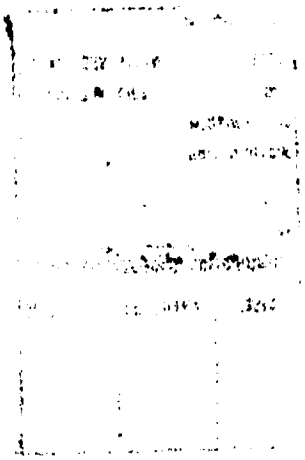
THE EXPOST EVALUATION OF FEDERAL WATER RESOURCE PROJECTS IN THE UNITED STATES



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I. INTRODUCTION

The construction of water resource projects often produces dramatic and widespread effects on the natural, economic, and social environment. Thus, the observation and assessment of these effects, which is what is meant by the term "expost" or "post-construction" evaluation, must inevitably be of great practical interest to the people of a country. This certainly is true today in the United States, and no doubt elsewhere in the world. It is appropriate and timely, therefore, that our host country, the Netherlands, together with the other development assistance countries, should sponsor this international seminar on expost evaluation.

I have had a three-fold purpose in mind in preparing this paper:

-- to make clear what expost evaluations are and why they are needed;

-- to identify and explain what I consider to be some of the basic analytical principles involved in expost evaluation; and

-- to give some specific examples of expost evaluations of water resource projects.

In doing these things, I shall rely heavily upon the considerable experience of the United States Army Corps of Engineers. The Army Corps of Engineers has played a pre-eminent role in the planning and development of the water resources of the United States. This pre-eminence has several dimensions which makes the experience of the Corps of Engineers of particular relevance:

-- The Corps of Engineers was the first United States Government agency to systematically assess the beneficial and adverse effects of each potential investment and, to the best of my knowledge, it is also the first Federal water resource agency to have a long-range program for the expost evaluation of completed projects;

-- The Corps of Engineers, in formulating water resource plans in accord with the laws and policies enacted by the President and the Congress, has had to respond to the conflicting demands for the nation's water resources; these demands frequently associated with diverse competitive groups; and most important

-- The Corps of Engineers for nearly two hundred years has been able to change the content and broaden the range of purposes served by water resource projects in conformance with the changing demands of the American people.

It is these things--a tradition of analysis, a willingness to adjust a national program to fit local needs, and sensitivity and responsiveness to changing objectives--which guarantee that expost evaluations performed by the Army Corps of Engineers will be more than the subject of academic and professional discussion, that they will in fact be used to improve the planning and execution of water resource programs. This brings me to a more formal definition of expost evaluations and why they are needed.

II. EXPOST EVALUATIONS: WHAT THEY ARE AND WHY THEY ARE NEEDED

In order to explain what expost evaluations are, one must draw a distinction between, on the one hand, the detailed observation and recording of the physical effects or outputs produced by a completed project and, on the other hand, an assessment of the contribution these outputs make to some previously stated beneficiary group or objective. With regard to the former, the emphasis is on such things as keeping track of the number of kilowatt-hours of electricity generated, whereas in the latter the emphasis is on the contribution which this power makes, for example, to the economic well-being of an impoverished group of people. Thus whether expost evaluation is thought of as a look at the past, void of normative judgment, or as a deliberate effort to modify and improve current and future planning decisions depends in large measure upon the motivations and aspirations of the individual analyst.

What purposes are served by performing expost evaluations of water resource projects? In my opinion, the single most important reason for performing expost evaluations of water resource projects is that if the results of these re-evaluations are related to exante or pre-construction analysis, the entire process of assessing project worth will be improved. Expost evaluations can serve another related need, however. They can be used as one basis for establishing the priority, in terms of the allocation of a limited budget, to be accorded to various public programs. More specifically, since the effectiveness of programs undertaken in the public sector are not monitored in terms of a profit and loss statement, other mechanisms need to be utilized, and expost evaluations are one such mechanism.

With regard to the use of expost evaluations as a basis for monitoring the effectiveness of a program, a word of caution is in order. By their very nature, expost evaluations are limited in scope, their focus usually is a particular project or system of projects. It is both inappropriate and unfortunate, therefore, that the results of some expost evaluations of individual projects have been used as the basis for making inferences about the totality of all such projects.

In introducing this note of caution, I do not wish to leave the impression that I am opposed to full and free discussion of expost evaluation, including evaluation of what might be classified as "unprofitable ventures".

Not at all. The point that I would like to emphasize, however, is that ideally the motivation for conducting and reporting expost evaluations ought not be criticism for the sake of criticism but rather constructive insight and comment aimed at improving pre-construction evaluations. Such an approach would not only screen marginal projects prior to the commitment of funds for construction, but would also give a truer picture of those projects where beneficial effects have been underestimated; for an evaluation which underestimates the effects of a highly productive project is equally erroneous as one which overestimates the effects of a marginal project.

III. SOME BASIC PRINCIPLES OF EXPOST EVALUATION

Assessment of Both Beneficial and Adverse Effects

During its early years, dating back almost 200 years, the Army Corps of Engineers responded to the demands of the American people, as expressed by the President and their elected representatives regarding the need for the development of the natural resources of an infant and underdeveloped nation. Since this development period was characterized by an abundance of natural resources, it was natural for the Corps of Engineers to devote its primary attention to providing the public with consumable goods and services. This early emphasis on the economic development of the United States through the use of our natural resources was characteristic not only of the public sector but of the private sector as well.

However, during the past two hundred years the priorities accorded to the different needs of the nation have changed. In recent years, the people of the United States have become increasingly concerned about the quality of the environment in which they live. In response to this change in public attitude, the Corps of Engineers is placing even greater emphasis on assessing and fulfilling the frequently conflicting demands for the preservation, conservation and development of our natural resources. Recognizing that priorities expressed by the public change and therefore that the weight given the adverse effects of a project relative to its beneficial effects may change with the passage of time, one readily concludes that the temporal dimension warrants critical consideration in water resource analyses. This suggests what I consider to be a basic principle of expost evaluation; namely, that all the effects of a project be assessed, that is, the full range of beneficial effects--whether or not they were intended at the time of project construction--as well as the complete spectrum of adverse effects, whether of an economic, ecological or social nature.

A Group-Dependent Definition of Project Effects

There is much truth in the assertion found in the best literature on water resource planning that effects of a project have significance only in

terms of a specific objective. But this assertion does not go quite far enough, for I find it somewhat theoretical to ask a taxpayer to choose between two water resource projects in the absence of knowledge of the gains and losses he himself sustains as a result of each project.

For example, in the absence of any additional information, if one were to ask a local official to choose between two projects affecting his municipality, one project designed to make the greatest contribution to national income and costing $10 million and an alternative project designed to make the greatest contribution to the income of his particular geographic area and costing $20 million, everything else being equal, I would guess that he always would choose the more costly project if all or most of the costs were to be borne by the Federal Government. However, his decision might be altered if he knew the distribution of the project effects in terms of the affected groups, whether defined by income class, place of residence, or similar criterion.

I recognize that the distribution of project effects by different groups could be displayed as complimentary information to that displayed in terms of the particular objective emphasized during design. But this ignores the fact that the outlook of the planner during the formulation of the project--as well as its expost evaluation--might change if he had to keep in mind from the outset that he was not establishing priorities among abstract objectives but among people. In other words, I would prefer to see alternative water resource plans developed first in terms of the particular beneficiaries which are going to be accorded the highest priority and that this information then be complemented by the contribution each plan makes to broader objectives. In essence, I believe the real choice to be made during the planning of a project is not between groups of assumptions related to broad objectives but between groups of people. Therefore another basic principle that I would like to emphasize is that expost evaluations should begin with an assessment of project effects on different groups of people followed by an assessment of its contribution to broader objectives.

The With and Without Principle

A third basic principle of expost evaluation is that effects likely to occur with a project should be compared with the effects likely to occur without the project, the difference being those effects attributable to the project. While this "with and without" principle appears obvious, the results of analysis based on this principle are nonetheless often confused with the results of a "before and after" analysis. Expost evaluations performed on a "before and after" basis usually lead to erroneous conclusions since they focus on a comparison of pre- and post-construction conditions with little attention given to the possibility that some of the post-construction conditions might have prevailed in the absence of the project as a result of other events unrelated to project construction.

I have read studies, for example, which have examined an area influenced by a reservoir or a highway and have noted that the area had no industrial base before the project was built and none after it was built. These studies then go on to conclude that the project had no economic development effects. This conclusion may or may not be correct, but it is difficult to make any conclusions based upon the study. In other words, had the analysis been done on a "with and without" basis, a projection of what might have occurred in the absence of the project might have indicated that there would have been a significant out-migration of population had not the project been undertaken; in other words, the project could have created many beneficial effects merely by reversing a downturn in economic activity although it generated no net increase over pre-project conditions.

On the other hand, I also have seen studies which praise a particular project for increasing jobs, say by x percent over what they were prior to project construction. This conclusion too was based upon a "before and after" analysis, since had it been done on a "with and without" basis this would have required a projection of what would have likely to have occurred in the absence of the project, a projection possibly indicating that many new industrial firms were going to locate in the project area even if the project were not undertaken.

A Two-Stage Statement of Objectives

In the United States, no Federal water resource project is constructed unless it gains the approval of the President and Congress in each of two distinct stages of the legislative process, first, authorization, and second, appropriations. Generally a project is "authorized" if it meets certain conditions including, but not limited to, (1) a projected or exante ratio of national income gains to project cost which exceeds unity and (2), an endorsement by the Governor of the state in which the project is located. It should be understood, however, that this first stage, project authorization, is a necessary but not sufficient condition for project construction. The second test that a project must pass is that it be "funded", that is, that money be set aside or appropriated for its construction.

The point that I would like to emphasize is that the objectives which initially led to project authorization may be quite different from the objectives which led to appropriation of project funds, thereby adding another consideration in the expost evaluation of water resource projects. More specifically, the complexities of expost evaluation are compounded not only due to the presence of competitive groups with conflicting demands but also because the authorization decision may be responsive to the demands of one group and the appropriations decision responsive to the demands of another.

Not only is this two-stage process of project authorization and project appropriation responsive to our legislative process but it also recognizes the economic facts of life, namely that there is a substantial backlog of proposed projects which have not been funded although preliminary economic analyses show them to be worthwhile investments. Recognizing that there is a limit on the amount of money that the United States can spend on water resource development, priorities must be established, not only between water and non-water programs but also between alternative water resources projects. Therefore it is during the appropriation process that explicit recognition is made of the many demands for the Federal dollar--that is, requirements not only for water resource development but for other needs such as defense, education and housing. Hence, one might view the authorization decision as establishing priorities among people or groups of people likely to be affected by a proposed project, whether beneficially or adversely and the appropriation decision as establishing priorities among alternative projects. It should be clear that the "authorization" and "appropriation" decisions are not unique to the United States but are common to any country which must first, identify feasible proposals and second, establish priorities among them.

Prior to expanding upon this point, I think it would be helpful if I were to describe the institutional setting in which water resource planning takes place in the United States. An understanding of this institutional setting is of critical importance since it defines the environment in which local groups express their views regarding the objectives to be served by a proposed project. In the United States, while there are many agencies and groups involved in project formulation, there are a significantly smaller number of agencies involved in both project construction and project formulation. Therefore, there are numerous local and state planning bodies which exert considerable influence on the formulation of Federal water resource projects although they themselves are not engaged in project construction. For this reason, even if there were in the United States a central planning bureau at the Federal level, as is the case in some countries, such a bureau would not have comparable authority unless its decisions governed the actions of local and state planning groups. Given the historical emphasis on the separation of State and Federal powers, it is unlikely that such a central planning bureau will be established in the near future.

I have described the institutional setting in which non-Federal entities affect Federal water resource development because, as previously stated, should the objectives and aspirations of local groups differ, or should the policies which govern project formulation at the Federal level stress objectives different from those advanced by local planning groups, the problem of expost evaluation becomes most difficult. For example, although a levee might have been designed for the sole purpose of reducing flood damages in the least costly manner, local development groups might insist that it be constructed to attract new industry to a particular area--not recognizing, for example, that the most serious impediment to economic

growth might not be flood damages but the lack of industrial water which could be provided by a reservoir. This leads me to another basic principle of expost evaluation: expost project evaluation should begin not only with a precise statement of the objectives which governed project design but also with a statement of the objectives and constraints--be they economic, social or political--which governed its selection over other water resource projects competing for the same limited financial resources.

Allow me to expand upon this point through the use of another illustration. In the past, if one were asked to state the single overriding criterion which governed the formulation of water resource projects--that is, a determination of their scale and the magnitude of their individual outputs such as flood control and power, the answer probably would be what is usually referred to as the "maximization of national income". This criterion, often labeled as "economic efficiency", is a criterion which leads to the production of the maximum quantifiable (dollars) output per unit cost with little explicit attention given to either quantifiable or non-quantifiable side effects such as the redistribution of income among income classes or geographic areas.

This is not to imply that these side effects are not considered, only that in many instances they are introduced at a later stage of the decision-making process, that is, not at the time of project formulation and authorization but at the time it is decided to build some projects and not build others; in other words, during the budget or appropriation process rather than during the formulation and authorization of a project.

Again consider the case of the levee, designed and authorized under the national income objective to reduce flood losses and chosen at budgetary time in lieu of a reservoir with the objective of inducing industrial development. In this instance, what should be the primary criterion used in an expost evaluation of the levee, the amount of flood damages it has prevented, the amount of industry it has attracted, or both? To answer "both" to this question is not necessarily the easy way out since to perform both analyses one would have to have knowledge of the alternative investments which were available for inducing economic development. In other words, one would have to identify the project or investment, if any, which would have been undertaken in the absence of the levee, that is the "opportunity cost" of the levee. In this connection, the Department of Army has developed a civil works program budgeting system which allocates a five-year budget among nineteen geographic regions based upon the water resource "needs" of each region. The opportunity cost of each investment in each region influences the rate that these needs are fulfilled.

The basic principles discussed above have general applicability to expost evaluation: The discussion which follows will illustrate the use of these principles.

IV. EXAMPLES OF EXPOST EVALUATIONS

The earliest activities of the Army Corps of Engineers--dating back to the late eighteenth and early nineteenth centuries--centered around the improvement of navigable waterways. Because the provision, operation and maintenance of navigational facilities is the oldest civil function performed by the Corps of Engineers, this has occasioned great interest in assessing the impacts of completed navigation projects. This interest in the efficacy of navigation projects is a result not only of their prominence in the Corps of Engineers' program but also results from the fact that inland waterways are an alternative to other transportation modes and thus their relative efficiency becomes an important topic in determining the role that navigation is to play in the national transportation system. Therefore my presentation will begin with the expost evaluation of navigation projects--one such evaluation having assessed the impact of fifteen inland waterways and the other, a status report on an expost evaluation currently underway by the Army Corps of Engineers Institute for Water Resources. This presentation will be followed by the results of an expost evaluation of a multi-purpose reservoir.

I would like to emphasize that the studies described below are by no means exhaustive of all expost evaluations performed in the United States, be they of the Army Corps of Engineers, other Federal or State agencies, educational or research institutions, trade associations or other parties interested in assessing the effects of water resource projects. Hopefully, however, the expost evaluations described below are representative of both the procedures being developed and utilized for expost evaluations as well as some of the problems encountered in these types of analyses.

The Expost Evaluation of Navigation Projects

ANNUAL REPORT OF THE CHIEF OF ENGINEERS (1951)

In 1951 the Chief of Engineers presented an indepth analysis of the inland navigation program. The findings and methodologies utilized for the study are summarized below.

(1) First, it was determined that 80 percent of the waterway traffic was carried on approximately 15 major waterways and that approximately 80 percent of the Federal expenditures for waterway improvement had been on these same waterways.

(2) In order to make use of the cost figures given in the then latest published report of the Chief of Engineers and because calendar year 1948--three years prior to the time of the study--was the latest year for which complete waterway traffic data were available, the 20-year period ending June 30, 1948 was selected as the period to be covered by the expost evaluation.

(3) To obtain an estimate of the transportation savings produced by the 15 waterways during the 20-year period, analyses were made of the principal commodities conveyed and of representative cargo movements.

(4) Unit savings per ton-mile of water route were calculated as the difference between water transportation charges and those that would have been charged by the least-cost alternative mode. Full barge-line service costs plus reasonable profit were used as a measure of waterway transportation charges since the preponderance of the barge-borne freight was known to have moved by contract and industry-owned carriers.

(5) Data on waterborne commerce on the 15 waterways, expressed in tons and ton-miles, were compiled from the annual reports of the Chief of Engineers for the 20-year period 1929-1948. This 20-year total was divided by twenty to place the traffic on an "average annual" basis.

(6) The product of the unit savings derived in step (4) above and the commerce identified in step (5) above represents an estimate of the annual transportation savings.

(7) For the purpose of comparing transportation savings with costs, the cost of each of the 15 waterways was expressed in terms of annual charges including interest, amortization, and maintenance of operation. Interest and amortization were computed using an interest rate of 3 percent and a 50-year economic life, and included costs not amortized at the start of the period.

(8) A measure of the economic performance of the 15 waterways was determined by computing a ratio of the transportation savings in step (6) to the costs in step (7). The results are summarized on the following page.

It should be noted that there is far from complete agreement on one of the central problems raised by the evaluation, namely, the rates or charges to be used for the "without" analysis, that is, the transportation rates to be charged by non-water carriers in the absence of the waterway. Consequently this example will illustrate some of the difficulties encountered when implementing the "with and without" principle.

Those of you who are familiar with the United States transportation system probably realize that transportation charges are not established in a perfect market and the rates charged by carriers often are "what the traffic will bear", that is are not directly related to the cost of carrying the traffic. With the construction of a waterway, competing transportation modes often reduce their charges so as to be competitive with a waterway. These depressed rates are frequently referred to as "water compelled" rates. The unit savings quoted above were not based upon "water compelled" rates but on the "prevailing" rates, the rates being charged by other modes prior

THE EXPOST EVALUATION OF 15 INLAND WATERWAY PROJECTS[1/]

Waterway	Average Traffic (Million Ton-Miles)	Savings (Mills Per Ton-Mile)	Savings in Millions of Dollars		Charges (Costs) in Millions of Dollars		Benefit-Cost Ratio		Period of Record (Years)
			Average (1929-48)	FY 1948	Average (1929-48)	FY 1948	Period of Record	FY 1948	
Lower Miss. River	4,371	5.6	24.6	68.0	7.0	13.4	3.5	5.1	14
Middle Miss. River	537	5.4	2.9	8.6	2.0	2.6	1.5	3.3	14
Upper Miss. River	872	5.2	4.6	11.5	5.2	8.3	.9	1.4	14
Ohio River	3,681	[illegible].8	17.4	41.8	8.3	10.2	2.1	4.1	20
Monongahela River	1,137	9.7	11.0	19.9	1.0	1.3	11.0	15.3	20
Allegheny River	42	11.2	.5	.9	.7	.9	.7	1.0	20
Illinois Waterway	883	4.6	4.1	12.1	1.3	2.1	3.1	5.8	14
Missouri River	41	5.8	.2	.3	6.5	11.4	*	*	14
Cumberland River	87	7.9	.7	1.6	.5	.9	1.4	1.8	14
Warrior System	319	5.8	1.9	2.5	1.0	1.3	1.9	1.9	20
Ouachita River	21	6.0	.1	.0	.4	.3	.3	0	20
Gulf Intra-Waterway	3,309	7.2	23.8	55.3	1.4	4.1	17.0	13.5	12
Columbia River	82	5.0	.4	.7	.9	2.0	*	*	12
Sacramento River	49	19.5	1.0	2.5	.2	.2	5.0	12.5	20
Kanawha River	174	5.0	.9	2.0	.7	1.0	1.3	2.0	20
Total			94.1	227.7	37.1	60.0			

*Project only partially completed at time of study; therefore, since representative traffic movements had no opportunity to develop, a benefit-cost ratio was not computed.

1/ Source: Annual Report of the Chief of Engineers, 1951, Part I, Vol. 3.

to the construction of the waterway. The choice as to whether "prevailing" or "water compelled" rates should be used in expost evaluations is directly related to which of the project effects are being evaluated; since as previously stated, "benefits" can only be measured relative to the gains realized by a well-defined group of society, for example, the residents of a particular geographic area, a specific income class, shippers, or taxpayers in general.

There is ample empirical evidence to support the statement that the introduction of a waterway generally has a reducing effect on prevailing rates in a region. To the extent that these "water compelled" rates attract industry to an area, an analysis based upon "prevailing" rates could be used as a surrogate measure of the contribution a project makes to the economic development of the area. In a similar manner, by assuming that the "water compelled" rates are surrogate measures of the economic cost of providing the service--that is, assuming that they are not below the marginal cost of providing the service or, more explicitly, that they are not subsidized by charging higher rates on traffic movements outside the region--then an expost evaluation based upon "water compelled" rates could serve as a surrogate for assessing the national income effects of a project.

THE STATUS OF A CURRENT EXPOST EVALUATION OF A NAVIGATION PROJECT

Late in 1967, the Army Corps of Engineers Institute for Water Resources established a research program to develop and test methodologies for assessing the effects of completed projects on a continual and systematic basis. Many approaches were developed only to be rejected after reviewing their results. This is not to imply that these efforts were unproductive since research which leads to the rejection of a proposed procedure eliminates a poor approach from additional consideration, thus saving time and money. One such approach, which was tested and then rejected, involved the use of an "analog model" to determine the "without" conditions in project analyses.

As previously stated, expost evaluations require that a projection be made of the conditions likely to prevail in the absence of the project. Generally this "without" analysis is based upon an extrapolation of preproject conditions tempered by specific knowledge of the project area. Basic to the "analog approach" is the identification of another area which is identical to the project area with the exception that it lacks a water resources project. A literal interpretation of this definition would make it impossible to identify an "analog" area. However, herein lies one of the biggest shortcomings in the analog approach, namely, a designation of those characteristics of the project area which must be associated with the analog area and an identification of other characteristics whose absence would not disqualify an area as an "analog" area.

For this reason, research directed toward the expost evaluation of navigation projects has not been directed toward procedures which would

identify analog areas, but toward the development of a systematic way of assessing and evaluating the effects of a project on a continual basis. More specifically, an expost evaluation might well continue over the entire economic life of a project. Such an expost evaluation could serve not only as a basis for assessing the merits of a particular project but, perhaps more important in some instances, provide information for "operating" the project more efficiently. By "operating" I do not only mean protecting the structure against physical deterioration but also regulating the outputs of the project so as to be responsive to changes in the social-economic environment. For example, the availability of an alternative source of energy might justify a reduction in hydropower output so that fluctuations in the level of the reservoir could be minimized, thereby permitting a higher valued use of the water such as, for example, water based recreation.

In order that the results of the research be most useful, the Corps of Engineers is developing expost evaluation procedures tailored to a particular project, namely the Arkansas navigation project. When completed, the Arkansas navigation project will provide a nine-foot navigation channel over nearly 600 miles of the Arkansas River, a major river in the Southwestern United States.

It is important to note that while previous expost evaluations of navigation projects were limited to those projects which had been in operation for a considerable period of time, the expost evaluation of the Arkansas project has not followed this precedent since research on the procedures to be used has been underway for the past several years--although the project is not yet physically complete. By beginning the expost evaluation prior to project completion, socio-economic "snapshots" of the project area can be taken while the project area develops, thereby providing a source of timely information. Therefore in the expost evaluation of the Arkansas navigation project we are not only making every effort to adhere to the "with and without" principle, but we are also giving considerable attention to the first principle I mentioned, an assessment of the complete range of beneficial and adverse effects of the project.

Consequently the expost evaluation of the Arkansas navigation project differs from other expost evaluations performed by the Army Corps of Engineers not only due to its initiation prior to project completion but also due to its emphasis on an assessment of the complete range of benefits and costs, be they economic, environmental or sociological. For example, economic effects such as the effect of the project on land values and tax base will be identified; sociological effects such as changes in demographic parameters (age distribution and family composition) and intraurban settlement patterns will be explored as well as the effects of the project on fish and wildlife and other environmental conditions.

The Expost Evaluation of Multi-Purpose Reservoirs

As previously stated, over the past two hundred years the activities of the Army Corps of Engineers have expanded in response to the need for conservation, development and preservation of the nation's water resources. In discharging this responsibility, the program of the Army Corps of Engineers has expanded to meet the emerging needs for water quality, hydropower, recreation, and other water related services. Therefore, expost evaluations of the Army Corps of Engineers cannot be limited to navigation projects, but must be expanded to include multi-purpose reservoirs.

While the Army Corps of Engineers has prepared several expost evaluations of its multi-purpose reservoir program, I would like to acquaint you with the results of an expost evaluation of a Corps of Engineers reservoir performed by Professor L. Douglas James of the University of Kentucky and reported in the June 1968 issue of Water Resources Research. This expost evaluation was performed on Dewey Reservoir, located in the Appalachian Mountains of Eastern Kentucky, and constructed between the years 1946 and 1949. The Appalachian Region is one which has witnessed a sustained level of employment and is one of the most severely depressed regions in the United States. Therefore, it was particularly relevant that the expost evaluation performed by Professor James not only addressed the effect the project had on the level of national income but also on its income redistribution effects.

NATIONAL INCOME EFFECTS

The primary gains derived from Dewey Reservoir can be classified as flood control and recreation benefits. Flood control benefits were evaluated as the average annual reduction in the cost of repairing, replacing or rehabilitating flood damaged property, principally buildings and contents.

Recreation benefits were evaluated as the value visitors receive from utilizing water-based recreation facilities. These benefits were estimated by applying travel cost data to demand curves generated from statistically derived relationships between visitation and distance.

Professor James concludes:

> "The annual efficiency cost of Dewey Reservoir Project was found to be $1,067,100. The annual efficiency benefit totaled $1,540,370. The project thus proved economically justified by a benefit-cost ratio of about 1.5."

Professor James states:

"The construction of a water-resources project redistributes income by taking funds from the taxpayers, paying these funds to those supplying labor and materials for project installation, and increasing the income of the users of project output. The taxpayers sacrifice for the benefit of the recipients of both project expenditures and project benefits. The income distribution effects depend on the income distribution of those in all three categories."

This expost evaluation illustrates several of the previously described principles in that it

-- has expanded the evaluation to include the assessment of project effects not identified during the pre-construction analyses;

-- has related project effects to specific groups of people.

The redistributive effects of Dewey Reservoir were assessed in the following manner:

-- Flood control benefits were distributed among income classes by first estimating the reduction in flood damages by each river reach and then distributing these benefits in proportion to property value,

-- Recreation benefits were distributed among income classes by assuming that the income distribution of the visitors from an area to the reservoir to be equal to the income distribution of area residents as a whole,

-- Project cost borne by United States taxpayers was allocated among income classes in proportion to the distribution of income taxes collected,

-- Project costs borne by Kentucky taxpayers were distributed among income classes according to the incidence of the Kentucky state income tax.

The results of this analysis are summarized on the table on the following page.

Professor James concludes:

-- "Flood control benefits were found to be relatively greatest for the middle income group. The lower income groups receive less benefit, because they own less damageable real property. The upper income groups pay a large enough share of the taxes to more than offset the larger share of the flood benefits they realize by owning more property.

INCOME REDISTRIBUTION FROM RESERVOIR CONSTRUCTION

Item	Annual Income Range					
	0 to 3000	3000 to 5000	5000 to 7000	7000 to 10,000	Over 10,000	Total
Costs--United States						
Dam Construction (1950)	40,630	78,350	33,290	40,660	148,170	341,100
Operation and Maintenance (1960)	1,750	5,120	7,710	9,420	19,800	43,800
Access Highways (1960)	5,620	16,450	24,750	30,230	63,550	140,600
Costs--Kentucky						
Parks and Access Highways (1960)	7,260	34,730	55,470	65,320	96,420	259,200
Operation and Maintenance (1960)	2,530	12,090	19,300	22,730	35,550	90,200
Total Costs	57,790	146,740	140,520	168,360	361,490	874,900
Flood Control						
Costs	42,380	83,470	41,000	50,080	167,970	381,900
Benefits	58,320	203,720	193,330	131,700	138,580	725,650
Benefit-Cost Ratio	1.38	2.44	4.72	2.63	0.83	1.89
Recreation						
Costs	15,410	63,270	99,520	118,280	193,520	490,000
Benefits	259,460	170,230	167,120	129,670	88,240	814,720
Benefit-Cost Ratio	16.84	2.69	1.68	1.10	0.46	1.66
Over-all						
Costs	57,790	146,740	140,520	168,360	361,490	874,900
Benefits	317,780	373,950	360,450	261,370	226,820	1,540,370
Benefit-Cost Ratio	5.50	2.55	2.56	1.55	0.63	1.76

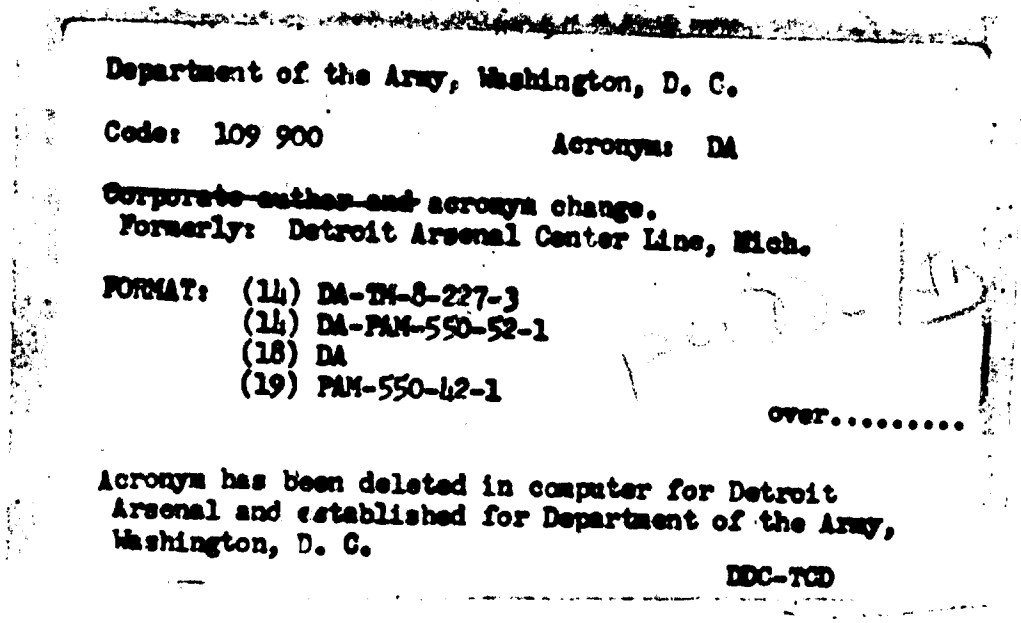
All values in 1961 dollars.

-- "Recreation benefits were found to be relatively greatest for the lowest income group. This group makes widespread use of the reservoir but pays a small share of the total taxes. As incomes increase, the share of taxes paid increases much more rapidly than recreation visitation.

-- "Dewey Reservoir definitely achieved an income redistribution from richer to poorer groups."

V. A CONCLUDING QUESTION

I recall a meeting I attended with a group of distinguished experts in the field of water resources planning at the time the Army Corps of Engineers was considering the aforementioned expost evaluation of the Arkansas Navigation Project. After a lengthy discussion, the consensus of the group, many of whom had authored articles and books on benefit-cost analysis, was that the effort was well intended but virtually impossible of accomplishment. I asked myself then, and I now ask you, "If post-construction evaluations are virtually impossible, then are not pre-construction evaluations (benefit-cost analyses) equally impossible?"



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13. ABSTRACT

A paper presented at the Organization for Economic Cooperation and Development Seminar on ~~Expost~~ (post-construction) Evaluation. Several basic principles of expost evaluation are presented, followed by some examples of such evaluations performed on water resources projects constructed by the Army Corps of Engineers. The expost evaluations include not only an assessment of the effects of the projects on national income but also their contribution to redistributing income.

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