and should not be treated as if it were a free good with no opportunity costs. In many areas, for instance, water diverted by

the bureau for agriculture has alternative uses at a much higher value in municipal and industrial sectors. Water also has both aesthetic and economically significant uses if it is left in stream for fish, wildlife, and recreation [Knetsch, 1971]. It may even be reused downstream for further irrigation. There is no economic validity in the common misconception that the water of the Platte River is 'now being wasted in the Gulf of Mexico' [U.S. Congress, 1964].

Nonetheless, the bureau's benefit-cost analysis takes no account of opportunity costs of water. Whenever a project will cause damage to wildlife and recreation, as Mid-State will, the bureau has been adverse to including these costs in its economic analysis. Sometimes it engages in 'mitigation of damages' and then illogically counts the added costs of mitigation measures as benefits. This is the case with the proposed wildlife refuge in the Mid-State plan. (However, the U.S. Geological Survey report on this proposed refuge makes the refuge appear unfeasible owing to the water balance between the wet meadows and the Platte River and to their concurrent dewatering [Keech, 1964].)

Because the mitigation of damages approach is inadequate in the Mid-State case, the Bureau of Sport Fisheries and Wildlife has said that it will oppose the project unless minimum flows are bypassed at the Mid-State diversion dam. The Bureau of Sport Fisheries and Wildlife has reevaluated the Mid-State project to take into consideration such tangible costs as in-stream fishery losses, river and wetland hunting and trapping losses, and the cost of restocking the reservoir fisheries when they periodically become dry. This reevaluation shows net negative benefits of \$347,400 (U.S. Department of the Interior, unpublished manuscript, 1971) (Table 2). However, this figure does not include the intangible costs of lost sandhill cranes, eagles, etc.

TABLE 2. Bureau of Sport Fisheries and Wildlife Environmental Evaluation of the Mid-State Project for Nebraska

	Acres Lost	Man-Days of Loss		Man-Days Gain In Fishing	Economic Value, \$		Net
		Hunting	Fishing		Loss	Gain	
Habitat							
Wet meadows	29,317						
Platte River	28,232						
Timber and shrub	27,513						
Hunting							
Waterfowl		33,532			100,596		-100,596
Upland game		16,919			42,276		-42,276
Big game		14,640			58,560		-58,560
Fur value					49,494		-49,494
Fishing							
Platte River			4,725		4,725		-4,725
Wood River			1,000		1,000		-1,000
Sand pits and lakes			6,988		6,988		-6,988
Bureau of Reclamation reservoirs							
Amherst				86,000		62,071	+62,071
Upper Prairie Creek				23,440		17,327	+17,327
Miscellaneous							
Leases for waterfowl hunting sites on Platte River					150,000		-150,000
Total	85,061	65,091	12,713	109,440	413,639	79,398	-334,241

In order to realize the full reservoir fishery benefits an average annual fish-stocking program costing \$13,195 must be implemented. Therefore the net grand total economic value is -\$347,436.

Source of data is U.S. Department of the Interior (unpublished manuscript, 1971).

The bureau has refused to meet the minimum flow standards for wildlife because there is not enough water in the Platte to do this and still provide the irrigation-water promised in the congressional authorization of Mid-State. Therefore we use the figure of -\$347,000 for fish and wildlife costs of the project. With the reductions in benefits from flood control and fish and wildlife the estimated benefit-cost ratios for the Mid-State project decline to a high of 0.89 at 3.125% (50 years) and to a low of 0.38 at 10% (Table 7).

New lands benefits. The bureau proposes to convert 44,000 ac of dry-farming land to irrigation in the Mid-State project area. (There is some question whether this much land remains unirrigated in the district because 14 years has elapsed since the estimate was made.) For the economic justification of the project the benefits from these 'new lands' are essential, amounting to \$2,471,000, or 43% of the total benefits.

The bureau calculates the benefits from increased farm output in a project area by means of farm budgets. These are simulated input-output accounts for one or more 'average' types of farms in the area (for the Mid-State project, 170-, 360-, and 800-ac farms were used). Estimates are made of cropping patterns, yields, sales value, and costs of inputs, and these data are used to calculate net farm income with and without project water. The difference in aggregate farm net income with and without the project represents net primary benefits for 'new lands.'

The productivity data presented in the farm budgets are presumably accurate, although in this case the bureau deviated from normal procedure. Instead of making an in-depth survey prior to the economic evaluation of the project it adapted the information from the farm budgets of the North Loup project, which is located 100 mi north of the Mid-State area. In the reevaluation of the Mid-State farm budgets that follows, only the economic, not the productivity, variables have been altered.

The bureau can be disputed for its treatment of three important variables in the farm budgets: the value (price) of farm products, the interest rate for farm borrowing, and the opportunity cost of owner-operator labor.

Under a regime of government price and output controls in the agricultural sector, prevailing commodity prices are not an acceptable measure of market value for purposes of benefit-cost analysis because they include a significant proportion of transfer payments to farmers. Recognizing this situation, the WRC issued a new set of price guidelines in 1966, known as 'adjusted normalized' prices, which were considerably lower than previous price schedules used by the agencies in project evaluation (Table 3).

Tables 4 and 5 show the results of using adjusted normalized prices in the Mid-State farm budgets. These values would have been obtained if the bureau had reevaluated the Mid-State project prior to its authorization. Yet, the 1967 reevaluation statement [*U.S. Congress, 1967*] makes no mention of the WRC guidelines issued the year before.

Table 6 summarizes the calculations of net benefits from new lands. Two changes of lesser impact have also been made in arriving at the final figures. First, the cost of farm borrowing has been raised from 5 to 7.5%. A 5% interest rate can only be obtained on subsidized loans from federal agencies such as the Federal Home Administration. The market rate, on the other hand, is approximately 7.5% (Federal Land Bank, personal communication, 1972). Second, the opportunity cost of owner-operator labor has been raised from \$0.51/hour to

TABLE 3. Price Schedules for Farm Budget Evaluation

Commodity	Pre-1966 Bureau of Reclamation Prices,* \$	Adjusted Normalized Prices,†‡	Unit of Measure
Corn	1.48	1.06	bushel
Wheat	1.70	1.27	bushel
Oats	0.79	0.58	bushel
Alfalfa	18.36	17.82	ton
Hay (wild)	15.74	15.74‡	ton
Pasture	4.00	4.00‡	ton
Sugar beets	14.79	12.17	ton
Beet tops	11.14	9.16	ton
Culled cows	11.47	11.47‡	cwt
Fat cattle	22.42	22.55	cwt
Sows	17.76	17.76‡	cwt
Fat hogs	16.99	15.05	cwt
Poultry	0.20	0.15	pound
Eggs	0.35	0.25	dozen
Butterfat	0.61	0.58	pound

* Note that these figures were the basis upon which the Mid-State project farm budgets (Bureau of Reclamation, unpublished data, 1961) were analyzed.

† Adjusted normalized prices were taken from interim price standards (U.S. Water Resources Council, unpublished data, 1966).

‡ Series was completed by using unchanged bureau prices.

\$1.25/hour. According to the bureau's calculations the introduction of irrigation will require a small increase in labor time required. The cost of this added time is the alternative labor opportunities forgone outside the farm (e.g., as hired help at \$1.25), not the average return to family labor on the farm itself (approximately \$0.50). In this case the opportunity cost of owner-operator labor is not significant (\$81,600), but in projects that bring uncultivated land into production this economic cost can be significant. For example, the Ainsworth project, located in northwest Nebraska, was shown to yield negative benefits as a result of the increased opportunity cost of owner-operator labor [*Freeman, 1966*].

The impact of new lands benefits from correcting the three most tractable variables in the farm budgets, prices, interest, and labor cost, is substantial. The original benefit estimate of the bureau, \$2,470,700, falls to \$1,136,400. Had the Mid-State project been reevaluated in 1967 by using adjusted normalized prices, which had been issued a year earlier, the resulting benefit-cost ratio would have been only 0.95 (all other things held constant), and the project could not have been approved by Congress.

Note on Secondary Benefits

In arriving at final benefit-cost figures we have eliminated secondary benefits associated with new lands benefits because there is no a priori reason to believe that secondary benefits actually result from the Mid-State project and no empirical evidence to the contrary has been put forward by the bureau in any of the documents concerning the project. Secondary benefits are defined by the bureau as the added net profits of agricultural supply and processing industries brought about by the increased productivity of the project area. The actual method of computation is a simplified system of multiplication factors for each crop applied uniformly to every project, regardless of actual conditions among secondary industries; e.g., 83% of the increase in direct cotton benefits equals secondary benefits from cotton. However, as *Margolis [1957]* has shown, the definition and estimation of true secondary

TABLE 4a. Gross Farm Income in Mid-State Area Without Project Based on Adjusted Normalized Prices

Commodity	Total Output, \$	Farm Use, \$	Home Use, \$	Sales, \$
Corn	981,200	751,600	0	229,600
Wheat	366,300	30,400	0	335,900
Oats	161,500	54,900	0	106,600
Alfalfa	365,300	365,300	0	0
Hay (wild)	124,300	124,300	0	0
Pasture	282,200	282,200	0	0
Total	2,280,800	1,608,700	0	672,100
Culled cows	115,300	0	0	115,300
Fat cattle	1,799,700	0	0	1,799,700
Sows	158,100	0	0	158,100
Fat hogs	805,800	0	0	805,800
Poultry	67,100	0	6,300	60,800
Eggs	157,900	0	10,000	147,300
Butterfat	183,200	0	26,400	156,800
Total	3,287,100	0	42,700	3,243,800
Grand Total	5,567,900	1,608,700	42,700	3,915,900

Source of data is Mid-State project farm budgets (Bureau of Reclamation, unpublished data, 1961). Prices were changed as indicated in Table 3.

benefits are far more complex than the bureau's standardized approach.

In order for secondary benefits to exist, secondary industries must either be suffering from secular stagnation and underemployment or be able to take advantage of economies of scale due to the expansion of farm output. Otherwise, increased profits in one industry or in one region will be no more than transfers of economic activity from some other industry or region. Since there is no evidence that the conditions put forward by Margolis exist in the prosperous Mid-State area, secondary benefits have been eliminated from the analysis because they represent pecuniary transfers and not real effects.

We can now combine the effects of the above alterations in the bureau's analysis. By using adjusted normalized prices for direct new lands benefits, eliminating secondary benefits, and taking account of fish and wildlife losses the benefit-cost ratio for the Mid-State project is lowered to a high of 0.63 at the original 3.125% interest rate and a low of 0.23 at a 10% interest rate. Table 7 contains a summary of results. From these figures it appears that the Mid-State project is a poor investment for the nation.

ADDITIONAL PROBLEMS OF NEW LANDS BENEFITS AND BUREAU POLICY

The preceding revisions of the farm budgets for the Mid-State project do not by any means resolve satisfactorily all the problems attending a logically complete benefit-cost analysis of increased farm output from a reclamation project. The implicit assumption behind the bureau's analysis is that the expansion of irrigated agriculture in the West takes place in a vacuum. This assumption has for years allowed the bureau to proceed in its policies as if the Department of Agriculture did not exist and, ignoring the obvious implications of government support and control of the agricultural market, to continue to use artificial support prices as an index of the 'value' of additional farm output from reclamation. Reclamation does not operate in a vacuum but affects the agricultural market and agricultural support costs nationwide.

Government programs such as acreage retirement, price maintenance, and community purchases not only create in-

come transfers to farmers (their main objective) but entail real resource costs in the form of storage, insurance, depreciation, and interest. Although transfer payments do not affect economic efficiency and therefore do not enter into benefit-cost calculations, the second category of resource costs does merit attention. In the United States in the early 1960's, interest and storage costs alone were approximately \$1 billion annually [Metcalf, 1966]. The share of this cost that can be attributed to reclamation is uncertain, but it is not insignificant according to the most thorough study of the matter to date by *Howe and Easter* [1971]. They estimate that \$83-179 million in annual payments to farmers under three major programs (diversion payments plus price support and certificate payments for cotton, wheat, and feed grains) can be attributed to output on reclamation-served land brought into production between 1944 and 1964; furthermore, if all other Department of Agriculture supply control and price support programs were taken into account, these figures would probably more than double [Howe and Easter, 1971]. Howe and Easter also contend that their estimates have been calculated so as to approximate real costs exclusive of transfers.

An additional problem associated with the assessment of new lands benefits arises from the fact that agriculture in

TABLE 4b. Net Farm Income in Mid-State Area Without Project Based on Adjusted Normalized Prices

	Value, \$
Gross farm sales*	3,915,500
Farm perquisites	229,100
Gross farm income	4,144,600
Annual equivalent cost of total farm investment (\$21,007,900) at 7.5% interest	1,619,100
Other expenses	2,508,400
Total expenses	4,127,500
Net farm income (gross farm income minus total expenses)	17,100

* Taken from Table 4a.

TABLE 5a. Gross Farm Income in Mid-State Area With Project Based on Adjusted Normalized Prices

Commodity	Total Value, \$	Farm Use, \$	Home Use, \$	Net Sales, \$
Irrigated				
Corn	2,826,600	1,142,000	0	1,684,600
Oats	133,300	59,200	0	74,100
Alfalfa	344,900	298,000	0	46,900
Sugar beets	915,200	0	0	915,200
Beet tops	68,700	68,700	0	0
Total	4,288,700	1,567,900	0	2,720,800
Nonirrigated				
Corn	444,600	0	0	444,600
Wheat	133,900	32,800	0	101,100
Oats	79,100	0	0	79,100
Alfalfa	303,800	153,400	0	150,400
Hay (wild)	113,300	67,900	0	45,400
Pasture	278,400	278,400	0	0
Total	1,353,100	532,500	0	820,600
Culled cows	116,000	0	0	116,000
Fat cattle	2,693,200	0	0	2,693,200
Sows	139,300	0	0	139,300
Fat hogs	1,036,300	0	0	1,036,300
Poultry	72,400	0	6,800	65,600
Eggs	170,300	0	11,300	159,000
Butterfat	197,500	0	28,400	169,100
Total	4,425,000	0	46,500	4,378,500
Grand total	10,066,800	2,100,400	46,500	7,919,900

Source of data is Mid-State project farm budgets (Bureau of Reclamation, unpublished data, 1961). Prices were changed as indicated in Table 3.

irrigated regions has displaced agriculture in other regions. The national pattern of agriculture has been altered by the expansion of reclamation in the West. Concurrent with western growth has been the decline of farming in the South and Northeast. Between 5 and 17 million ac in the latter regions is estimated to have been displaced by the increase in bureau project lands in the West (approximately 19 million ac) [Howe and Easter, 1971]. The estimated cost to those regions in terms of income forgone is from \$50 to 170 million [Howe and Easter, 1971]. A less tangible cost is the displacement of the farmers who worked this land. Tolley [1959] has estimated that 1 out of every 20 farmers in the South has been displaced by irrigation in the West.

It might be shown that the irrigated lands of the West have a comparative advantage over their southern and eastern counterparts, that is, greater natural productivity due to soil or climate, or greater potential for realizing returns to scale. If the West did have such an advantage, then net benefits to the

nation might result from displacing southern and eastern farming. But net benefits would still have to be calculated by subtracting costs created by additional failing farms in the East and South because farm labor and capital are rather immobile and are often unemployed for some period of time after a farm is abandoned. Benefits calculated in this way would be considerably less than the gross benefits presently computed by the bureau. However, one must also consider the possibility that the comparative advantage runs the other way: Ulrich [1953] estimated that for one-seventh the cost of the Columbia Basin project in Washington an equal amount of acreage and equivalent production could be generated by reclaiming semiwoodland in the Virginia piedmont.

It cannot therefore be decided a priori whether or not increased reclamation in the West is economically efficient. This is an empirical question but one that has not been answered by the benefit-cost analysis performed by the Bureau of

TABLE 5b. Net Farm Income in Mid-State Area With Project Based on Adjusted Normalized Prices

	Value, \$
Gross farm sales*	7,919,900
Farm perquisites	247,900
Gross farm income	8,167,800
Annual equivalent cost of total farm investment (\$26,234,000) at 7.5% interest	2,021,900
Other expenses	4,835,300
Total expenses	6,857,200
Net farm income (gross farm income minus total expenses)	1,310,600

* Taken from Table 5a.

TABLE 6. Benefits From New Lands as Derived From Farm Budgets

	Unadjusted Benefits, \$	Net Benefits,* \$
Original bureau estimate	2,634,000	2,471,000
Estimate using adjusted normalized prices		
Net income with project (from Table 5b)	1,310,600	
Net income without project (from Table 4b)	17,100	
Difference	1,293,500	
Labor alternate	81,600	
Net difference	1,211,900	1,136,500

* Adjusted for 5-year development period by a factor of 0.938. Tables 4 and 5 are source of data.

TABLE 7. Summary of Benefit-Cost Reevaluation of the Mid-State Project

Description	Value, \$	Total Annual Benefits, \$	Benefit-Cost Ratios			
			$I = 3.125\%$ $C = 4,543,000^*$ ($C = 5,283,200$)	$I = 5.375\%$ $C = 6,487,000$	$I = 7\%$ $C = 9,002,800$	$I = 10\%$ $C = 12,193,000$
Total benefits unchanged from 1967 bureau estimates						
New lands	2,471,000					
Secondary	499,000					
Land acquisition/ withdrawal	-295,000					
Supplemental water	1,096,000					
Groundwater stabilization	772,000					
Flood control	518,000					
Recreation	175,500					
Fish and wildlife	425,000	5,661,500	1.24 (1.07)	0.87	0.63	0.46
Total benefits after reducing multi-purpose benefits						
Fish and wildlife (adjusted)	-347,000					
Flood control (adjusted)	341,500					
All other benefits (unadjusted)	4,718,500	4,713,000	1.03 (0.89)	0.72	0.52	0.38
Total benefits after reducing new lands benefits and multi-purpose benefits						
New lands (adjusted)	1,136,500					
Secondary (adjusted)	0					
Fish and wildlife (adjusted)	-347,000					
Flood control (adjusted)	341,000					
All other benefits (unadjusted)	1,748,500	2,879,000	0.63 (0.54)	0.44	0.31	0.23

Costs equal annual equivalent costs of \$112,000,000 at given interest rates plus annual operating costs of \$863,000.

For source of data see text and other tables.

* This cost is for a 100-year period of analysis. All others are for a 50-year period of analysis.

Reclamation. Whereas the logic of benefit-cost analysis demands a national accounting stance [Cicchetti *et al.*, 1973], the methodology of the bureau is to add up local benefits (increased income to farmers) and call these the net benefits of the project, ignoring the wider effects of the project and reclamation policy on the rest of the nation's agricultural economy. As a result, benefit-cost becomes a kind of self-fulfilling prediction that a local area will gain from a large federal investment heavily subsidized by the general treasury.

In addition to the preceding economic arguments there is a policy consideration that makes the inclusion of new lands questionable. If it is claimed that there is a serious groundwater depletion problem in the Mid-State area, it seems that the problem will only be aggravated by expanding the demand for water through the addition of irrigation acreage (new lands). It is a strange policy that first makes the problem greater and then proposes a solution. But the apparent reason for this paradoxical action is that new lands benefits are required to justify the project. Although the additional water needed for new lands makes a small problem into a bigger one, the bureau is best equipped to deal in large solutions, such as major diversion dams. Other alternatives

for dealing with the alleged problem of groundwater depletion are never considered. For instance, the groundwater problem might well be solved by a smaller investment in sprinkler systems or by controlling the use of wells through economic disincentives. Where these policies have been used, it has been found that the efficiency of water use increased dramatically [Howe and Easter, 1971].

CONCLUSION

The preceding analysis takes a critical view of the Mid-State project and the Bureau of Reclamation's practices in using benefit-cost analysis. The results differ significantly from those presented by the bureau. It would seem that the bureau's justification of reclamation is indeed on arid ground. But this conclusion is too easy. The basic problem is to explain how the tools of economics have been used by different analysts to come to such divergent conclusions. The answer is that the analysis is filled with both disputes over basic assumptions and widely divergent choices as to the 'correct' solutions to difficult issues such as the level of interest rates, the value of wildlife, the effect of government programs on agricultural markets, and the impacts of political and ad-

ministrative expedients. Although benefit-cost analysis can enlighten us on these issues, it does not provide us with an unambiguous technical solution to public expenditure decisions. In spite of years of refinement in the theory of benefit-cost analysis no one has succeeded in making it impartial or indisputable.

It appears, then, that the selection of appropriate water projects is a political process, no matter how deeply hidden the political choices are beneath the complex analytics of benefit-cost analysis. Benefit-cost may well be a useful administrative tool for organizing and utilizing technical and economic information about proposed public investments, but it should not be asked to do more than it can reasonably do. That is, it cannot be expected to 'take the politics' out of public decisions by replacing them with 'rational' technical criteria of choice. Not only are good logic, technical skill, devotion to rationality, etc., hard to insure in everyday government, but the supposedly neutral 'rationality' of economics is itself based on theory and judgment that are open to dispute. Economists have erroneously placed the onus of political bias on government agencies and their application of benefit-cost and have felt that if only benefit-cost could be perfected theoretically and applied impartially, decisions would necessarily improve. This 'incremental' strategy has not borne fruit. Furthermore, it may actually do real harm. As economists have sought to perfect the techniques of public policy analysis and introduce them into the public decision-making process, they have only succeeded in driving politics deeper into the technical analysis, veiling the real choices from the public's eye. The public and its representatives in Congress who innocently believe that the single-number ratio represents economic truth are thereby excluded from the actual decision-making process. An agency, its beneficiaries, and a few congressmen continue to make policy largely as they please.

The experience of benefit-cost parallels that of another area of government reform, the independent regulatory commissions. Since the inception of the Interstate Commerce Commission in 1887 it has been hoped that enlightened regulation of business in the public interest could best be achieved by technical experts and impartial commissioners operating 'outside of politics.' But the practical results have been very much the opposite of what was expected. In his classic study of the regulatory commissions, *Bernstein* [1955] concluded that apolitical government by commission and the ability of experts to make the best public policy were largely myth and the dogged adherence to these myths by reformers has contributed to the well-known failure of regulatory agencies to serve the larger public. Clearly, reforming the abuses of politics and introducing expert judgment into public affairs are useful, but carried to their logical extremes, they can become counterproductive. This situation is a lesson for proponents of benefit-cost as a political panacea.

Basing this critique on pre-1967 benefit-cost practices may seem outdated in the light of the recent reformulation of project planning and analysis by the WRC. But the WRC principles and standards are only another, albeit dramatic, chapter in the reform movement that has attended benefit-cost since its inception. The WRC has repeated the basic error of its predecessors in reform by trying to do the impossible: to reconcile incommensurable values in one quantitative objective figure. In their original form the new principles espoused a fourfold accounting system in which national, regional, social, and environmental net 'benefits' were assayed and

summed. Not only were the measuring rods noncomparable, but the goals represented by each account might well be at odds [Cicchetti *et al.*, 1973].

Conflict between these goals is unavoidable, and no amount of technical wizardry will succeed in absolving us of the need to resolve this conflict through political processes. One might go so far as to propose that open conflict is beneficial to the extent that it widens participation in the political process. Unfortunately, the traditional solution has been to avoid conflict whenever possible by utilizing technical bureaucracies to make and administer decisions. Although many social problems have seemed to be resolved by this method, we are beginning to discover that bureaucratic complexity and technical analysis often only hide the problems from public view and that bureaucracy is itself becoming a problem. The issue is whether we as a democratic people want government decisions made openly in the forums of the legislatures or covertly by bureaucratic and academic technicians.

We thus concur with Ralph Turvey, who, in summarizing a recent conference on the advances in the state of the art of benefit-cost analysis, suggested that Britain was pursuing a wiser course of action than the United States; the British do not require benefit-cost analysis, and when it is conducted, it is kept uncomplicated so that assumptions can easily be identified. If this approach were followed in the United States, economic analysis would be more useful in the public decision-making process.

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