SAGEBRUSH TO CROPLAND

A Western Water Project

Idaho Water Resources Research Institute
University of Idaho
Moscow, Idaho

A DYNAMIC REGIONAL IMPACT ANALYSIS OF FEDERAL EXPENDITURES ON A WATER AND RELATED LAND RESOURCE PROJECT -- THE BOISE PROJECT OF IDAHO

THE BOISE IRRIGATION PROJECT

March 1979

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RESEARCH TECHNICAL COMPLETION REPORT

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Lima beans pour into bins on a truck from a combine in a field west of Meridian. Lima beans are one of the lesser varieties produced but in 1976 there were 2,655,000 cwt. of edible dry beans harvested in Idaho. (1977)

Double line of trucks loaded with sugar beets, are lined up waiting to unload at the Notus beet receiving station. Drivers indulge in a dice game in the shade of a truck to pass the time while waiting. (1974)

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Prologue

During the early 1970's, the Office of Water Resources Research funded an ambitious ex-post analysis of the Boise Project, a large Bureau of Reclamation irrigation project in southwest Idaho and eastern Oregon. There were two major purposes of the analysis. One was to evaluate the total impact - social, environmental, economic -of a federal water resource investment project in the western U.S. A broad and detailed analysis of this scope had never been carried out before. Over the years there have been conflicting claims about the value of these irrigation projects, but specific data have been scarce; it was felt that there was a definite need to assess and evaluate the total impact of an existing project.

The second major purpose of the analysis was to develop the methodologies needed to examine a project such as this, methodologies that could then be applied to the analysis of other projects in the future.

The analysis was done in two parts. The first part, conducted in 1973 and 1974, was a support study, which was designed to serve as a guide for the research that was to follow. This consisted of a hydrology study, an economic and ecological history study, and a plan of study.

The second and larger part, which was the main body of the analysis, was done between 1975 and 1978, and consisted of five reports: a direct economic impact study, a secondary economic impact study, a "without" scenario, a sociological study, and an environmental study. All these reports have now been completed and printed.

The coordinators of the research project felt that the post-audit analysis was important and interesting enough to merit wider readership than is normal for such studies.

To facilitate this, they commissioned a "popularized" or journalistic summary of the analysis. This summary, "Sagebrush to Cropland -- a Western Water Project," is an overview of the work that was done by the researchers. It is aimed at the interested layperson and deals primarily with the history of the Boise irrigation project. It does not involve itself with the more technical aspects of the post-audit, and the development of the methodology of analysis.

While the journalistic summary will suffice for people who want an overview of the Boise Project -- how it began, what it has accomplished - professionals and experts in the various subjects covered by the analysis may of course wish to examine the individual research reports. The author(s) of each of the reports have written a short summary of their reports, and these will be found in the appendix following the journalistic summary. The reports themselves are available upon request

The authors of the individual research reports emphasize that the article Sagebrugh to Cropland," while based on their reports, is a journalistic interpretation of their work, and not a literal condensation.

The author of "Sagebrush to Cropland -- a Western Water Project," while basing the article on the research reports, also added some descriptions and quotes during several tours around the Project, not to alter the conclusions of the reports in any way but rather to provide some journalistic interest.

Part I

Plan of Study Subproject Report by Wayne T. Haas, Idaho Water Resource Board, and Richard W. Schermerhorn, Department of Agricultural Economics, University of Idaho, June 1974.

Hydrology Support Study -- by C. C. Warnick and C. E. Brockway, Department of Civil Engineering, University of Idaho (1974).

Economic and Ecological History Support Study -- by H. H. Caldwell, Department of Geography, University of Idaho, and M. Wells, Idaho Historical Society, (1974).

Part 2

Direct Economic Impacts -- by Roger Long, Terry Nelson, Gary Hines, Department of Agricultural Economics, University of Idaho, (1977).

Secondary Economic Impacts of the Boise Project of Idaho, 1947-1970 -- by Roger Long and Clarence J. Potratz, Department of Agricultural Economics, University of Idaho, (1977).

Methodology for Analysis of Irrigation Development that Might Have Occurred Without Federal Expenditure -- by Daljit Singh Jawa, Department of Civil Engineering

A Social Impact Analysis -- by John E. Carlson and Merle Sargent, Department of Agricultural Economics, University of Idaho (1977).

Economic Scenario of the Boise Region "Without" a Federal Irrigation Project -- by Terry Nelson, Department of Agricultural Economics; Calvin C. Warnick, Department of Civil Engineering; and Clarence Potratz, Department of Mathematics, University of Idaho (1977).

The Environmental Impact of the Boise Project -- by John Hultquist Department of Geography, University of Idaho (1978).

An Ex-Post Study of the Economic Performance of Federal Investments in Flood Control Projects in the Boise Valley, Idaho -- by Yoseph Gutema, Department of Argicultural Economics (Aug. 1977).

Notes: Abstracts of the above reports are in the Appendix.

You can obtain any of these reports by writing directly to the investigator and department listed on the reports.

SAGEBRUSH TO CROPLAND

by

John Francis*

The Boise Valley is a picturesque area of farmlands, ranches, and small towns in the southwest corner of Idaho. The Boise and Payette Rivers descend from the Sawtooth Moutains down through rugged canyons and foothills to rolling cattle country above the city of Boise, and then to gentle terraces and flatlands along the river bottoms.

The major city in the valley is Boise, a sprawling city of 100,000 and the Capital of Idaho. To the west some 20 miles are the cities of Caldwell, population 17,000, and Nampa, 26,000.

Boise is much preoccupied with government, and the buildings around the Capital dome house a large number of departments, agencies, commissions, courtrooms, libraries, and archives. Beyond these are the offices of an assortment of law firms, architects, contractors, labor unions, and professional associations that inevitably cluster around government.

There is a pronounced agricultural ambience around Boise. The suburbs soon give way to smallholdings - individual houses on a few acres, with some cattle or horses -- but soon the land changes to level fields of mint, corn, beans, alfalfa, onions, and a variety of other crops. The agricultural atmosphere is even more pervasive around Nampa and Caldwell. The two cities are ringed with canneries, processing plants, packing houses, seed companies, grain elevators, implement dealers, and other businesses dependent upon farming.

A County Extension agent expressed the view of the area's farmers. "Farming, that's the name of the game, that's what everything's based on here," he said. "We don't have any big industry. The government keeps a lot of people working in Boise, but they don't produce anything. Without farming here, you wouldn't have anything. And without the Boise Project, you wouldn't have the farming." Farming is the lifeblood of the valley, and the Boise Project's water is the lifeblood of the farms, he said. It would be difficult to find a Boise area farmer who disagreed with him.

The Boise Project was one of the first big Bureau of Reclamation projects. Its dams and reservoirs store 1,972,900 acre-feet of water during the winter and spring, and then send it out in carefully measured amounts through 1800 miles of canals and laterals spread over some 340,000 acres, or 530 square miles, of farmland.

A visitor who is uninterested in irrigation could drive right through the Boise Project and scarcely notice it. The quiet, grass-lined canals that pass under the road at intervals, the narrow ditches that border the fields, the concrete boxes half hidden among the crops, blend inconspicuously into the landscape.

Yet these canals, laterals, drains, and risers are the veins and arteries of this complex and intricate network that is so vital to the valley.

"Even the people who live here hardly notice the system anymore," said one farmer. "Heck, unless you're an oldtimer, the water's always been here. They just take it for granted. They don't know what it was like without it."

Just how important these unremarkable looking canals are is best seen by visiting one of the small pockets of unirrigated land in the Project. Suddenly the fertile fields vanish, and the land becomes once more the grey, sagebrush-covered semi-desert as most of it was before the irrigation came.

***This is a summary report of the research project "A Dynamic Regional Impact Analysis of Federal Expenditures on a Water Related Resource Project: Boise Project, Idaho and Oregon." This summary report is authored by John Francis and is a journalistic interpretation of the individual research reports listed in the Prologue.**

THE ARROWROCK AND PAYETTE DIVISIONS

There are two series of dams and reservoirs in the Project: one on the Boise River and one on the Payette. Both rivers are tributaries of the Snake River, which in turn is a tributary of the giant Columbia River.

The dams on the Boise River comprise the Arrowrock Division of the Project, the older and larger of the Project's two divisions.

About seven miles upstream from the city of Boise, the Boise River Diversion Dam diverts river water into the Main Canal, an imposing canal 64 feet wide at the top and 42 feet at the bottom, and deep enough to hold 9½ feet of water. The canal winds circuitously along the benchland above the valley for 40 miles, 26 as the crow flies, to Lake Lowell.

Lake Lowell is a man-made lake, and one of the biggest off-stream impoundments in the world. It is 11 miles long and four miles wide at its maximum points, and can store 169,000 acre-feet of irrigation water. Water from the Main Canal and Lake Lowell is spread to 165,000 acres of farmland. Another 111,000 acres are irrigated directly from the river.

Three large dams create storage reservoirs upstream from the Diversion Dam: Lucky Peak, Arrowrock, and Anderson Ranch. Lucky Peak was built by the Corps of Engineers, and officially is not part of the Project. In practice, however, all three dams, along with Lake Lowell, are carefully coordinated so the combined storage water can be used to the best advantage.

Lucky Peak is a flood control dam, and each spring, before and during the spring runoff from the snowpacks, there is some delicate estimating to decide how much water to release. Release too much water, and the reservoir will not fill and precious water will be lost. Release too little, and the dam will reach capacity, and then cannot moderate the floodwaters enough to prevent damage downstream.

The decision on how much water to release during the spring runoff sometimes leads to disputes between those who control the dams -- the Corps of Engineers for Lucky Peak, the Bureau of Reclamation for Arrowrock and Anderson Ranch -- and the representatives of the irrigation districts, who handle the water deliveries to the farms, and who represent the farmers. The districts contend the Corps and Bureau tend to overestimate the anticipated runoff, and release too much water.

The smaller division, Payette, has one diversion dam, Black Canyon, and two storage dams, Deadwood and Cascade. About 53,000 acres are watered solely by the Payette River diversion, and another 54,000 acres are partially dependent.

Another 7,000 acres are irrigated by water that has already been used in the Arrowrock Division. The water is piped under the Boise River Valley to the "Notus Unit," named after the nearby town of Notus. This is the oldest part of the Payette Division.

Table 1. Storage Reservoirs, Boise Project

Name	River	Active	Total	Year completed
Anderson Ranch	Boise-So. Fork	423,200	493,200	1950
Arrowrock	Boise	286,600	286,600	1915
Cascade	Payette-No. Fork	653,200	703,200	1948
Deadwood	Deadwood (Payette)	161,900	161,900	1931
Lake Lowell	Offstream	169,000	190,100	1908
SUBTOTAL		1,693,900	1,835,000	
Lucky Peak*	Boise	279,000	279,000	1955
TOTAL		1,972,900	2,114,000	

*Corps of Engineers Dam.

Plentiful Supply

In the Arrowrock Division, the Arrowrock Dam reservoir can store 286,600 acre-feet of water, Lucky Peak reservoir 279,000 acre-feet, and Anderson Ranch Dam reservoir 423,200 acre-feet (see Table 1). With Lake Lowell's 169,000 acre-feet, this gives a total storage capacity of 1,157,800 acre-feet.

In the Payette Division the Deadwood Dam reservoir has a storage capacity of 161,900 acrefeet, and the Cascade reservoir has 653,200 acre-feet, for a total of 815,100 acre-feet. The overall capacity of the two Divisions is 1,972,900 acre-feet of active storage capacity.

What these figures mean, in practical terms, is that except for the very driest of years, there is as much water as the farmers need, and even when a serious drought strikes, there is enough water to allow everyone to get by fairly well.

The two Divisions actually cover 390,000 acres, or 610 square miles, but only 340,000 acres are farmland. The rest are cities, towns, and roads.

The Boise Project acreage is broken down into "beats" of 4,000 to 5,000 acres, and each beat is patrolled by a "ditch rider" who raises and lowers the water flows by regulating turnout gates. His "customers" -- the farmers -- leave Request Cards at points along the beat detailing their needs for the following days. The flows are coordinated by Water Masters, who in turn follow the directions of each irrigation district's project manager.

Shifting several million gallons of water along miles of canals so that the right amount arrives at the right spots at the right times is not a skill that can be acquired quickly or easily. "He knows water" is a compliment earned for a very specific and hard-won ability.

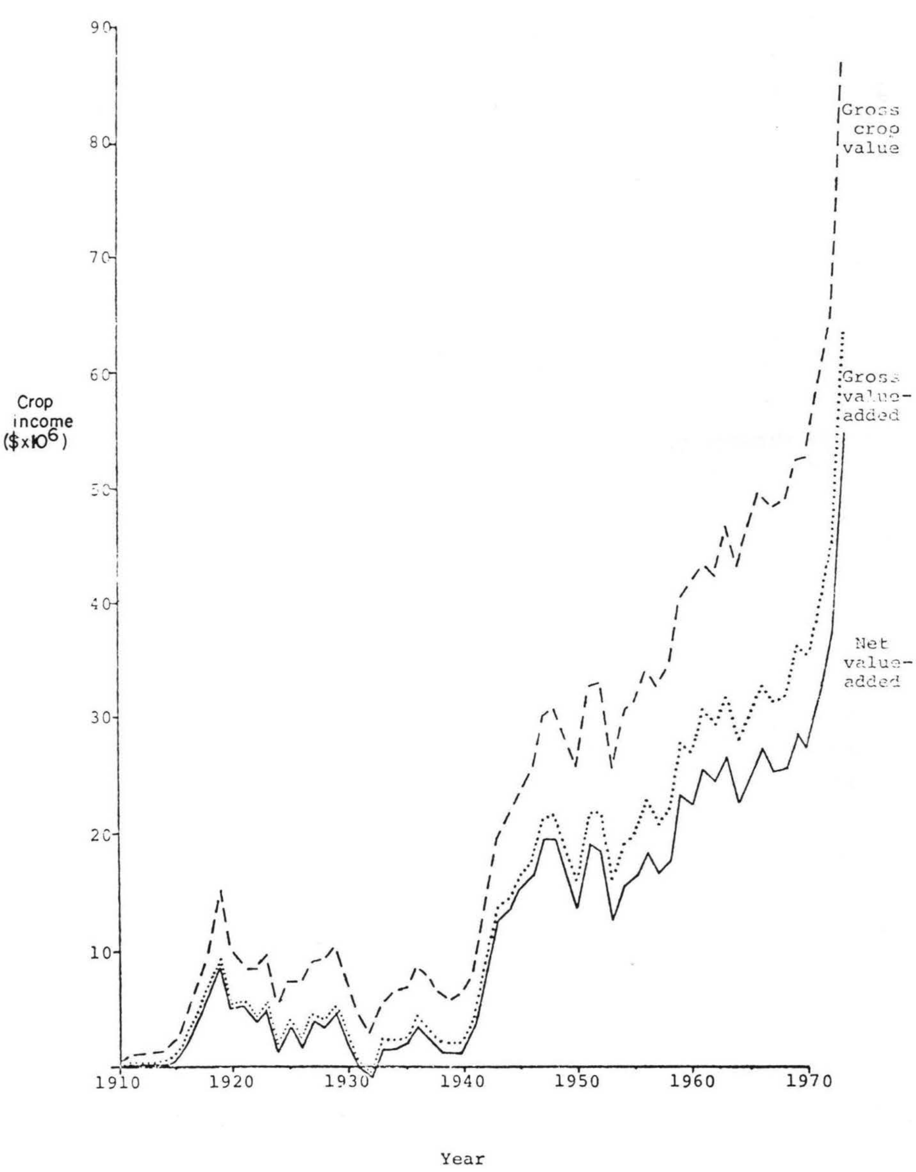
During the irrigation season - roughly April 10 to October 15 -work crews constantly patrol the waterways, spraying weeds and repairing holes dug by gophers. During the offseason they clean and dredge the canals, and each year replace a few more laterals with underground pipes.

About 15 percent of the land is irrigated by sprinklers fed from wells. The gravity-furrow or "flood" irrigation of the Project and the sprinkler systems work to the mutual advantage of both Seepage from the gravity-furrow irrigation would, in some places, raise the water table too close to the surface and could cause drainage problems. The sprinkler systems pump enough ground water to keep the water table level fairly constant.

Primary Economic Impact

How can one put a dollar figure on the value of such an irrigation system? There is no question that the farming made possible by the irrigation plays a vital part in the area's economy, but determining an actual dollar figure is a difficult and complex task. When one considers the ripples that the money from the farming community creates -wages to farmworkers, purchases from implement dealers, seed suppliers, and fuel companies, the money spent in supermarkets and clothing

Figure 1. Crop Income, Boise Project, 1910-1973



stores -- one begins to appreciate the magnitude of the task. Then there is the money spent by the food processors and other businesses dependent upon the crops, and the money spent by their employees.

A less difficult task is the determination of the costs of the Project, but that is still far from simple. One cannot merely add up the construction costs and the annual amount spent on operation and maintenance. There is the matter of depreciation, and one must also calculate the amount of money that could have been earned had the money that was spent building the Project been invested elsewhere.

In 1973 the "gross-value-added" (g.v.a.) of the irrigated crops produced on the Project -- the market value minus direct production costs; in other words, gross profit -- was $63,000,000. If one subtracts depreciation, one gets the "net-value-added," $55,000,000. (See Figure 1). During the same year the cost of the Project was $5,500,000. That includes all operation and maintenance costs, paying off the original investment, depreciation, and the estimated earnings of alternative investment. So in just one year, 1973, the Project, in direct benefits alone, produced 10 times its cost for that year. A ten-to-one return is a good return by anyone's standards.

(The year 1973 is frequently used in this study because it was the last year for which figures were available when the economic studies were conducted.)

The Project hasn't always been this profitable, however. The benefit-cost ratio remained low until 1941. It took a tremendous jump during and after World War II, reaching its highest point in 1947, 21 to 1. It remained up in that region until 1950, and has remained between 5 to 1 and 10 to 1 since then.

Figures don't really tell the story, however. The early years of the Project were a time of backbreaking work and little profit for the farmers, and often defeat. The Project was nicknamed "Heartbreak Row" by many of the farmers who came from the Midwest, attracted by visions of virgin land with abundant water promised to be delivered soon.

"Usually the first person on the land went broke," mused one farmer whose family came to the Project in 1914 when he was 3, and who has spent his life on the Project. "We settled on a homestead relinquishment of a fellow who gave up, and a lot of our early neighbors didn't make it."

Table 2. Annual Benefits and Costs, Boise Project, Idaho 1910-1974

Year	Benefits1/	Costs2/	Benefits-costs ratio
1910	$ 81,176	$ 92,253	0.88
1911	189,453	158,401	1.20
1912	251,098	178,306	1.41
1913	277,085	227,141	1.22
1914	428,143	215,240	1.99
1915	967,709	535,122	1.81
1916	2,141,320	568,796	3.76
1917	4,491,297	634,499	7.08
1918	6,320,271	1,223,147	5.17
1919	8,912,594	1,119,887	7.96
1920	5,040,977	1,357,102	3.71
1921	5,471,206	1,316,556	4.16
1922	4,201,691	1,090,028	3.85
1923	5,191,287	1,076,110	4.82
1924	1,540,804	1,083,701	1.42
1925	3,596,347	1,072,131	3.35
1926	1,981,333	1,002,727	1.98
1927	4,241,786	915,623	4.63
1928	3,696,307	1,002,866	3.69
1929	4,940,363	1,110,489	4.45
1930	2,596,434	820,970	3.16
1931	258,281	937,329	0.28
1932	-585,280	986,745	-0.59
1933	1,846,833	909,770	2.03
1934	1,990,237	954,189	2.09
1935	2,102,459	886,742	2.37
1936	3,758,259	894,983	4.20
1937	2,573,607	912,378	2.82
1938	1,601,629	848,292	1.89
1939	1,399,328	831,054	1.68
1940	1,435,221	795,306	1.80
1941	3,803,055	751,472	5.06
1942	8,694,476	813,762	10.68
1943	12,940,085	802,197	16.13
1944	13,572,153	871,772	15.57
1945	15,315,932	845,719	16.05
1946	16,550,460	878,139	18.85
1947	19,543,841	918,052	21.29
1948	19,508,075	1,310,295	14.89
1949	16,263,428	1,440,990	11.29
1950	13,624,552	2,449,264	5.56
1951	19,213,022	2,571,348	7.47
1952	19,491,682	2,609,283	7.47
1953	13,252,344	2,730,573	4.85
1954	16,228,609	2,511,156	6.46
1955	16,866,341	2,731,207	6.18
1956	19,282,881	3,289,993	5.86
1957	17,207,402	3,481,992	4.94
1958	18,592,658	3,358,138	5.54
1959	23,881,514	3,722,956	6.41
1960	23,020,971	4,190,924	5.49
1961	26,388,833	3,570,992	7.39
1962	25,161,280	3,894,026	6.46
1963	27,056,793	3,990,167	6.78
1964	23,293,714	4,164,056	5.59
1965	25,246,479	4,214,788	5.99
1966	27,539,946	4,444,172	6.20
1967	25,785,702	4.672,526	5.52
1968	26,214,227	4,775,835	5.49
1969	27,183,799	5,163,897	5.65
1970	27,997,367	5,456,328	5.13
1971	32,759,669	5,172,588	6.33
1972	38,099,994	5,112,211	7.45
1973	55,298,527	5,563,773	9.94
1974		5,685,621	

First the farmer had to build shelter, then clear the land, then level it so the irrigation water could flow across it. The levelling was done with teams of horses, and was a slow, arduous job. He then had to dig his ditches, learn the tricky process of irrigation, and finally grow some crops and hope prices held. All this meant several years of hard work with little if any income. "Most of them went broke because they had too much to do and too little to do it with," said a wrinkled farmer in his 80's, who came to the Project in 1910.

Another long-time resident of the Project added: "From what I've seen, it was usually the third or fourth person who settled a piece of land here who finally made it."

The farming economy of the region developed slowly until World War II. The years from 1913 to 1935 were, for the most part, years of subnormal rainfall, and even with the Project there was usually not enough water.

"Sure you make money here today, but it wasn't always like this," said the farmer in his eighties, who still works his land. "It took real sweat then, and a lot of people didn't last."

Pre-Project History

The history of the Boise area is the very stuff of the Wild West legend -- fur trappers and mountain men, Indian wars, the Old Oregon Trail, lawless mining camps, the coming of the ranchers, followed by the sheepmen, and finally the arrival of the settlers and the fencing of the range.

The Boise Valley was first discovered by whites in 1811. In 1834 the Hudson's Bay Company built Fort Boise at the confluence of the Snake and Boise Rivers, about 50 miles west of the present site of Boise. In 1853 it was wrecked by floods, and its demise and the growing hostility of Indians halted any attempts at permanent settlement for 10 years.

In 1862 gold was discovered in some creeks in the rugged foothills above Boise, and less than a year later silver was discovered 60 miles southwest. The gold rush was spectacular. In January, 1863, there were 3,000 people in the Boise area. By July there were 19,000! As the gold and silver seekers poured in, enterprising farmers quickly began to plant crops on the easily-irrigated bottomland along the Boise River to feed them.

Who could tell in the early 1800s we would one day be able to view man's water diversion accomplishment in the Boise region such as this view of Arrowrock Dam and Reservoir. (1967)

The next few years were the most colorful in the area's history. Ramshackle mining camps were hastily slapped together out of canvas and raw lumber, whiskey was often paid for with gold nuggets in the many saloons, and pokes of gold dust were smuggled out of the camps at night to evade robbers. It is estimated that from 1864 through 1867, 28 million ounces of gold were mined in the area.

By 1868 the gold was beginning to peter out. Idaho City, which at its peak contained somewhere between 15,000 and 30,000 people, dropped in two years to under 1,000. But permanent settlements had taken root, and many people stayed on as farmers. Farmers along the bottomlands painstakingly lengthened their small canals in an effort to help their crops of grain and vegetables survive the dry summer months.

As the miners left, cattlemen moved in and began grazing their herds throughout the area. By 1880 sheepmen moved in, forcing the cattle back to the higher ground.

The number of farmers grew. From the 1870's onwards, small groups of farmers banded together to dig canals on the bottomlands, or hired contractors to build canals and small diversion dams to raise water to the lands along the sides of the valley. By 1900, there were an estimated 96,500 acres of irrigated farmland in the area, most of it along the bottomlands of the two rivers, but some part way up the first benches, thanks to modest diversion schemes.

Farmers were constantly planning or trying to build projects to raise water higher up the benchlands. Researchers pieced together this brief sketch of one, the New York Canal.

"Investors from New York, seeking to develop a large-scale canal that could be used for both irrigation and placer gold mining, financed the start of the canal in 1882. Efforts to complete the canal were hampered by business failures, national financial panics, and occasional floods which wiped out significant construction work. Anticipating a firm supply of water from the new canal, settlers had taken up homesteads as early as 1884. The failure of the private interests to provide water to these pioneers was especially resented."

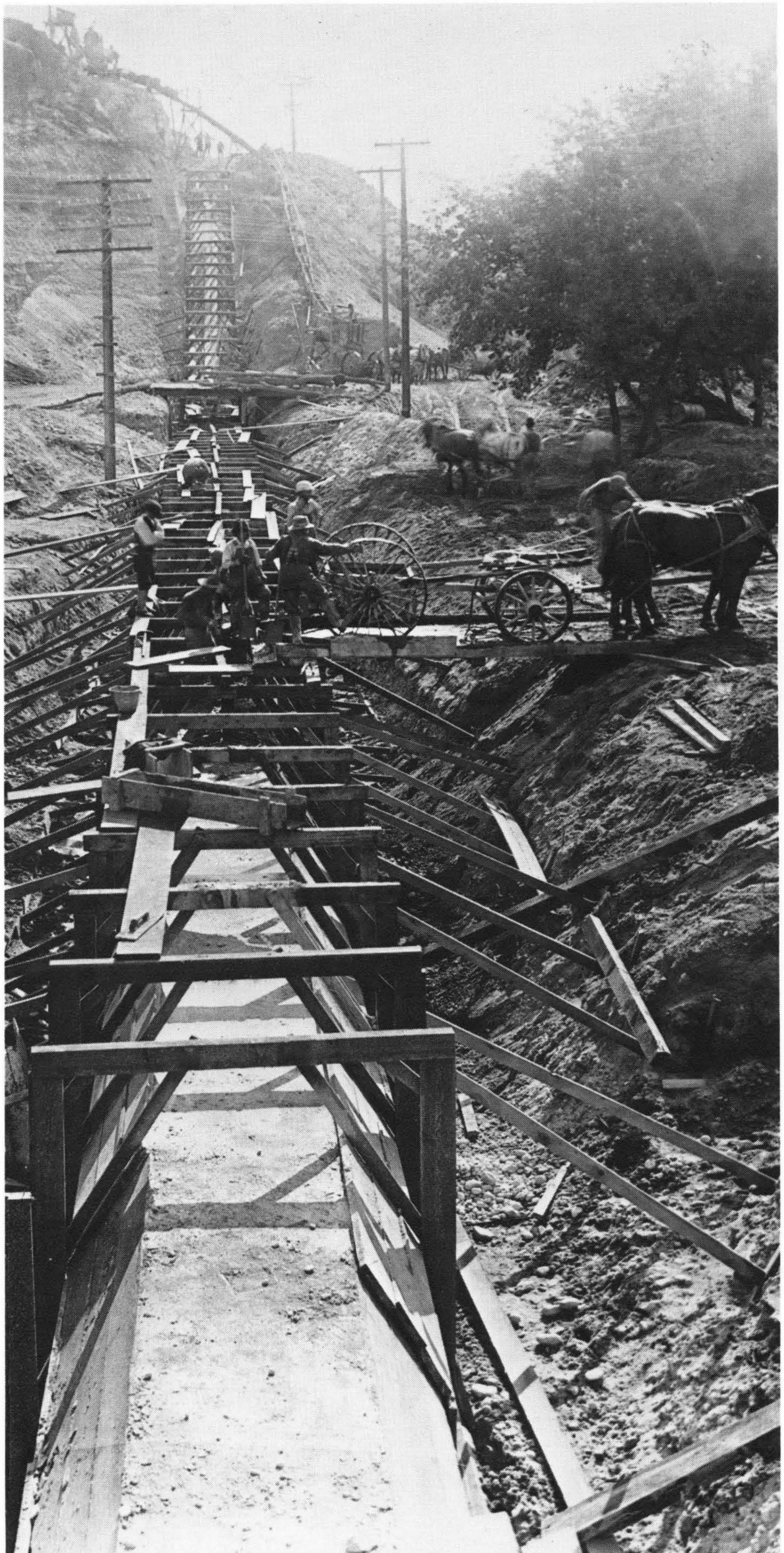
"Finally in 1900, 19 years after the initial construction, the New York Canal was opened. As originally conceived, the canal's capacity was to be 4,500 second-feet of water; in 1900 it carried 200 second-feet. Diversion into the canal was by the rubble diversion dam that had to be rebuilt each season. The grandiose plans of the private developers had collided with the late 1800's technology of building and financing." Many farmers who had anticipated quick completion of the canal had by this time gone bankrupt and abandoned their farms.

Planning the Boise Project

The Reclamation Service was formed in 1902, and actively sought irrigation projects that could be quickly and successfully developed. The need for a project in the Boise Valley was obvious, and the Reclamation Service began considering one, but the tangle of private canals and the many ongoing conflicts over water rights detracted from the attractiveness of the Project.

People had been filing water rights since the 1860's, and on paper the rivers were vastly overappropriated. Litigation to clarify the situation was started in 1902 and took four years. In 1906 the Stewart Decree established priorities for all who had appropriated Boise River water from June 1, 1864, to April 1, 1904. It also provided a sliding scale mechanism for allocating water when the demand exceeded the supply.

While the water rights litigation was taking place, other requirements for the Project were being met. In 1900 the Idaho legislature



Reparing the break in the New York Canal.

had legalized the formation of irrigation districts, and farmers began to form them. In 1904, the Pioneer Irrigation District and the Nampa-Meridian Irrigation District, together with a number of landowners who supported the project, organized the Payette-Boise Water Users Association. This provided a unified agency that could legally deal with the Reclamation Service.

Project History

The Boise Project was formally approved by the Secretary of the Interior on March 25, 1905. Soon after the Stewart Decree was issued, the Reclamation Service signed a contract with the Water Users Association providing a credit of $14 per acre for their earlier investments in canals and improvements. With the legal arrangements complete, the work on the Project could begin.

The plan called for the building of the Boise River Diversion Dam, the enlarging of the New York Canal, and the creation of Lake Lowell (at that time called Deer Flat Reservoir). Three large embankments would be built around the edges of Lake Lowell to enable it to hold water diverted to it via the New York Canal. Many canals would be built to distribute water throughout the area.

In the summer of 1906 the Reclamation Service began controlling water deliveries through existing canals, and work began on the dam, the New York Canal (renamed the Main Canal) and Lake Lowell. Many photographs of the construction work exist today. They show rugged men standing stolidly beside teams of mules and horses hitched to heavy wagons and scrapers.

It was an enormous undertaking. The three embankments of Lake Lowell took 2.3 million cubic yards of material, most of it hauled a mile or more. Many farmers joined the construction crews during the offseason to earn some extra money. They were also busy levelling their own land and preparing their ditches. The water would only be delivered to the high corner of a farmer's land, and what he did with it after that was his responsibility.

Lake Lowell was not completely finished until 1909, but by the fall of 1908 water diverted by the Boise River Diversion Dam was flowing through an enlarged and resurfaced Main Canal and filling the reservoir. In the spring of 1909 some new acreage was being irrigated, although figures don't show how much.

Fully three-quarters of the water stored in Lake Lowell that first year was lost through seepage and percolation, as is often the case when irrigation water is first stored on hitherto dry land. Soon after deliveries finished, the remainder of the water vanished through the porous bottom of the reservoir. The general opinion was that it might take 15 years before the reservoir would hold water, and many farmers were close to despair. There was immediate pressure for more storage space, and this led to the construction of Arrowrock a few years later.

By 1910, the first year for which figures are available, 33,000 acres of formerly dry land were being irrigated by the Project. The New York Irrigation District had 18,000 acres already under irrigation and began buying supplemental irrigation water. The construction of Lake Lowell had cost $1,068,000, and the Boise Diversion Dam had cost $572,500, which included a small powerplant.

The waterloss problem slowly lessened as natural silting began to seal the bottom of Lake Lowell. By 1914 seepage and evaportion loss had dropped to 42 percent, and about 50 miles of drainage ditches to handle the seepage were under construction downgrade from the lake.

All the construction costs had to be repaid by the farmers. Unlike today, none of the cost was allocated to other benefits such as power or recreation. They payments were calculated on a per-irrigable-acre basis. Whether the farmer was actually irrigating a particular piece of land did not matter -- if that land could be irrigated, he was charged for it.

(Repayment formulas were changed a number of times over the years to make them less onerous. Repayment periods were extended to 20, and then 40 years. For a long time, fixed payments were replaced by percentage formulas based first on the previous year's crop, and then upon crop averages over a period of years.)

By July, 1910, Lake Lowell, in its first year of full storage, was already unable to supply the full demands of its customers. Arrowrock Dam was authorized, and construction began in 1911.

It was a big job. It took four years, cost $5,322,000, required the excavation of a half million cubic yards of material and used another half million yards of aggregate for concrete. When it was finished it was the highest dam in the world, 257 feet above streambed, with another 93 feet to bedrock, for a total height of 350 feet. When filled, the dam pool extended about 10 miles back along the two major forks of the Boise River.

Originally the dam had been planned to hold 150,000 acre-feet of storage, but because of the cries for more water, and the unexpectedly high seepage rate of Lake Lowell, the proposed height was raised twice. The final design anticipated a storage capacity of 230,000 acrefeet, but when the reservoir was finally filled it was discovered there was an extra 47,000 acre-feet of storage. Moreover, the final construction cost of the dam $5,322,000, was only 70 percent of the estimate. As with Lake Lowell, 100 percent of the construction cost was charged to the water users.

So concerned was the government about being repaid for every cent it spent on the Boise Project that before the Project was begun the potential water users themselves posted an $8,000,000 bond as a guarantee. Otherwise the government might not start the

Project at all, they believed.

The years from 1906 through 1917 were a time of furious construction and expansion. Most of the Arrowrock Division's hundreds of miles of canals, flumes, and drainage ditches were built during this period. By 1918 the canals and drainage construction were essentially completed, at a cost of $9,491,000, an enormous figure in those days.

Irrigated acreage jumped from 51,000 in 1910 to 63,500 in 1911, and to 79,700 in 1912. After a lull in 1913, it jumped to 101,000 in 1914, 132,000 in 1915. By 1918 it had reached 183,000, and then took its biggest jump ever, to 224,300, in 1919. Growth after that was slow and steady, the big rush was over. Today, over 340,000 acres are irrigated (See Figure 2.)

The completion of Arrowrock in 1915 only temporarily ended the clamor for more storage. Several dry years, particularly 1924 and 1926, prompted farmers to call for yet more water.

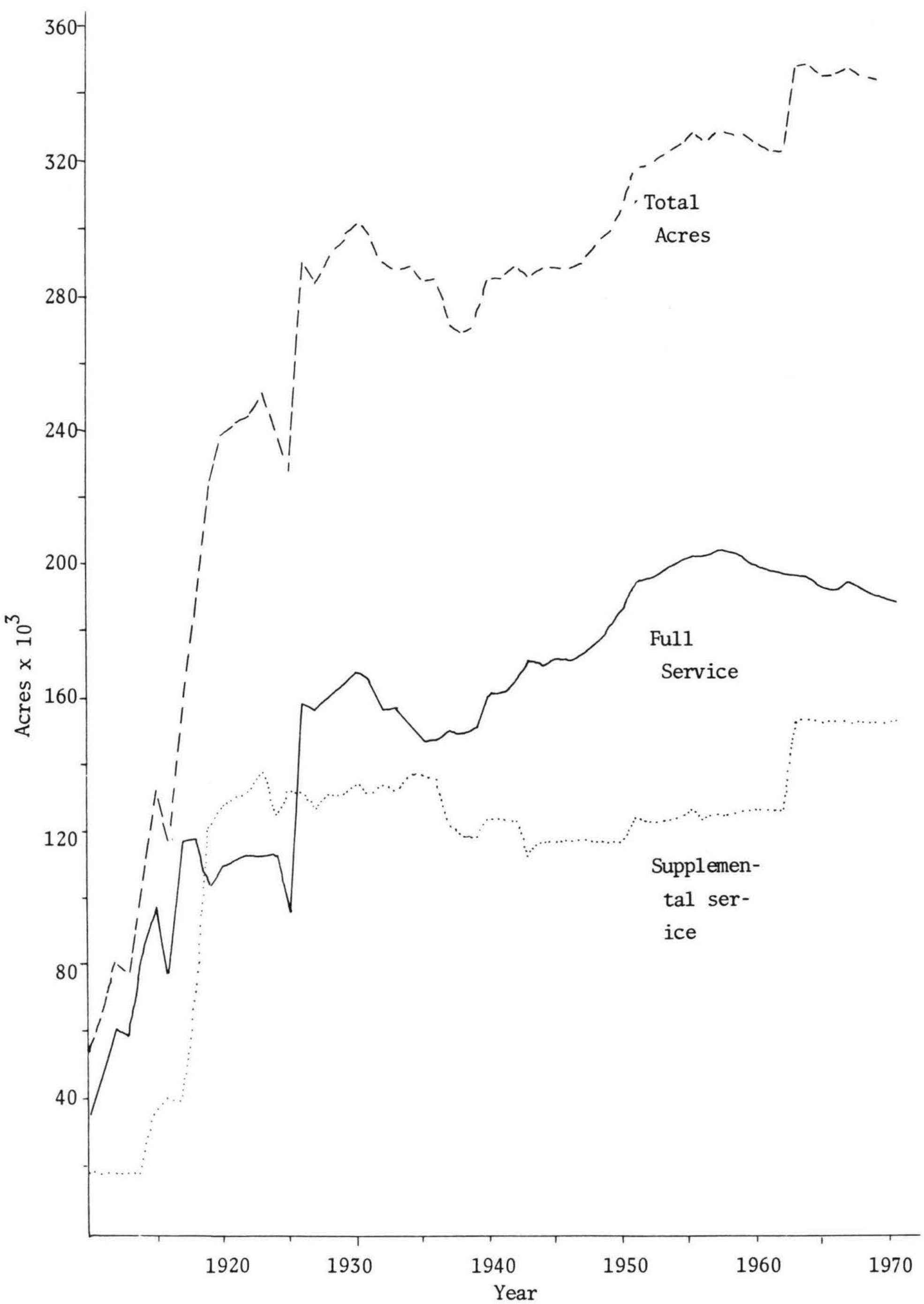
Reclamation engineers found that drainage water at one part of the project could be piped under the Boise River and used to irrigate land on the other side. The "Notus siphon" -- a misnomer, as technically it's not a siphon -- and the Notus Canal into which it emptied, was built in 1919-20, and the first 6,900 acres of what eventually became the Payette Division of the Project began receiving irrigation water.

An expansion of the Payette Division occurred in 1924 when the Bureau of Reclamation (the Reclamation Service was renamed in 1923) completed the Black Canyon Dam for $2,600,000. The main canal that it was to divert water into, however, wasn't begun for another 10 years. Until then, the dam's main function was to divert, by hydraulic pumps, water for the Emmett Irrigation District, which was almost collapsing because of water shortage. The dam also produced power from two 4,000-kw generators.

In 1926 the five irrigation districts of the Arrowrock Division -- New York, Boise-Kuna, Nampa-Meridian, Wilder, and Big Bend -formed an umbrella organization, the Boise Project Board of Control, to handle the administration of their areas and represent their interests to the Bureau of Reclamation.

In 1931, Deadwood Dam, 40 miles upstream from Black Canyon, was completed after two years of construction. It cost $1,400,000 and provided 161,900 acre-feet of storage. The storage had little use aside from assuring water for power production, until the Main Black Canyon Canal was constructed from 1936 to 1940.

Figure 2. Total irrigated acreage, Boise Project, Idaho, 1910-1973



The Depression

During the Great Depression the Boise Project irrigation system protected the Boise Valley farmers from the worst. "There just wasn't any money at all, but you could get by," one farmer recalled. "You had the water, and could raise some crops; selling them was the hard part. Everybody had some cows and chickens, and some hogs. You could get by on what you raised. Everybody kept cows; those cream checks were just about the only money anybody had."

For some farmers, the economy of the Boise area almost reverted to a barter system. "Money was so scarce that when they did come in with their cream checks to buy goods, I didn't have any change to give them," recalled the owner of a mercantile store on the Project.

Complaints about lack of storage persisted in the Arrowrock Division, and in 1936-37 the Bureau of Reclamation raised Arrowrock Dam five feet to provide an extra 9,000 acre-feet of storage. It wasn't a big increase, but every little bit helped.

In 1936, work on the Main Black Canyon Canal and subsidiary canals began. By the time they were completed in 1940 about 27,000 acres had become irrigable. This put great demand on Deadwood Dam's storage, and so in 1940 Cascade Reservoir, an immense reservoir of 653,000 acre-feet, was authorized for the Payette Division. It was located 75 miles north of Boise on the North Fork of the Payette River and cost $8,462,000. Its construction was delayed by World War II and was finished in 1948.

A large storage reservoir for the Arrowrock Division, Anderson Ranch Dam, was also approved in 1940, and its completion was also delayed because of the war. It was built in the foothills about 65 miles southeast of Boise on the South Fork of the Boise River, and had a capacity of 423,000 acre-feet. Water storage began in 1945, although the dam was not considered officially complete until 1950.

The Anderson Ranch Dam reservoir was more than 13 miles long, and almost doubled the Arrowrock Division's water storage capacity. It cost $29,885,000, far and away the greatest expense of the Project. In fact the entire capital cost of the Project up to Anderson Ranch Dam's construction was $29,300,000, less than the cost of the dam. Originally Anderson Ranch Dam was supposed to cost $13,000,000, with 50 percent of the

"What a difference a ditch makes." This aerial view of the Black Canyon Canal shows very graphically how arid desert land can be transformed into highly productive farm lands with the addition of irrigation water. The cultivated lands in the photo are mostly fruit orchards of the Emmett Valley. (1966)

cost being allocated to irrigation and charged to the farmers. Most of the rest of the cost was allocated for power, with a small amount for recreation. Costs ballooned, and the dam ended up costing more than double the original estimate. The farmers were protected; there was a 10-percent override provision, so they ended up paying only 60 percent of the original anticipated estimated cost. The extra cost was allocated for flood relief.

In 1949 a pumphouse in the Payette Division housing five large pumps came on line, pumping water 90 feet up from the Black Canyon Main Canal to a higher bench level and putting 24,500 acres within reach of water. Large-scale construction of canals and laterals accompanied this, and when finished in 1956, had cost $9,273,000.

This brought construction of the Boise Project to a close, as far as the Bureau was concerned, with a total construction outlay of $69,167,000. There was still the Corps of Engineers' Lucky Peak Dam to come, though. This flood control dam was needed because Arrowrock and Anderson Ranch Dams could not always handle all the spring runoff. Lucky Peak could contain the surplus water and thus prevent flooding, and of course the water it stored would be available for irrigation. Lucky Peak cost $22,066,000, was finished in 1954, and stored 279,000 acre-feet.

Originally it was envisaged that the Lucky Peak reservoir would be drawn down before Arrowrock during the summer. But the reservoir became very popular, with water skiers and boaters from Boise, as it was far more accessible than Arrowrock. The procedures were changed so that Lucky Peak reservoir was kept full while Arrowrock was drawn down. In normal years, Lucky Peak can be kept full until around September 1, and is available for the peak vacation period of July and August.

Economics

As might be expected, there have been dramatic changes in the amount and type of agriculture in the Boise Project over the years. The amount of money earned by the crops has increased tremendously, and the agricultural production has attracted much secondary and service industry.

The audit's studies of the Boise Project's direct and secondary economic impacts are long and complex. The economists who conducted them examined reams of data, and encountered some areas where data were sparse or nonexistent. The Boise Project has now become a great economic success: the value of the crops made possible because of the Project's water has exceeded the cost of the Project many times over. But the question of exactly how much is a far more difficult one to answer. In trying to determine these figures, the economists began by splitting the economic impacts into direct and secondary impact.

Direct Economic Impacts

Back in 1880 there were about 20,000 acres of crops in the Boise Valley: 6,300 acres in hay and pasture, and 13,600 in grain. By 1890 this had grown only slightly to 24,700 acres. Grain acreage had fallen by half, there were about 1,200 acres in fruit and vegetables, and the rest was hay and pasture.

There was a big jump from 1890 to 1900, to 70,000 acres. Most of that, 45,500 acres, was hay and pasture, with 20,700 acres in grain. In 1910, which is considered the first full irrigation year of the Project, 51,400 acres of irrigated crops were harvested in the Project area, with a g.v.a. of $205,500.

The researchers obtained the irrigated acreage figures, crop yields, and crop values from various Reclamation Service reports and publications. The Service did not collect production costs, however. The economists computed production costs for the most important crops grown in the valley, using 1971 prices. Another set of crop production budgets was created for the 1920's using Experiment Station bulletins. It was assumed that cost projections for 1971 would be accurate back to 1950, and the 1920 budgets would be accurate up to 1930. The period from 1930 to 1950 was a transitional period, and the two price ranges were averaged, with an index.

Project Cropping Patterns

By 1914, when Lake Lowell had been providing water for four years, irrigated acreage had jumped to 101,600, with 83,600 totally dependent upon the Project for water. The market value of the crops raised that year on the Project was $1,654,000. Just over $1,028,000 was spent producing the crops - most of this money accruing to merchants and workers in the Boise Valley--leaving the farmers with a gross profit or g.v.a. of $625,800. Alfalfa hay was a particularly popular crop. In 1911, 6,000 acres were planted. This rose to 10,400 in 1912, to 15,400 in 1913, and 23,400 by 1914, a phenomenal increase.

The year 1914 marked the beginning of what was to become another major crop, alfalfa seed. Only some 300 acres were planted that year, but years later it would reach a peak of 23,000 acres before stabilizing around 11,000 acres.

A fledgling apple crop had been started at the beginning of the Project and by 1914, 272 acres of trees were harvested. Prices dropped drastically, however: apples that had earned the grower $185 per acre in 1912 and $122 per acre in 1913 suddenly brought in only $11.15 per acre in 1914 while the cost of raising them remained around $53 per acre. Needless to say, apple growers lost money and continued to lose money as their orchards, planted in times of high prices, began to mature. Apple growers as a whole lost money in fully 18 of the 36 years between 1914 and 1940.

The early days of the new Project was a time for trying out new crops. Barley, clover seed, corn silage and field corn were all introduced about this time and went on to become major valley crops. Others became only moderately popular, eventually attaining a modest place in the valley's agricultural economy. Green beans, for example, were first planted in the Project in 1913. The 120 acres returned a small profit, so the next year growers planted 600 acres. The price dropped, however, and growers lost money. That diminished the enthusiasm for green beans as a crop. With minor exceptions, the acreage never rose above 900 until the heady days of World War II. By 1973, bean acreage had stabilized around 3,000 acres.

The first attempt to start what eventually became a small but healthy onion industry began in 1913 and 1914. But in both years the 10-acre crop lost money, and it would be many years before onions became a significant factor in the valley's economy.

The years 1913 and 1914 saw the start of a prune crop, with 8 and then 12 acres harvested. The 1914 harvest earned its growers the grand reward of a $105 loss, not counting depreciation.

As water became available from Lake Lowell, residents of the irrigated areas started truck gardens. By 1914 these occupied 726 acres and had earned a gross profit of $15,000.

In 1915 the Arrowrock reservoir was filled, and suddenly there was 454,600 acre-feet of storage for the project instead of 177,000. Up to that time an estimated 18,000 acre-feet of water had been sold each year to "supplemental users," that is, irrigation districts formed by farmers who were not totally dependent upon Project water. In 1915, with the extra water available for sale, the amount sold to the supplemental users jumped spectacularly to 98,350 acre-feet.

Water supplied to "regular users," as distinct from the others, was 273,000 acre-feet that year, compared to 220,000 the year before. (Water deliveries to "regular users" had been increasing steadily every year. In 1911 it had been 81,500 acre-feet, in 1912, 120,000 acre-feet, and in 1913, 139,000 acre-feet.)

In the period 1915-1924, up to the time Black Canyon was completed, total irrigated acreage rose from 132,000 to to 240,000 acres. The number of acres being fully supplied rose only a small amount, from 97,000 to 114,000, but the number of acres receiving supplemental water rose dramatically from 35,000 to 126,000.

So far as crops during that time were concerned, the greatest increase occurred in the alfalfa hay crop, with acreage growing steadily from 22,000 in 1915 to 47,500 in 1924.

From a small start of 82 acres in 1910, the barley acreage had reached almost 2,800 acres by 1915. It fluctuated around that figure for a few years and by 1924 more than 6,000 acres of it were being grown.

In 1915 there were 1,400 acres of potatoes and this increased yearly as the price of potatoes rose, until by 1921 5,200 acres of potatoes fetched the unheard-of price of $260 an acre. This induced many more farmers to begin growing potatoes, and in 1922 12,000 acres had been planted. The market collapsed, and an acre of potatoes fetched only $29, about $12.50 less than it cost to grow it. Acreage then declined to 7,600, 5,100, and 2,600 over the next three years, and prices rose.

Prune acreage grew slowly but steadily, and by 1924 there were 984 acres. Unfortunately, the crop only turned a profit twice from 1916 to 1924.

One of the larger crops in terms of acreage on the Project was wheat. By 1915, 17,500 acres of wheat were planted. Acreage fluctuated during the next decade, reaching a maximum of 30,000 acres in 1918 and then dropping to 15,400 in 1924.

From 1925, when Black Canyon was completed, to 1931, when Deadwood was finished, irrigated acreage jumped from 227,000 to 297,000 acreage. This was a time of unpredictable prices. Pasture increased considerably, from 9,000 acres in 1925 to 24,000 in 1931 and 26,500 by 1932. Wheat acreage was 21,600 in 1925, rose to 42,000 in two years, then subsided to 19,000 by 1931.

Cushioned

The Boise Project cushioned the impact of the Great Depression on Project farmers. The Depression years were still considered "hard times" by the Boise Valley farmers, but considering what farmers elsewhere were experiencing, things could have been a lot worse.

The driest year was 1931, with only 580,000 acre-feet delivered to the farms, 1.95 acre-feet per acre. Growers had become used to almost 4 acre-feet per acre. Nineteen thirty-four was also a dry year, with only 2.32 acre-feet per acre delivered. These two dry years cut yields, but did not cause crop failures by any means. Water deliveries were close to normal for the rest of the thirties.

Profits dropped precipitously, however. The g.v.a. in 1929 was more than $3,000,000. In 1931 it was only $784,000. In 1932, in the depths of the Depression, with no water shortage, it was actually a minus figure, -$64,000.

In the late 1920's the g.v.a. of the crops averaged about $5,000,000 annually. This dropped to the low points of 1931 and 1932, hovered around $2,500,000 annually from 1933 through 1935, then dropped to around $2,000,000 a year during 1938, 1939 and 1940. The farmers were marking time. It was a period of stagnation and it ended abruptly.

World War II

The forties were a dramatic time in the Boise Project's history. The worldwide depression was ending under the impetus of the demand from Europe, where World War II was underway. In 1939 the g.v.a. of the Project's crops was just over $2,000,000 but in 1940 it more than doubled to $4,500,000. In 1942 the g.v.a. more than doubled again to

$9,500,000. In 1943 the g.v.a. rose to $13,000,000, the next year to $14,500,000. In 1945 it was $16,300,000. It didn't stop rising when the war ended either; demand stayed high. In 1946 the g.v.a. was $17,800,000, in 1947 more than $21,000,000, and in 1948, $21,300,000. Not until 1949 did it drop to $18,300,000.

The Boise Project had "taken off." It had reached a new level and it never returned to the old one. Some people have likened the Project at that time to a car with a powerful engine that had never been driven fast. When the power was needed, it was there. The canals were dug, the water was available, the Project was idling along in low gear simply because prices were low. Prices jumped, and it was as if someone had tramped on the accelerator.

Some crops leaped during the war, then settled down again, or fell out of favor. Others received a major boost and remained important. Truck gardens, which had never figured heavily in the agricultural economy, suddenly in one year, 1943, doubled in size to 6,800 acres of truck gardens, an acreage never achieved in Idaho before or since, produced crops with a g.v.a. of $1,160,000. Next year, acreage increased to 11,800, but the g.v.a. plummetted to $372,700, and truck gardens began to decline. By 1973 they occupied less than 500 acres in the Project.

In 1943, wheat acreage jumped to 19,000 acres from 11,000 acres the year before, and g.v.a. almost tripled to $562,000. This marked the beginning of a rapid long term expansion of wheat. By the early 1970's the crop had achieved a g.v.a. of $2 to $3 million annually.

Other crops that made spectacular jumps during the war years were potatoes (from 4,300 acres and a g.v.a. of $467,000 in 1942 to 13,000 acres worth $1,323,000 a year later), pasture (40,660 acres and a g.v.a. of $537,000 in 1942, 46,400 acres with a g.v.a. of $1,367,000 in 1943), and "other seed" (8,580 acres with a g.v.a. of $427,000 in 1942, 12,800 acres with a g.v.a. of $1,181,000 in 1943, 17,000 acres with a g.v.a. of $2,084,000 in 1944).

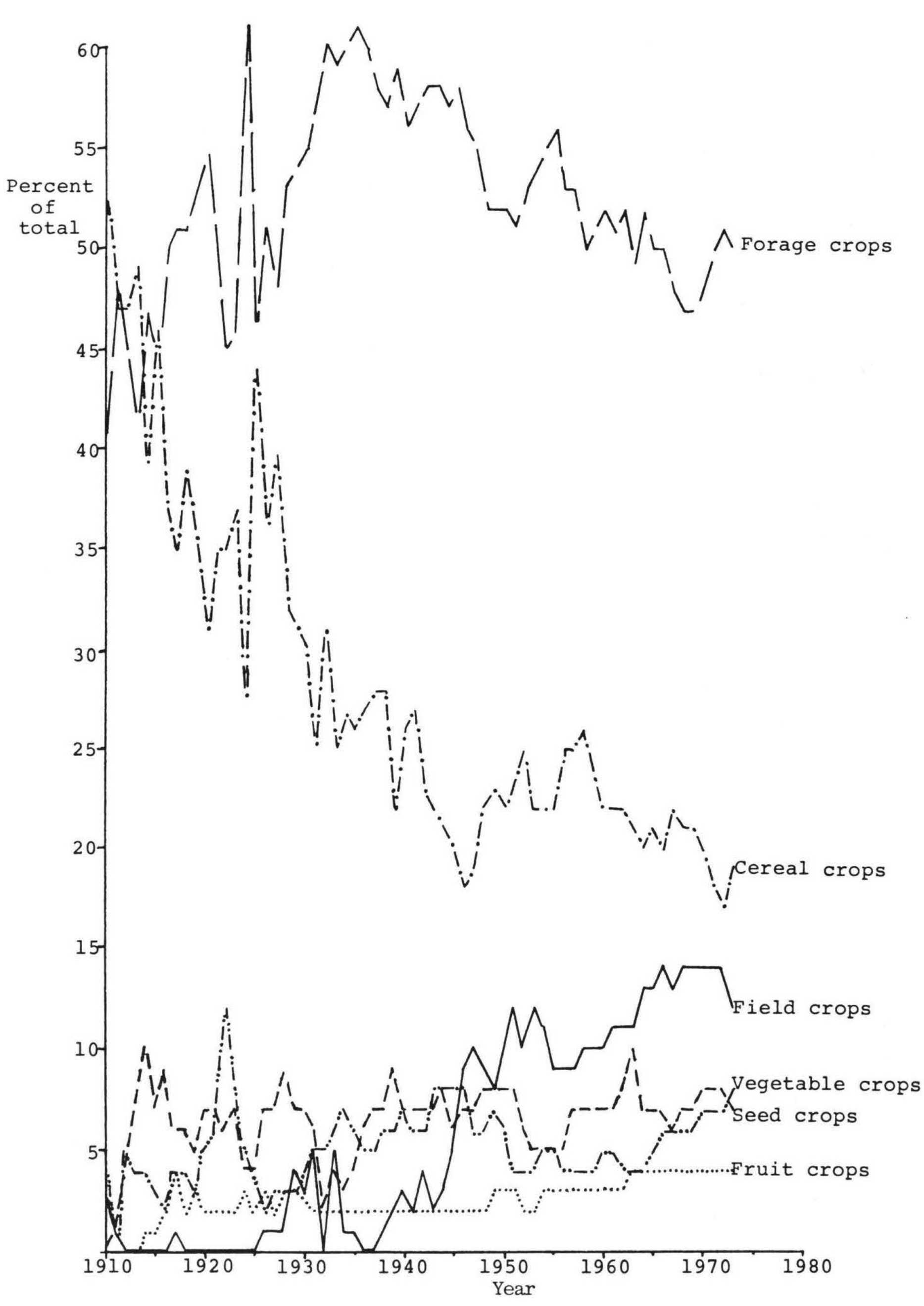
Mature Project

In 1948 Cascade Reservoir came on line, ending any water storage worries for the Payette section. Soon after, the pumphouse on the Black Canyon Main Canal opened, giving some 24,500 acres potential irrigation. Anderson Ranch Dam and then Lucky Peak ended storage problems for the Arrowrock Division.

Cropping patterns up to 1973, the last year of statistics used in the study, have not varied widely since the Project became "mature." (See Figure 3.) Alfalfa has enjoyed a steadily increasing profitability. Alfalfa seed has also become more profitable. There was a sudden jump in alfalfa seed acreage in 1963 to more than 23,000 acres, but that has since returned to around 10,000, still a big change from the 300-odd acres raised prior to World War I.

Apple acreage grew steadily up to the late '60s and has now levelled out to between 7,000 and 8,000 acres. The g.v.a. fluctuates widely from year to year.

Figure 3. Cropping patterns, Boise Project, 1910-1973



Barley acreage dipped in the '50s, but bounced back in the '70s with rising acreages and profits.

Clover seed has dwindled in acreage and lost the importance it had in the '40s and early '50s, although it showed a nice profit in 1973.

Corn silage acreage has grown spectacularly from less that 3,500 acres in 1951 to more than 31,000 in 1973, with a g.v.a. of $3,800,000.

Hops, lettuce seed, mint, and onion seed are among the crops that have been introduced in the past 20 years and have made a place for themselves in the valley's agricultural scheme.

Oats and 'other forage' acreage have declined. Major crops such as onions, fruit, potatoes, sugar beets and sweet corn all seem healthy. Their profitability varies from year to year.

In general, there has been an increase over the years in intensive, high value crops -- seed, row crops, vegetables, and fruit. By 1973 they accounted for 30 percent of the acreage in the project, compared with 15 percent in 1940.

From 1947 to 1973, the Boise Project's crop output values remained around 10 or 11 percent of Idaho's. This is indicative of the growing output per acre of Project land, because the Project's acreage remained fairly constant during that time while farmland area in Idaho as a whole expanded.

The largest crops, by acreage, in 1973 were: alfalfa hay, 22 percent; pasture, 17 percent; corn silage, 9 percent; sugar beets, 8.5 percent; barley, 7 percent; wheat, 5 percent; and potatoes, 3.5 percent. These together accounted for three quarters of the acreage in the Boise Project.

The market value of the crops grown in 1973 alone was $87,500,000, while the total construction cost of the Project was $69,000,000. Of course a dollar in 1973 was worth less than one spent in 1909, and one must remember that crops of some value would have been produced with the Project. Nevertheless, the comparison is a striking one.

Secondary Economic Impacts

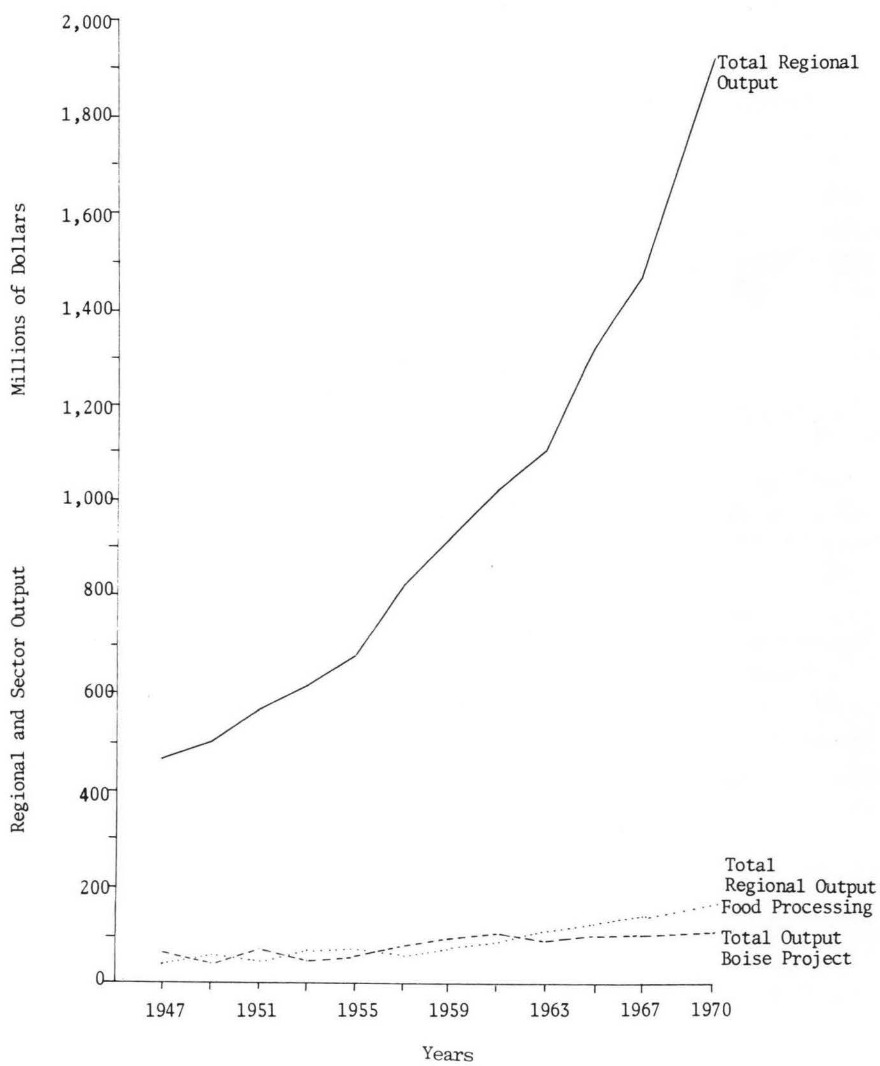
The direct profits realized from the crops of the Boise Project do not tell the whole story. An estimated one third of all household income in the Boise Project is derived directly or indirectly from the Project.

The main task of the economists studying the Boise Project's secondary economic impacts was to develop an aggregate regional model that would simulate the economies of Idaho, the Boise region, and the Boise Project area in order to evaluate the impact of the Project on income and output.

During the time the Boise Project was expanding, so was the output of the state as a whole, so it was necessary to try to separate the increases caused by the Project from the increases that would have occurred regardless. This was a complex task, as statistics were only available either on a county-by-county of statewide-only basis, when they were available at all.

It is obvious that the secondary impact was of enormous importance. Money earned by the farmers was spent on seed, chemicals, machinery, clothing, food, fuel, and other goods and services. Indeed, according to most farmers in the area, until the forties, everything they earned from their crops was immediately spent -- and often money they didn't have as well. The money earned by the builders, owners, and laborers of the

Figure 4. Comparison of total outputs for the Boise Region of food processing on the Boise Project, Idaho, 1910-1973.



food processing industry was also spent in the community to a large extent. But these secondary economic impacts are far easier to describe in words than measure in numbers.

The economists stated that while some of the data needed to evaluate the impact of the Boise Project are missing, there are enough to permit reasonable estimates of these impacts.

Food processing is the most conspicuous industrial offshoot of the Boise Project. As one drives through the Project area, particularly the outskirts of Nampa and Caldwell, one is impressed by the large number of packing houses, food processing plants, crop warehouses, container factories, and similar businesses related to food processing.

The food processing industry developed as a result of the Project, but after 1961 the industry began expanding faster than the Project's output, and began processing crops grown outside the Project area and shipped in.

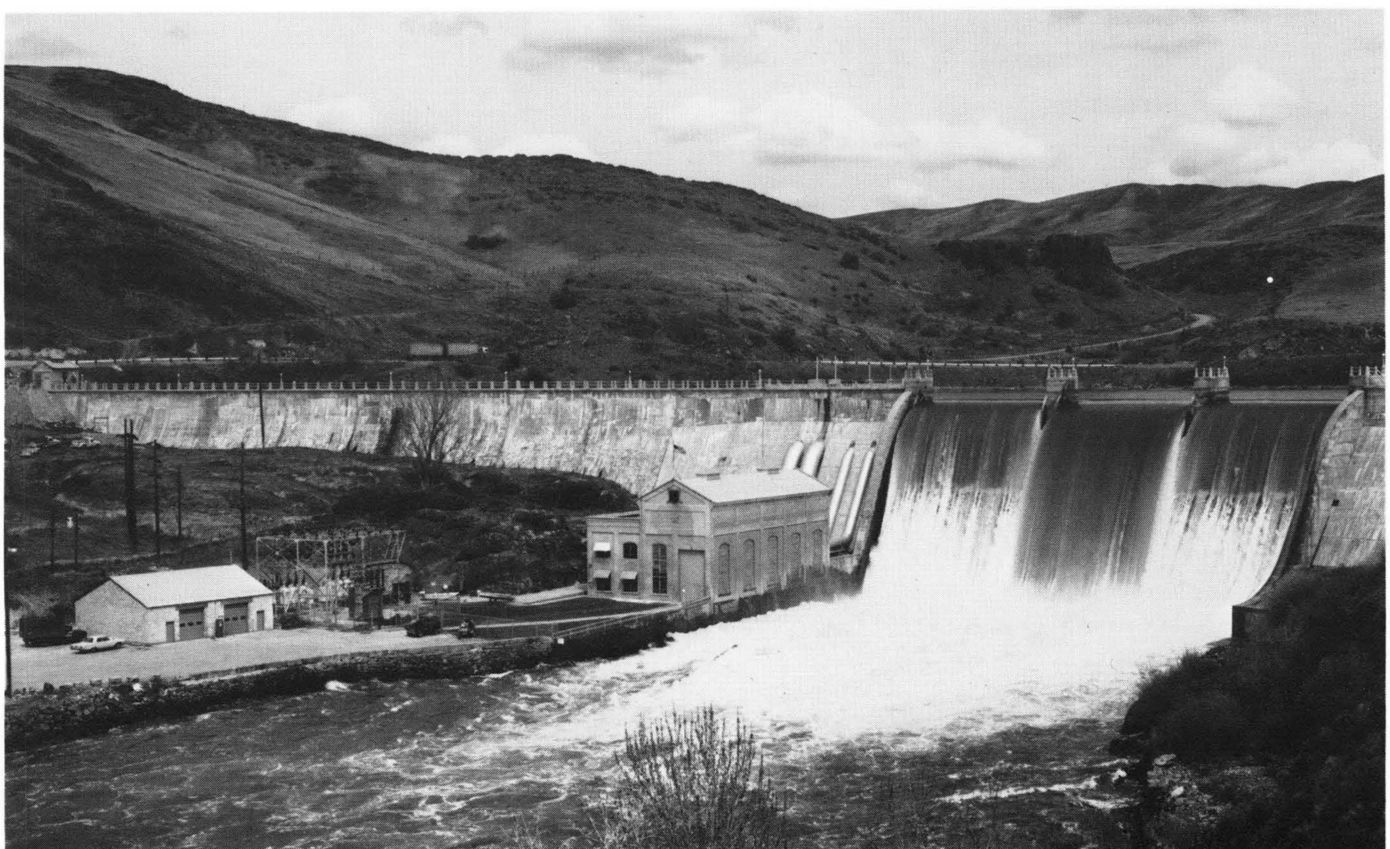
Prior to 1940 the food processing industry was not as important to the region in terms of money as the crops themselves. In 1947 the total output of Boise Project crops and the output of food processors in the Project area were about the same. By the 1960s the food processing industry's dollar impact had surpassed the Project's. In 1970 the annual output from food processors was worth $55,000,000 more than total output from Boise Project's crops. (See Figure 4.)

The Project is becoming a smaller portion of the Boise area's economy. The Boise area has been growing rapidly over the past two decades. (See Figure 4.) Between 1947 and 1970 the total annual output of the Boise Project doubled (from $51,000,000 to $114,000,000) while the total output of the Boise region quadrupled (from $466,000,000 to $1,923,000,000). The percentage of the regional output derived from Boise Project crops fell to 22.1 percent from 41.3 percent. At the same time the total impact of the food processing industry on the area's economy fell much less, to 25 percent from 30.3 percent.

Power Production

Three of the Project's dams contain power plants. The Boise River Diversion Dam has a power generating capacity of 1,500 kw and in its first year generated about 8,000,000 kwh, worth $13,500.

Black Canyon Dam has an 8,000 kw plant. Anderson Ranch Dam has by far the biggest power plant, 27,000 kw. Power generated by the three plants averages about 220,000,000 kwh annually, and earns $550,000 to $600,000. Seven percent of the Boise Project's total construction and O&M costs have been allocated to power. As this is exceeded by power revenues, power has consistently shown a profit.



Black Canyon Dam with all the spillways running during a heavy spring runoff. (1971)

The 'Without' Scenario

Before any federal project is built, anticipated benefit-cost ratio must be established, and the anticipated benefits must exceed the cost of the project. The government also requires a "without" scenario. The future growth and output of an area "without" the project must be estimated in order to ascertain the project's desirability.

A "without" scenario was not required when the Boise Project was built, but three researchers-and engineer, a mathematician, and an economist--created one for this audit. They first created a hydrologic model of the area, a month-by-month picture of the streamflow of the Boise and Payette Rivers since the Project began. Fortunately, streamflow measurements had been taken from the beginning. Once the streamflow was known, the researchers could estimate how much land could have been irrigated each year, what type of crops could have been grown, and what sort of yields the growers might have achieved. Because crop prices for each year were known, the value of these hypothetical crops could then be estimated.

The model took into consideration monthly streamflow fluctuations, and the time lag between increasing or decreasing water supply, and increase or decrease of farm acreage. Changes in cropping patterns, markets, and technology were assumed to have occurred in the same manner as actually occurred with the project. The introduction of sprinkler irrigation was included in the model as was the assumption that there would have been some privately-funded construction of storage capacity.

The "without" researchers estimated that irrigated acreage would have started at 84,000 acres and would have risen to 261,000 by 1973. The "without" scenario postulated that by 1972 the Boise Project area without the Boise Project would have had 77 percent of the actual Project's acreage, 36 percent of its water, and 18 percent of its agricultural income. One should keep in mind that even if the Project had never been built, some canals and drains would have been constructed. The g.v.a. of crops in the Project in the "without" scenario was estimated to be $60,000 in 1910 (the real g.v.a. that year was $81,000), and the 1973 g.v.a. would have been $7,300,000 (the real g.v.a. was $54,700,000).

Until 1941, according to the scenario, the market value of the crops in reality always exceeded the "without" scenario figures by two or three times. In 1941, the "takeoff" year, the actual market value of $3,707,000 exceeded the "without" scenario's hypothetical figure by more than four to one, and that gap never lessened.

The three researchers also devised a trade-flow model. Idaho was broken down into two regions - the Boise area and the rest of the state. Twenty sectors of the economy were selected -- eight crop production sectors, one livestock sector, five food processing sectors, and six miscellaneous sectors. This degree of specificity permitted the researchers to separate the highly intensive agriculture of the "with" Project from the less intensive farming that would have occurred without the Project.

The researchers said that the area that now comprises the Arrowrock Division might have evolved--had the Project not been built by 1914 enough canals would have been dug to provide natural flow irrigation to 105,000 acres. By 1920 this would have risen to 174,000 acres, the maximum the river could support. Acreage would have dropped to 132,000 during some of the drought periods. It might have sunk as low as 62,000 acres during the Depression before returning to the 174,000-acre maximum in the '40s.

The researchers speculated that irrigation by the Payette River might have reached a maximum of 87,000 acres in 1920. It is interesting to note that not until 1924 does the Payette Division's actual irrigated acreage figure significantly exceed the estimated "without" figure. From then on, the gap between the real and the estimated "without" acreage figures widens steadily.

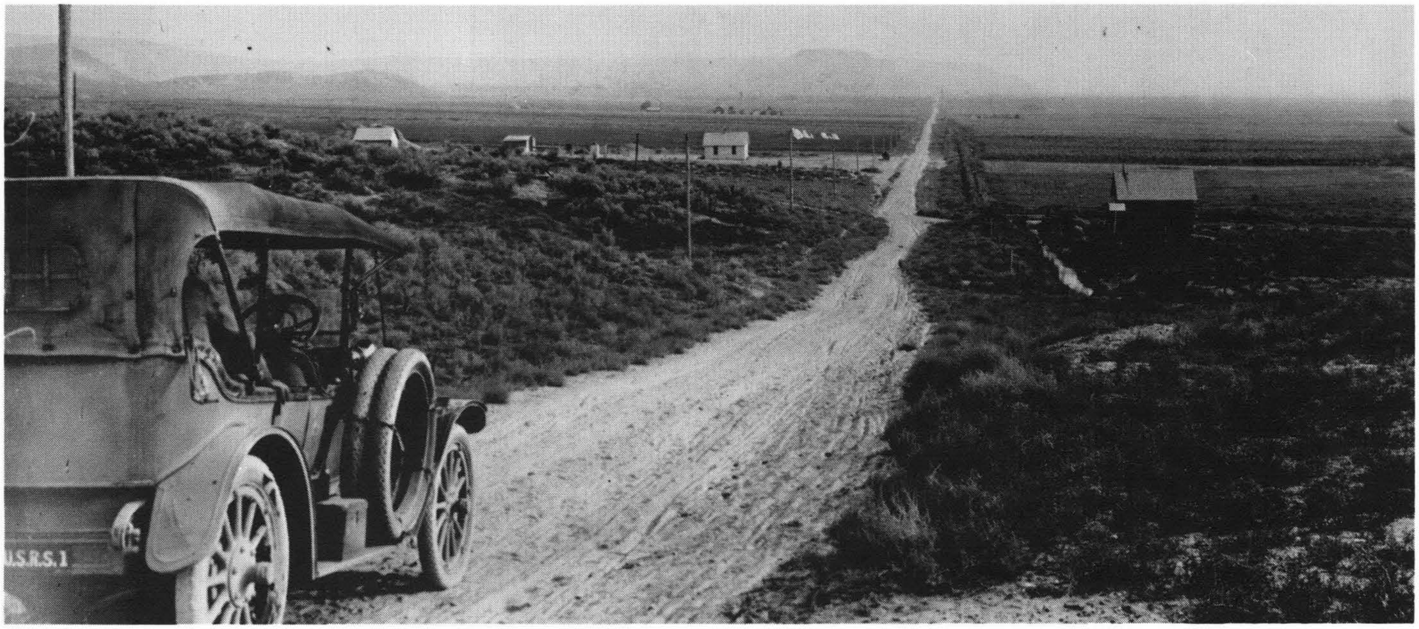
People

It is far easier to measure the effect of the Project on crop output than it is to measure its effect upon people. Today we are aware that the conventional wisdom of a few years ago -- more jobs in an area, and more money, equals a happier population -- is not necessarily true. An area ravaged by strip mines may be wealthier than before, but not necessarily happier. When the audit of the Boise Project was proposed, the researchers said it was essential that the Project's impact on the population of the area, not just the economy and environment, be studied.

The sociologists could not statistically examine the Project's population because the Project spreads over five counties without totally encompassing any of them, while statistics were available only on a county-by-county basis. They decided to examine the population of Ada and Canyon Counties, as those two counties contain most of the Project's acreage and population. About one-sxith of Ada County, including most of its irrigated farmland, is in the Boise Project. Canyon County is only half Ada's size, but more than 50 percent of its land is in the Project.

The sociologists examined the period 1940 to 1970, as many statistics for the period before 1940 were unavailable.

After considering a number of different methodologies, the researchers decided to examine residents of the two counties under seven categories: education, housing and neighborhoods, formal



The Lucky Peak hydroplane races below are in sharp contrast to this older transportation form above. (1967) The early 1914 photograph shows Riverside Community Road with Valley Mound Butte in the background about three miles south of Lake Lowell.

achievement, health, law enforcement, accessibility, and recreation.

Under "education" they examined median years in school, the number of 14-to-17 year-olds in school, and the number of over-25's who had completed high school.

Under "housing and neighborhoods" they examined median rent, percentage of homes with indoor plumbing, percentage of migrants, and the number of people owning their own homes.

Under "formal achievement" they examined income, employment, types of blue collar and white collar jobs, and number of families under the poverty line.

"Health" covered infant mortality, death rate, deaths from selected respiratory diseases, death from heart disease, suicides, and deaths from accidents other than motor vehicle.

Under "law enforcement" they examined the number of arrests for violent crimes, property crimes, narcotic and drug offenses, and percentage of reported crimes that led to arrests.

Under "accessibility" they examined public carriers, miles of roads, traffic accidents, and determined the length of state, federal, and other roads per square miles in Ada and Canyon Counties.

Under "recreation" they examined indoor recreation facilities, acreage of outdoor facilities, and visitor days.

A very significant factor in the society of Ada and Canyon counties, particularly of Ada's, is the presence of state government, a state university, and much business and industry. The sociologists assumed that the impact of these factors would be the same whether the Boise Project had been built or not.

In order to produce the required "without" scenario, the sociologists chose two counties as controls, Cassia County for Ada and Gooding County for Canyon. Both control counties have little federal investment in irrigation development, and are mainly rural. The sociologists believed that the pattern of development in these two control counties was similar to that which would have developed in Ada and Canyon without the Project and without the state capital in Boise.

The sociologists reported that by 1970 Ada County's population was 78 percent urban and Canyon's 57 percent urban. The population of Idaho as a whole was 54 percent urban.

The sociologists estimated that in 1940, 30 percent of Ada County's population could be attributed, in one way or another, to the existence of the Boise Project, but by 1970 this had fallen to 8 percent. By contrast, they estimated that in 1940, 54 percent of the people living in Ada were there because of the state capital and its related effects, and in 1970 that rose to 85 percent.

In Canyon County, 58 percent of the population was attributable to the Boise Project in 1940, but this dropped to 22 percent in 1970, they estimated. They also estimated that in 1940, 22 percent of the population of Canyon County was there due to the influence of the state capital and other effects; that rose to 60 percent in 1970.

While the Boise Project did not halt the trend toward urbanization, it likely did slow it, the sociologists said. They estimated that had the Project not existed, in 1940 only 16 percent of the population would have been farmers in Ada and Canyon Counties, instead of 31 percent. In 1970, the percentage of farmers in the two counties was 7 percent, and the sociologists estimated that had the Project not existed, that figure would have only been 4 percent. The change would have been more marked in Canyon than in Ada, they estimated.

The sociologists said they believe the Project had little or no impact on education.

Median family incomes in Ada County for 1940 and 1970 were $3,200 and $9,700 respectively. Canyon County was lower, $2,700 and $7,700. Considering both counties together, it would seem that the income in the two counties was at about the state median level in 1950 and slightly above by 1970. Income was distributed more evenly in the two counties than it was in the state as a whole. Changes possibly caused by the Boise Project are; a slightly higher median income, a small increase in employment, and the creation of somewhat more prestigious jobs.

The percentage of families under the poverty level was below the state average in Ada County in 1950, 18 percent, while Canyon County was above the state average with 30 percent. The gap had narrowed by 1960, and by 1970 both counties were near the state level with 10 percent. The sociologists said that the percentage might have been higher had the Project not been built.

Also, when state unemployment figures rose in 1970, employment rose in Ada and Canyon Counties, indicating greater economic stability in the area than in the rest of the state.

Ada and Canyon Counties appear to have crime rates considerably higher than the rest of the state, and the "without" scenario of the two sociologists indicates that the crime rate would drop only slightly if the Project did not exist.

Accessibility was somewhat better in the two counties than over the state as a whole. The Project may have been responsible for additional miles of roads, but the increased population has also brought some additional pressure on existing facilities.

Improved water-based recreation directly related to Boise Project reservoirs, particularly in outdoor recreation, appears to be the greatest social impact of the Project. Indoor recreation may have suffered somewhat as population grew faster than facilities, but the deficiency was more than compensated for by the additional outdoor opportunities.

There are few members of racial minorities in Ada and Canyon Counties, but "Spanish language" in the 1970 census accounted for 1.5 percent of the population of Ada County and 6.3 percent of Canyon. The majority of those, 57 percent in Ada and 65 percent in Canyon, were new to the area within the past five years, which indicates many may be migrants. In Canyon County the median education for Spanish language residents was 6.9 years, compared to 12.1 for the county population as a whole. The economic status of the Spanish language group was below average, and the sociologists estimated that had the Project not existed it would have been even lower.

The Farm Population

Ada County's 1970 population of 112,000 was double Canyon's. But the farm population of Canyon, 8,271, was double Ada's. It is important to remember the difference between "rural" and "farm" population. Anyone living in a town of less than 2,500 is classed as "rural." The rural population of the two counties declined to 29 percent of the total population from 52 percent between 1940 and 1970, while the farm population declined from 31 percent of the total population to 7 percent. Those declines are slightly greater than the state average.

In Ada County, 48 percent of the land is in farms, and in Canyon the figure is 92 percent. In Idaho as a whole, 29 percent of the land is farmland. The average size of farms in Ada County is 191 acres, and in Canyon 122, much smaller than the state average of 516 acres.

Most farm operators in the two counties reside on the farms which they operate. The percentage of tenant farms was around 13 to 16 percent, the same as the state average.

The majority of the farms in the Project, 60 to 70 percent, are Class I to Class 5 farms, meaning they have sales of more than $2,500 a year.

It is important to take into consideration the Class 6 farms, those farms which have sales of less than $2,500 in a year. There are nearly 1,500 of them, and they represent fully 39 percent of the farms listed in Ada County and 30 percent of the farms in Canyon. Nearly all have some irrigated land, and average in size around 19 acres. Most owners of these farms live on them but two-thirds work more than 100 days a year off the farm. These farms contribute little to

Freshly harvested onions are proudly displayed by Mrs. Terry Kawahara of Caldwell, Idaho. Her husband, Harry Kawahara, raised this crop of onions for the J.C. Watson Co. on a field about five miles southwest of Caldwell. (1967)

farm income totals, but do occupy a considerage area of irrigated land -- 25,000 acres.

Farm population would likely have experienced a sharp decline either with or without the Project, the sociologists said. However, the presence of Project water has likely kept many farmers on the land, and acreage restrictions have held down the size of the farms. The sociologists said they believed that without the Boise Project there would be only a quarter as many farms in Ada and Canyon Counties, and those farms on the average would be 50 percent larger than the present ones.

Educational levels for the farm population have been lower than for the total populations of the two counties, but there appears to be little or no impact as a result of the Project, the sociologists said. The Project is estimated to have produced somewhat more income for farmers but it is still less than for the majority of county residents, they said.

The Environment

A square mile of sagebrush-covered semi-desert that has been turned into a field of sugarbeets may be considered an example of environmental improvement or environmental destruction, depending upon who is doing the considering. The Boise Project irrigation has provided an agreeable habitat for the ringneck pheasant, an immigrant that now flourishes there. To some people, this species is a welcome addition to the gamebird population, and an environmental plus. To others, it is a gaudy intruder and an environmenta minus. It is difficult to make a moral judgment on the environmental impact of the Boise Project. One can say the farmland is flatter, but it's hard to say whether the land is "better" or "worse" environmentally.. A study of environment can easily become a study of values and philosophies.

The concept that "wild" or uncultivated land has its own intrinsic value and need not be considered inferior to "useful," cultivated land has only become common in the past decade. During the years the Boise Project was being built the prevailing assumption was that turning dry scrubland into irrigated farmland was unquestionably a desirable and worthy goal. There was no such thing as an Environmental Impact Statement, and no systematic effort to collect data about flora or fauna that might be harmed by the changed environment brought about by the Project. Consequently, researchers have very little information about the Project area's environment at the turn of the century to help them gauge the Project's role in changing the environment.

An early traveller described the Boise River in 1834 as "this beautiful stream, about one hundred yards in width, clear as crystal and, in some parts, probably twenty feet deep. It is literally crowded with salmon, which are springing from the water almost constantly."

The first impact on the environment occurred during the gold and silver mining times in the early 1860s, when extensive excavation and placer mining fouled many of the creeks and streams. As the gold and silver lodes petered out, ranchers brought herds of cattle into the Boise Valley to graze. Overgrazing began to occur almost immediately.

In the 1880s large flocks of sheep were brought in and crowded the cattle upland into the Boise River watershed. The Boise area was a busy place by frontier standards. Trapping, mining, ranching, lumbering, and farming, coupled with a favorable crossroads position and the relatively late time of major settlement combined to promote rapid growth, which in turn placed pressure on the environment.

The cyclic nature of rainfall was not understood in those days. The dry grassland was sensitive to lack of water. Settlers in a wet cycle would engage in farming practices that would not only degrade the land but would lead to serious failures when they tried to ride out what they hoped would be a brief drought. Heavy grazing would remove the nutrients which had to be stored for next season's growth. When the next season turned out to be a drought, the vegetation had lost its ability to resist. Farming also caused compaction and loss of plant cover, which increased runoff and erosion.

Some changes in the environment were brought about deliberately. William H. Ridenbaugh, a Boise businessman and city father, introduced bobwhite quail, pheasant, black bass, crappie, perch, and bullfrogs to the Boise area. Although Ridenbaugh was the most ambitious wildlife "colonizer," several other settlers introduced animals that were not native to the area. Nowadays it is generally believed that from an ecological perspective transplants are more likely to cause harm than good. Once an area has been altered, overgrazed, for example, this may no longer hold true. Cheatgrass may be inferior to native grasses, but it is better than no grass at all.

Rapid, uncontrolled changes in the environment caused by the settlers sometimes produced bizarre results. In 1878 the Boise area experienced a jackrabbit plague caused by deterioration of the range by overgrazing. A column of gaunt jackrabbits 40 miles wide laid the country to waste so thoroughly that not a sprig of green was left. A 4-cent bounty almost bankrupted one county. One man organized a drive into a pit that netted him 10,000 rabbits in a single day.

Much of the environmental damage in the Boise Project area occurred shortly after the turn of the century, just as the Project was getting started. One report of the Grouse Creek drainage in the Boise watershed described it as "a wavy sea of grass" in 1904 and "grazed completely barren" in 1910. In 1920 the U.S. Forest Service reported that 90 percent of the land it investigated in the Boise watershed area was depleted to some extent.

Over the years there have been

increasingly ambitious attempts to control and rehabilitate the eroded grazing land in the Boise Project's watershed area. The Sawtooth Forest Reserve was created in 1905, and later was included in the Boise National Forest. The serious problem of sediment silting in the Arrowrock Reservoir led to the enactment of the 37,000-acre Arrowrock Purchase Unit by the Forest Reservation Commission in 1935.

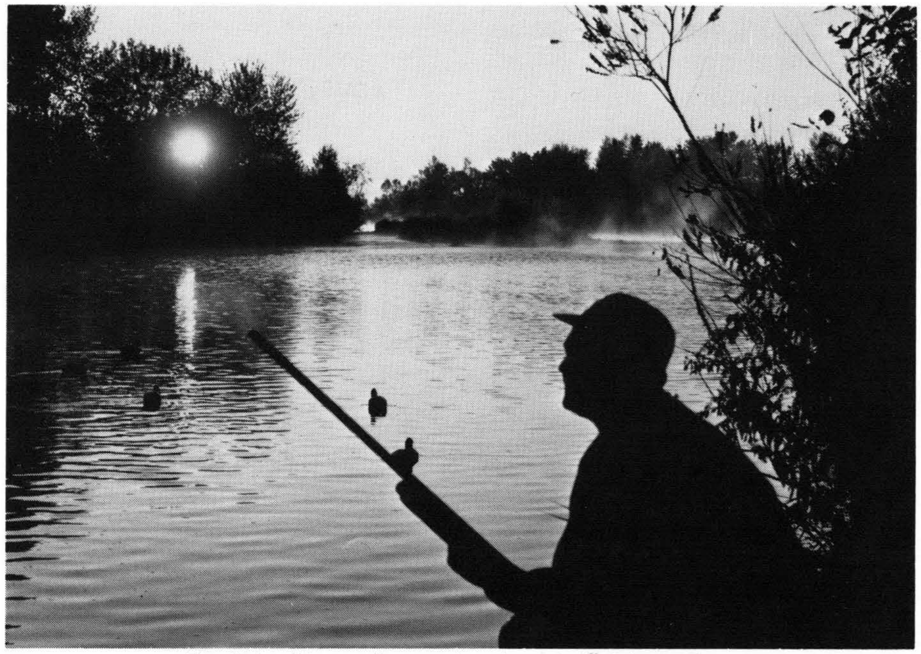
Today there is a mixed ownership pattern on the Southwest edge of the Boise National Forest. Federal and state agencies are attempting to ease the management problem by carefully selected land exchanges with each other and intermingled private ownerships.

As late as 1949 the Forest Service reported worsening conditions in the watershed, with extensive damage and silting because denuded lands could not absorb runoff during the spring melt and summer thunderstorms. Enlightened management practices now have the upper hand, and the wounds of the watershed are being healed.

Silting is still a problem. This includes silting in the ditches, where careless irrigation causes topsoil erosion. Project workers say this is becoming less of a problem as farmers become more environmentallly conscious, and also more aware of the clean water requirements that have been set by Congress.

The Project brought about a food processing industry, with pollution causing waste by-products. Does the blame for this pollution rest with the Project or the companies? If there had been no Project, there would have been no companies, and thus no pollution. But if the companies had used non-polluting methods of waste disposal, there also would have been no pollution.

Arrowrock Dam ended the anadromous fish run up the Boise River, but scientists said that the run was doomed anyway. Low water levels and overfishing had led to the virtual extinction of the run several years before Arrowrock was built. During 1914, however, when the dam was under construction, there was a large run, the first for a number of years. The "without" scenario shows that within a few years the entire flow of the Boise river would have been used for irrigation for several months each summer, so runs would have been eliminated. The researchers added that other reasons for believing the runs were doomed are: dams on the Snake and Columbia Rivers; sediment; overfishing.



The Boise River as it meanders through the irrigated farm lands of the Boise Valley, offers many good resting spots for both resident and migratory water fowl. Here a hunter awaits a flight of wary ducks in the early dawn of a cool fall morning. (1966)

Wildlife Refuge

The Deer Flat National Wildlife Refuge encompasses Lake Lowel and some downstream islands. When the reservoir was built the federal government declared that all the federal land within it -- 10,000 acres, (virtually the entire reservoir) and some adjacent lands -- would be a refuge and breeding ground for migratory birds and other wildlife. Certain nearby lands and some islands along the Snake River were added later.

The refuge provides an excellent example of how a situation can be viewed as either environmentally negative or environmentally positive. Wildlife lovers, not surprisingly, like the refuge, Many farmers, not surprisingly, consider the wildfowl that it shelters to be a marauding army that uses the lake as a staging area for raids on crops. Plantings of small grain and green browse on the refuge have reduced but not eliminated the raids.

Occasional environmental problems have occurred in the canals themselves. In one incident, a large amount of organic material was flushed from the Boise River into the canals, and the resulting eutrification killed many of the fish living in the canals. Another problem that has arisen is the inhibition of the Boise River's streamflow by silt deposits, because control of the water has reduced the natural scouring action of the river.

....

Although the primary purpose of the Project remains irrigation, flood control and recreation benefits now rank above power production, which was originally second. With the growing energy problem, and higher power prices likely, power may regain its second spot. Investigations are being conducted into the possibility of installing low-head power generating equipment at the dams and even at some of the canal drops.

The people who administer the Project are proud of what it has accomplished over the years. "The Project made this valley," said an irrigation district manager as he drove his pickup along a dusty backroad between fields of row crops. He gestured at the flat fields of beans, beets, and onions that stretched away on all sides. "Look at all this. Without the Project, this would be nothing but sagebrush and jackrabbits."

Over the years most of the leaky timber and sheet metal flumes that carried water over dips and gullies have been replaced by pipes. Each summer, irrigation district crews replace a few more laterals with buried pipe, making plowing easier for the farmers and lessening evaportion and weed problems.

Most of the construction costs have been paid off. Most Boise Board of Control farmers have to pay 75¢ per acre per year until 1991. Repayments differ depending upon many historical factors, and Payette Division payments will last longer. None are more than a few dollars per acre per year, not a big factor for the growers.

Most of the growers' water cost is operation and maintenance, but considering how vital water is, the costs are low. In the Payette Division's Notus Unit farmers get as much water as they want for $14 an acre. In the Second Unit, payment is about $14 for five acre-feet per acre, and $3 for every additional acre-foot. In the Arrowrock Division, yearly payment varies around $13 for 3.5 acre-feet per acre, and about $3 for each additional acre-foot.

Water is plentiful. The only recent year dry enough to cause serious fears of a water shortage at the Project was 1977. The open-market price for an acre-foot of Boise Project water rose to $30, and some Arrowrock Division farmers found it profitable to sit back and sell their water to their neighbors, rather than raise a crop. Even those who didn't buy extra water were not seriously hurt. "People just learned to handle their water a little more carefully. They didn't come out of it too bad," said a Project official.

Every year the suburbs of Boise nibble away some of the farmland on the Project, but this doesn't decrease the demand for water. The suburbanites "like the irrigation water. They use it for their lawns and garden," said a Board of Control official. "The New York Irrigation District is 17,000 acres and we've got 10,000 accounts there now."

The Boise Project has come a long way. It's quite a jump from the beginning, when the project delivered less than 2 acre-feet to 50,000 acres, to the present, where it delivers 3, 4, or 5 acre-feet or more each year to 340,000 acres.

The post-audit study of the Boise Project shows as specifically as possible, considering the data that are missing, the effect that a federal irrigation project can have on an area. What had been known in a general sense, in many instances, can now be backed up by concrete figures. And the way in which the audit was conducted -- the search through statistics, the means of estimating the data that were missing, and the way the tables and models were built and applied -may serve as a useful guide for others planning to evaluate irrigation projects in the future, or planning to build projects themselves.

Acknowledgements

While "Sagebrush to Croplands" is based upon the work done by the researchers who wrote the reports listed in the Prologue, thanks are due to a number of other people who also helped.

The farmers and irrigation workers on the Boise Project gave freely of their time to show me around the Project or describe their life on it. Thanks also to officials of the Bureau of Reclamation at Boise who answered many questions about the Project and checked the manuscript.

Dan Applegate, former Project Superintendent of the Central Snake Project Office (retired in 1972), kindly took me around much of the Project, and doesn't seem to have forgotten a single statistic.

Finally, special thanks are due Royce Van Curan, the indefatigable Project Manager of the Boise Board of Control since 1958, who is acknowledged by everyone as knowing more about the Arrowrock Division than anyone, alive or dead. His guided tours around the Project and patience in answering hundreds of questions are greatly appreciated.

Abstracts

PLAN OF STUDY SUBPROJECT REPORT
Wayne T. Haas and Richard W. Schermerhorn

Modern technology, increased affluence and population growth have resulted in an expanding use of the nation's water and related land resources. The public is demanding better management and use of natural resources while at the same time the conflicting demands are creating more and more issues.

Federal expenditures make up a substantial portion of all government expenditures in water development. This Plan of Study Subproject report presents an analysis of the federal role in water development and planning criteria; and the report proposes an approach for completing the ex-post analysis of the Boise Project in southwest Idaho and eastern Oregon.

As a result of the work completed during the first year on the Plan to Study Subproject Study and the Hydrology and Ecomonic History Support studies the following conclusions and recommendations are presented and discussed:

—Ex-post analysis of a selected water resource project can contribute to more responsive planning, decision making and a better allocation of resources.

—Ex-post analysis, structured so as to utilize the Principles and Standards, will provide maximum utility to the planner.

—Ex-post analysis should be structured following societal objectives rather than traditional water use functional objectives. The Principles and Standards, with modification, can accommodate this approach.

—The influence of exogenous forces on beneficial and adverse effects must be considered if a realistic appraisal is to be obtained through an ex-post analysis.

HYDROLOGY SUPPORT STUDY
C. C. Warnick and C. E. Brockway

This study of the water use and water control of the Boise River Project as a part of a case study of Federal expenditures on a water and related land resources project has reviewed the basic hydrologic system, the reservoir system, the irrigation system, the water rights, the ground water conditions, the floods and flood control, and general reservoir operations over time. Emphasis in the study has been the accumulation, classification, and arrangement of water information for later use in the overall research effort of studying whether the objectives of water development are being met. This has been done recognizing that the planning for and development of the Boise River Project has been evolutionary over a period of over 100 years. Where possible an audit has been presented of whether the water use and water control functions are meeting good standards. Brief conclusions are presented with recommendations for detailed studies that might be accomplished in future phases of this continuing project.

ECONOMIC AND ECOLOGICAL HISTORY SUPPORT STUDY
H. H. Caldwell and M. Wells

Prior to the Boise Project, any extensive irrigation in the Boise area was confined to the flood plain and Eagle Island. Federal expenditures in area dams and reservoirs provided irrigation water for the entire agricultural area for the length of the growing season. Without these expenditures, irrigation would be far more dependent on groundwater sources, and probably would cover a smaller area.

Many ecological changes and damage in the area were not as a result of the Boise Project, but of previous mining and logging operations in the upper reaches and irrigation in the lower valley. Post-project pollutants include industrial effluent, urban surface runoff, and topsoil sediment loss.

Initial study attempts to differentiate project and nonproject impacts by specific time intervals was handicapped by widespread pre-existing irrigation, the long time interval between congressional discussion of authorization and completion of the project, the impact of private entrepeneurs, the role of the railroad in route and townsite selection, and the role of Boise as state capitol, transportation node, large city and region and federal trade center.

DIRECT ECONOMIC IMPACTS
Roger B. Long, Terry Nelson, Gary Hines

The Boise Project of Southwestern Idaho was built by the Bureau of Reclamation during the period from 1910 to 1956, at which time the irrigated acreage increased from 51,377 to 340,613 acres. This first report of the economic subproject brings together the relevant direct cost and return (benefit) information from the project. Since the public is often concerned about the economic justification for such a project, an effort is made to present the cost and return information in such a way as to indicate the public expenditures made in terms of tax dollars and the income benefits received in terms of value added. Benefit-cost ratios are presented in terms of value added (net income) per dollar of project cost for each year from 1910 to 1970. This measure of success (or failure) of the project varies from a negative $0.59 in 1932 to a positive $21.29. Prior to 1940, and especially during the depression years, the project was what one might consider a marginal economic success. After 1940 and the second World War, however, the above measure indicated each dollar of public funds expended were associated with about $5 in income to someone in the area. Obviously, the project also had secondary or indirect impacts on the region in which it was located -- these impacts will be identified and discussed in the second volume of this report.

It should be emphasized that the numbers in this report (costs and returns) represent all the economic factors involved in the project and the subsequent irrigated crop production. No attempt has been made to allocate benefits to water, land, technology, or management. The income benefits of the project are the result of the use of all relevant inputs and should not be attributed to any one input (such as water). Income benefits are those associated with the economic activity resulting from the project.

SECONDARY ECONOMIC IMPACTS OF THE BOISE PROJECT OF IDAHO, 1947-1970
Roger B. Long and Clarence J. Potratz

The Boise Irrigation Project of southern Idaho was built by the Bureau of Reclamation between 1910 and 1955. Whether or not one considers this project an economic success depends on the point in time when the question is asked. Prior to 1940 direct benefits (income) from the project were not always greater than costs and at one time (during the depression) they were negative. Since 1940, however, direct income impacts have increased to about $28 million per year (in 1970). This value-added figure is 40 percent of the total investment cost of the project ($69.1 million).

Secondary benefits from the Boise Project result from economic activity stimulated by project output. These benefits are associated with inputs purchased and output processing. Using a regional input-output table describing the Boise Region (Ada and Canyon counties) and the Rest of Idaho, secondary income impacts of the project were estimated. Analyses indicate that direct income impacts increased from $17.9 million in 1947 to $28.1 million in 1970, while indirect impacts increased from $45.9 million in 1947 to $99.1 million in 1970. In 1947 the total impact of the project was estimated to be 41.4 percent of regional income, while in 1970 the total impact of the project dropped to 22.1 percent of regional income. Both the region and the project have been expanding since 1946 - the former at a more rapid rate.

The influence that the Boise Project has had on the development of the local food processing industry is probably its greatest single economic contribution. By 1970 the food processing industry had considerably greater economic impact on regional income than did the Boise Project itself ($143.7 million compared to $127.2 million). The economic development described above for the Boise Project and the food processing industry is the result of many factors -- water resource development being just one of those many factors. Over the period of the Boise Project, 1910 to 1970, it appears that the annual income benefits ($28.1 million of direct income and $99.1 million of indirect income) will repay the project costs of $70 million in tax dollars many times. For a comparison annual costs of the Boise Project (including depreciation, capital costs, and operative and maintenance costs) were $5.5 million in 1970. The degree of economic development associated with the Boise Project would have been nearly impossible to foresee in 1910, or for that matter during the 1930's; however, since 1940 the benefits (income) associated with the project have been increasing steadily.

METHODOLOGY FOR ANALYSIS OF IRRIGATION DEVELOPMENT THAT MIGHT HAVE OCCURRED WITHOUT FEDERAL EXPENDITURE
Daljit Singh Jawa

One of the factors responsible for agricultural high production in the United States is the comprehensive irrigation system that has been developed for which much of the funds have come from federal expenditure. This treatise attempts to analyze the possible outcomes in the absence of any federal support in this field, by means of a case study of a federally funded (Boise) project and its possible non-federal alternatives.

In this study a useful methodology of simultaneously combining hydrologic and water supply operations analyses with economic analysis of a water development project has been developed in accordance with "The Principles and Standards" specified by U.S. Water Resources Council concerning evaluation of "conditions expected without" the federal expenditure.

On the basis of comparison of engineering, economic and financial efficiencies of the historic irrigation development due to the federal Boise Project and four possible non-federal alternatives (with seven different variations of each), it has been demonstrated that the federal project was as good as any other non-federal alternative could possibly have been under the circumstances existing prior and during the period of study. Yet, there was a possibility of improving the economic efficiency up to 70% by delaying the installation of the Project or by using better expansion criteria.

Thus the study brings out the importance of better planning criteria such as initial size, time of installation and expansion policy for achieving higher èconomic and financial efficiencies. Of course this still depends upon the economic conditions and the hydrologic occurrences and how they phase together.

A SOCIAL IMPACT ANALYSIS
John E. Carlson and Merle Sargent

The basic objective of this study was to provide insight into the social impact of a federal expenditure on a water and related land resource project, using the Boise Project as the case study.

The most significant apparent impact of the Project has been on population numbers. While the increase in population has been spread fairly evenly over all sectors (farm, rural nonfarm, and urban) the greatest proportional impact is estimated to have been on the farm population. In spite of the Project, farm population has declined sharply over the period but not as much as would have occurred "without Project."

The Project has apparently had little impact on education, with levels rising over the time of the study but with little or none attributable to the Project. Income has been somewhat greater for all segments "with Project." While there has been growth in numbers in all occupations as a result of the Project, the only major percent change is in a greater number of farmers and farm laborers.

Housing for the whole area has apparently been unaffected by the Project except for an improvement in quality in 1940. Health was unaffected by the Project except for a predicted small increase in heart disease in 1940 and 1950. Our estimates indicated that the increased population associated with the Project has brought with it small increases in all types of crime, paricularly violent crime. Accessibility was estimated to have been impacted slightly by the Project with the only substantial change being more miles of roads per square mile of area.

Improved water-based recreation directly related to Boise Project reservoirs appears to be the greatest social impact of the Project, particularly in outdoor recreation.

The apparent social impacts of the Project have not been major, with some positive benefits balanced out by some negative impacts. While the Project has apparently not contributed substantially to the social situation, neither has it detracted from it.

ECONOMIC SCENARIO OF THE BOISE REGION "WITHOUT" A FEDERAL IRRIGATION PROJECT

Terry Nelson, C. C. Warnick and C. J. Potratz

Ex-post analysis, as implied by the Principles and Standards for Planning Water and Related Land Resources issued by the Water Resources Council, involves measuring project impacts by comparing the observed state of the world "with" the project to the state "without" the project. In an irrigation project, as the Boise Reclamation Project, the productivity of the soil and water is improved via the investment in storage and conveyance facilities over the productivity naturally inherent to the system through dryland farming or limited irrigation. The objective of this report was to present one possible scenario of what might have occurred "without" the Boise Project and then to compare the historical development against this "without" scenario.

The "without" simulation was accomplished by estimating the gross crop production that could have been produced by using a hydrologic model based on natural, unregulated flows of the Boise and Payette Rivers and from implementing an interregional trade flow model based on the information from the hydrologic model. Together these two models expressed a simulated picture of the economic conditions that might have occurred under the assumptions made in the model in both the Boise Region and the rest of Idaho in the absence of federal investment in irrigation within the Boise Region.

The annual benefits and costs were determined following an accounting framework created to show how the information from the "without" scenario could be used in project evaluation. Except during the early history of the Project, on an annual basis, simulated benefits have always exceeded simulated costs. By 1970 there was, as simulated, a difference of $23 million dollars income between the with and without situation and $81 million dollars of indirect income. These benefits exceeded the annual cost of some $5.5 million dollars in 1970 by 300 and 1800 percent, respectively.

The reader should not conclude that the Boise Reclamation Project was a successful or unsuccessful federal investment based on the above analysis alone. The Project produced other benefits and costs, not examined in this report - recreation, power, and flood control, as well as beneficial and detrimental environmental and sociological impacts.

Hopefully, the methodology developed in the postaudit analysis of the Boise Project will aid the efforts of planners in the future in determining project impacts.

THE ENVIRONMENTAL IMPACT OF THE BOISE PROJECT

John Hultquist

This report is a general synthesis of the many issues regarding post-project environmental evaluation, using as a frame of reference the Boise Project of the Bureau of Reclamation. The report does not comprehensively summarize the existing literature for the area of an environmental nature or provide systematic analysis of ecological processes in the Boise River Valley.

Three issues plague environmental evaluation studies of this type, and these are further confounded by the particular characteristics of the Boise Post-Audit Study. The three issues are termed the data/information, the intent, and the methodology problems.

The availability of data is an issue in any study as is the manner of converting available data such as tables, maps, photographs and the like to usable information. In the Boise Project area, the problem is magnified by the settlement history which brought changes to the area and produced an unstable situation upon which the Project was thrust. While knowledge of the settlement of 1900 helps constrain possible alternative scenarios, evaluation of environmental information for the period must be tempered by the realization of significant and ongoing changes. This study attempts to characterize the region prior to the Project and to demonstrate the significance of the changes having taken place or in progress. Environmental information over the seventy plus years of the Project is both sketchy and selective. Evaluation of particular situations is further complicated because of the different points of view of the evaluators.

Many evaluations do not consider the intent of a project. But the issue of intent is not meant in relation to the goals of the study, but rather refers to the goal of the resource project. Consider such projects as thermal power facilities or bridges, about which a goal of minimal environmental impact is both understandable and possible. If either could be constructed and operated without local environmental impact, no detraction from the intended purpose of the project would result. In contrast, an irrigation project must change the environment to achieve its intent. When the bounds of a project topography is altered, land use undergoes change, and drainage is altered--all by choice. It may be appropriate to evaluate the newly built landscape as agreeable or disagreeable from a personal point of view. But, it seems somewhat odd to construct the evaluation on an element by element comparison with its former self. As an analogy, nothing much is gained in an evaluation of a chair made of leather by commenting on the condition of the steer prior to its demise.

The methodological issue follows directly from the points just presented. Most of the methodological approaches to evaluation have been based on the implicit and faulty premise that impacts ought to be minimized. It is rather improbable that a before-after comparison will ever provide an acceptable evaluation methodology for situations like that of interest here. In a dynamic sense, monitoring of environmental variable can direct attention to situation which may require initiation of a negative feedback mechanism. Numerous such instances have occurred in the area of the Boise Project. Excessively high water table, fish kills, sedimentation are examples. Recognition of more subtle problems have justified more systematic studies and monitoring efforts.

Others have written on the role of energetic principles in understanding the interactions of society and the environment. Briefly a project provides its benefits by imposing an orderliness on the pre-project landscape and the results cannot be obtained or maintained without continued effort. This effort is an energy subsidy drawn from and resulting in general environmental disorder. This concept is presented in the report mainly as a proposed approach to the issue of project evaluation methodology. It was not possible to work out details or to apply the idea to an overall review of the Boise Project. Material is presented to show the direction such work would necessarily take in the framework of the Boise area development and to demonstrate the complexity of environmental evaluation in general and of the Boise Project in particular.

AN EX-POST STUDY OF THE ECONOMIC PERFORMANCE OF FEDERAL INVESTMENTS IN FLOOD CONTROL PROJECTS IN THE BOISE VALLEY, IDAHO

YOSEPH GUTEMA

The primary purpose of this study is to estimate the benefits and costs of federal flood control products on the Boise River, southwestern Idaho. The estimation of benefits and costs of federal flood control projects is essential because there is doubt regarding the economic efficiency of these projects. Ex-post estimation of benefits and costs will also reveal how accurate the ex-ante estimates of benefits and costs were.

In this study flood control is viewed as a production process which utilized limited federal funds as inputs to produce flood control services as outputs. The outputs of flood control cannot be directly valued in the market as flood control services are collective goods. To overcome this handicap, it was assumed that consumers are willing to pay an amount equivalent to the damages prevented. Thus, for a flood control project to be economically feasible the damages prevented (benefits) should exceed the cost of preventing the damages (costs of the flood control measures). To estimate the prevented damages one needs to know the damages with and without flood control projects.

This study uses data from an actual flood plain survey and develops six models to estimate annual flood damage with and without the flood control benefits for the period 1950 to 1974. Each of the six models hypothesize that flood damage is dependent upon the level of economic development in the flood plain and the magnitude of floods.

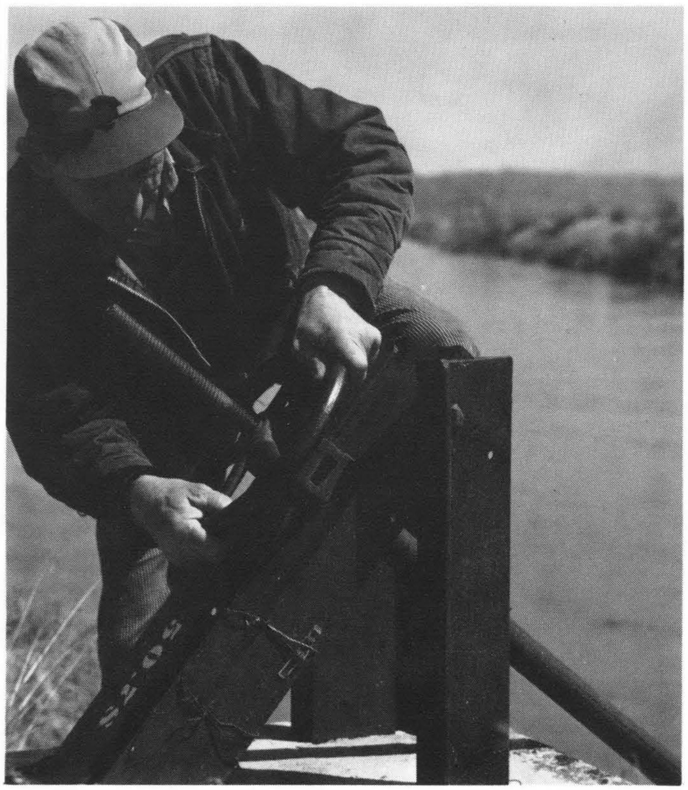
In estimating the annual cost of the flood control projects on the Boise River, this study considers the annual cost of borrowing the federal funds from the government, the annual cost of operating and maintaining the flood control projects, and the annual depreciation of the flood control projects as the projects have a definite life time.

Due to theoretical and methodological limitations this study will not even attempt to estimate intangible costs and benefits. It should be borne in mind, however, at least from a theoretical standpoint an optimum economic use of limited resources cannot be determined until all effects including intangible effects are fully evaluated. But, one cannot sit and wait until intangibles become quantifiable to evaluate public projects because decisions have to be made.

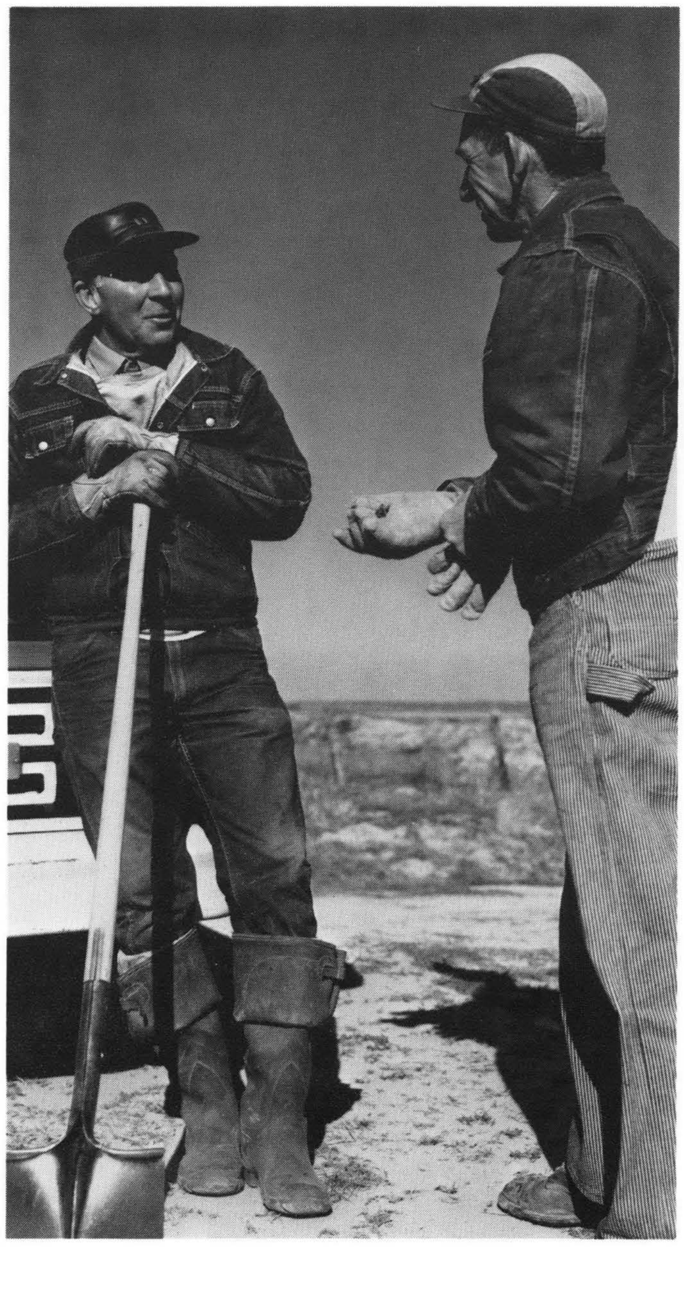
In assessing the economic performance of the federal flood control projects in the Boise Valley for the period 1950 to 1974, this study found the results given below:

Annual rate of economic growth	Benefits (damages prevented) (1943 dollars)	Costs (1943 dollars)	Benefits costs
0 percent	13,043,500	18,972,053	0.69
2.2 percent	19,167,269	18,972,053	1.01
4.2 percent	29,187,413	18,872,053	1.54

Ditchrider Bill Summers is constantly keeping the weir pools clear of weeds and trash.



On one of his many stops along the New York Canal, ditchrider Bill Summers opens a gate to fill one of the many small laterals that deliver water to the fields.



The daily visit between the ditchrider and the farmer is not always all business or farm talk. Sometimes it's just a thank you for a good job of water delivery or they may just be comparing notes on their last fishing trip. (1966)