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Salmon Recovery in the Pacific Northwest

A Summary of Agricultural and Other Economic Effects

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Measures that will be taken in the Pacific Northwest to recover three Snake River wild salmon runs protected under the Endangered Species Act--and to improve the Columbia River Basin salmon fishery as a whole--will result in various benefits and costs to the Northwest economy. This report, which describes the principal findings of a larger USDA study, analyzes the effect of Snake River management alternatives on agricultural production, profit, and resource use in the Northwest. Measures examined include reservoir drawdown along the Lower Snake River and irrigation water supply reductions in the Upper Snake River Basin. For the Northwest region, adjustments in agricultural crop production cause producer profit to decrease by less than $10 million per year (less than 1 percent in baseline profit) under five of the seven scenarios. Two scenarios would reduce profit $30-$35 million per year (2-3 percent of baseline). This report also examines secondary impacts on regional income and employment that result from the adjustments in agricultural production. Agricultural employment could decrease by 50-2,600 jobs, depending on the scenario, while total employment could decrease by 600-5,500 jobs. Finally, this report discusses selected economic benefits of salmon recovery, including improvements in commercial and sport fishing.

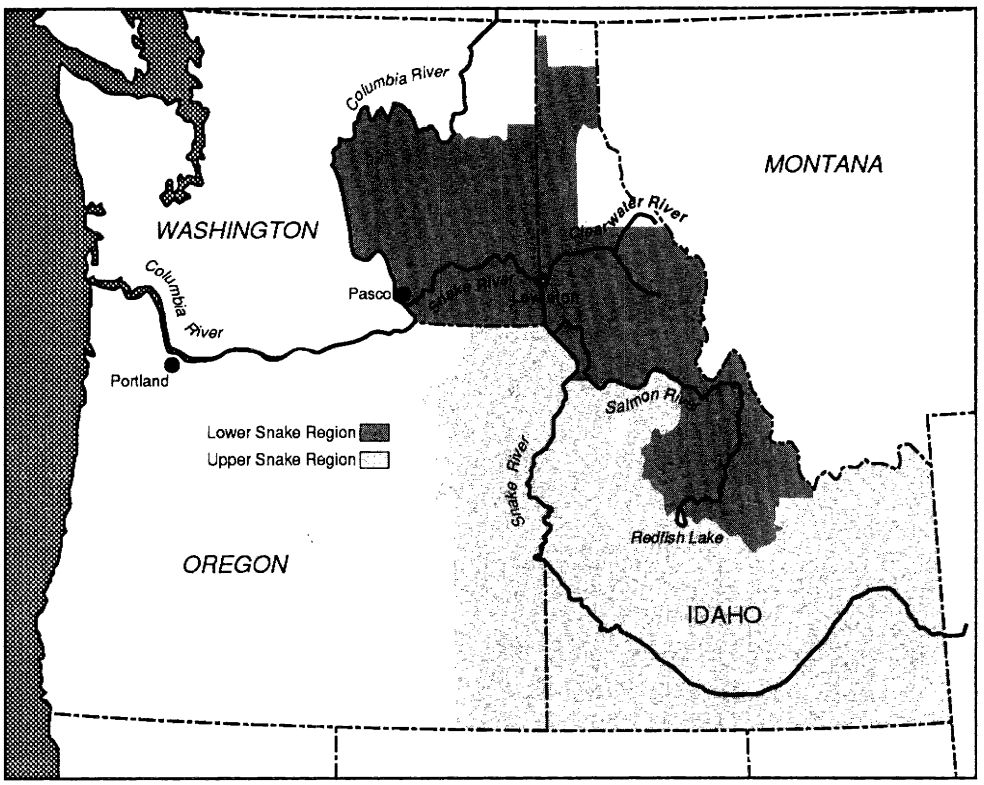
Keywords: Salmon, Endangered Species Act, recovery measures, Pacific Northwest, Columbia River Basin, agricultural sector, secondary economic effects, economic benefits, commercial and recreational fishing

Introduction[1]

Salmon populations in the Columbia Basin (fig. 1) have declined severely as a result of fish harvesting and river development activities. Populations of salmon and steelhead have fallen to roughly 20 percent of the peak historic level of 10-16 million spawning adults per year (Blumm and Simrin, 1991). Wild and naturally spawning salmon are at 2 percent of historic levels. Habitat degradation due to hydropower development, irrigation diversions, and land-use activities such as logging, mining, and grazing contributed to the decline of the fishery. Fish hatchery practices and extensive fish harvesting for commercial, recreational, and subsistence purposes further reduced native salmon populations. Since 1991, three Snake River salmon runs have been listed as threatened or endangered under the Federal Endangered Species Act (ESA), with an additional 10 salmon runs considered in critical condition.

Measures that will be taken in the Pacific Northwest to recover the three ESA-listed salmon runs--and to improve the Columbia River Basin salmon fishery as a whole--will result in various benefits and costs to the Northwest economy. Permanent recovery measures have not been finalized. In this report, selected measures of significance to agriculture are analyzed to inform the policy discussion.

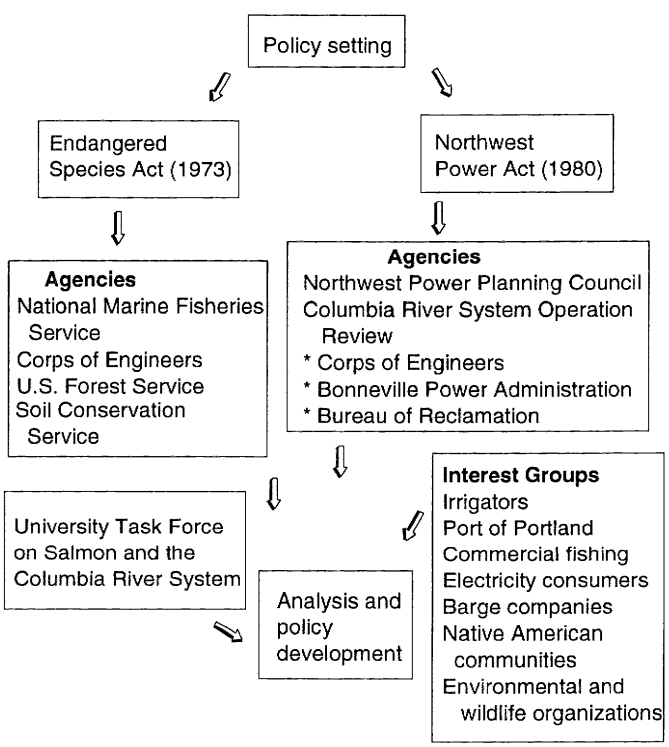
Figure 1
Columbia River Basin
The map's Snake River regions are defined for study purposes; they do not reflect precise hydrologic boundaries.



Policy Initiatives

A complex policy environment surrounds the efforts to rebuild Columbia Basin salmon stocks (fig. 2). Two laws establish a policy framework for salmon recovery measures: the Pacific Northwest Electric Power Planning and Conservation Act (1980) and the Federal Endangered Species Act (1973). The former mandates that fish and wildlife be considered on an equal basis with traditional uses of the Columbia River and that a comprehensive salmon restoration plan be developed. The Northwest Power Planning Council was created to develop and implement these objectives, in collaboration with the Northwest States, Native American communities, and several Federal agencies (including the Bonneville Power Administration, U.S. Army Corps of Engineers, Bureau of Reclamation, U.S. Department of Agriculture, and Federal Energy Regulatory Commission). The Endangered Species Act requires development of a program to recover species threatened with extinction. The National

Figure 2
Study setting



Marine Fisheries Service directs implementation of the ESA for salmon, in consultation with the organizations listed above.

Many measures have been proposed, individually or in combination, to restore the three ESA-listed Snake River salmon runs and to rebuild the salmon fishery in general (Columbia River System Operation Review Interagency Team, 1992a, 1992b, 1992c; Huppert, Fluharty, and Kenny, 1992; Northwest Power Planning Council, 1992; U.S. Army Corps of Engineers, 1992). This report examines the effects on agriculture and related regional economies of selected measures to improve salmon survival during migration within the Columbia-Snake River systems. Analysis focuses on modifications in Snake River flow to facilitate salmon migration, including:

- **Reservoir drawdown** below barge operating levels of four Lower Snake River reservoirs to increase river flow velocity; and
- **Irrigation water supply reductions** in the Upper Snake River Basin (fig. 1) to augment river flow volumes.

Other feasible recovery measures are not studied in this report. For example, inriver barging of juvenile salmon through the Lower Snake River system would not affect agricultural crop production and, thus, is beyond the scope of this study. Similarly, riparian habitat restoration is not expected to significantly affect crop production. Habitat improvements may affect livestock grazing on public lands. However, analysis of this issue is available elsewhere (Haynes, Bolon, and Hormaechea, 1992).

Study Procedures

Reservoir drawdown and irrigation water supply reductions would exert their effects on the agricultural sector through adjustments in agricultural input costs and availability. Potential input adjustments examined in this study include:

- power rate increases,
- grain transportation cost increases, and
- surface water supply reductions.[2]

This report analyzes the impact on regional agricultural production and profit of feasible changes in these input variables.[3] In addition, the report examines secondary impacts on regional income and employment of agricultural production shifts. Finally, the report discusses selected market and nonmarket benefits of salmon conservation and recovery measures (see box, "Potential Benefits of Salmon Recovery," p. 8).[4]

Recovery measures are grouped by ERS analysts into four general strategies (fig. 3). The strategies adopt generic elements of Snake River flow options that are under consideration (Columbia River System

Figure 3
Alternative Snake River management strategies, with related effects on agricultural inputs

(1) Core measures set for implementation
- Core: 4-percent power rate increase

(2) Irrigation water supply reductions--Upper Snake River Basin
- Low: Irrigation water supply reductions to achieve 0.127 maf* flow augmentation
- High: Irrigation water supply reductions to achieve 1.127 maf flow augmentation

(3) Reservoir drawdown--Lower Snake River Basin
- Low: 2-month drawdown; 8-percent power rate increase; Low grain transportation cost increase
- High: 4.5-month drawdown; 12-percent power rate increase; High grain transportation cost increase

(4) Combined measures of (1), (2), and (3)
- Low: Irrigation water supply reductions to achieve 0.127 maf flow augmentation; 8-percent power rate increase; Low grain transportation cost increase
- High: Irrigation water supply reductions to achieve 1.127 maf flow augmentation; 12-percent power rate increase; High grain transportation cost increase

*maf = million acre-feet

Operation Review Interagency Team, 1992a, 1992b, 1992c; Huppert, Fluharty, and Kenny, 1992; Northwest Power Planning Council, 1992; U.S. Army Corps of Engineers, 1992). They do not replicate actual proposals or scenarios found in existing planning documents. In particular, they do not constitute formal recovery plans for the threatened or endangered salmon runs.[5]

The four strategies developed here are based on implementation of either irrigation water supply reductions or reservoir drawdown, or both. Every strategy includes a Bonneville Power Administration wholesale power rate increase, reflecting a core group of management measures that are already set for implementation.

Reductions in Upper Snake River diversions to ensure flow requirements for salmon would primarily affect irrigation water supplies, with implications for water use and cropping patterns in southern Idaho and eastern Oregon. The actual volume of water needed for flow augmentation may depend on annual streamflow and reservoir storage conditions in the Snake River.

Reservoir drawdown would disrupt barge operations along the Lower Snake River, thus making grain transportation more costly in parts of northern Idaho and eastern Washington. Moreover, as the Federal dam system is traditionally managed to maximize the value of regional hydropower generation (subject to flood control, water supply, and other objectives), reservoir drawdown is likely to result in increased retail power rates for irrigators in areas of the Northwest.[6]

Overview of Northwest Agriculture

Agricultural production in Idaho, Oregon, and Washington was valued at $7 billion in 1987, contributing over 5 percent of the total value of U.S. agricultural production (table 1). Major crops in the region include wheat, barley, and hay. In addition, specialty crops such as Irish potatoes, sugarbeets, fruits, and vegetables represent an important source of revenue for regional producers and comprise significant shares of national production. Federal Government payments totaling $404 million were made to Pacific Northwest farms in 1987. Irrigation is important to agriculture in the region, with roughly

Table 1--Characteristics of Northwest agriculture

Item	Regional value	National share
	$ Million	*Percent*
Value:		
Crops sold	3,835	6.5
Animal products sold	3,200	4.2
	Million bushels	
Production:		
Wheat	250	13.3
Barley	103	22.5
	1,000 tons	
Hay	8,480	6.6
Irish potatoes	8,973	48.9
Sugarbeets	4,320	15.9

Source: 1987 Census of Agriculture

6.5 million acres of cropland and pastureland under irrigation. Agricultural production and processing account for about 166,000 jobs within the region.

Study Results

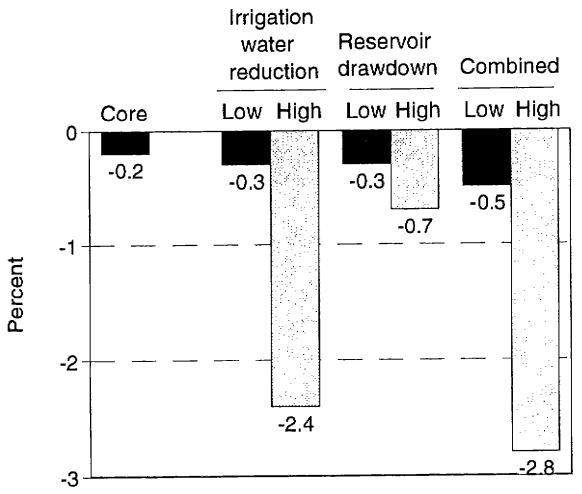
Primary Effects on Crop Production in the Northwest

This report compares effects of the Snake River management strategies on economic profit (dollar value of returns to producers) from crop production. (The analysis does not consider the effect on the livestock sector.) Baseline profit, prior to implementation of recovery measures considered here, is estimated to be $1.278 billion for the Northwest, including $527 million for Idaho, $237 million for Oregon, and $514 million for Washington. Results indicate that the effect of these measures on Northwest agriculture would be relatively small. Decreases in producer profit of less than $10 million per year, or less than 1 percent in regional profit, were estimated for five of the seven scenarios (fig. 4). Two scenarios would reduce profit $30-$35 million per year, or between 2 and 3 percent of baseline levels.

Increases in power rates and grain transportation costs, induced by reservoir drawdown, would have a relatively minor effect on agricultural profit in the Northwest. In the absence of irrigation water

Figure 4

Percentage change in producer profit, Pacific Northwest, by salmon recovery scenario



Note: Baseline producer profit from crop production in the Pacific Northwest is $1.278 billion.

reductions, these increases would reduce regional producer profit by less than $10 million per year.

Power rate adjustments would primarily affect areas of Oregon and Washington, where the Bonneville Power Administration provides a substantial share of power supply. The effect of grain transportation cost increases would be concentrated in eastern Washington and northern Idaho, where grain producers rely heavily on barge operations along the Lower Snake River.

Reductions in irrigation water supply have the greatest effect on producer profit and resource use. The two scenarios involving a major reduction (resulting in 1.127 million acre-feet (maf) of Upper Snake River flow augmentation[7]) reduce profit $30-$35 million per year in the Northwest region. Some observers suggest that farm profit losses due to reduced irrigation water diversions could be partially or wholly offset by monetary compensation through water markets or other forms of compensated transaction (Hamilton and Whittlesey, 1992; Huppert, Fluharty, and Kenny, 1992). Water market development, although an important issue, is not examined quantitatively in this study.

Often, relatively minor economic impacts from a regional or national perspective are magnified at the local level. Scenarios involving the 1.127 maf of flow augmentation illustrate this point. Reductions in irrigation water supplies to achieve targeted flows in the Lower Snake River would be concentrated in the Upper Snake Basin areas of southern Idaho and eastern Oregon. Of the decline in Northwest profit of $30-$35 million per year, over $27 million would occur in the Upper Basin.

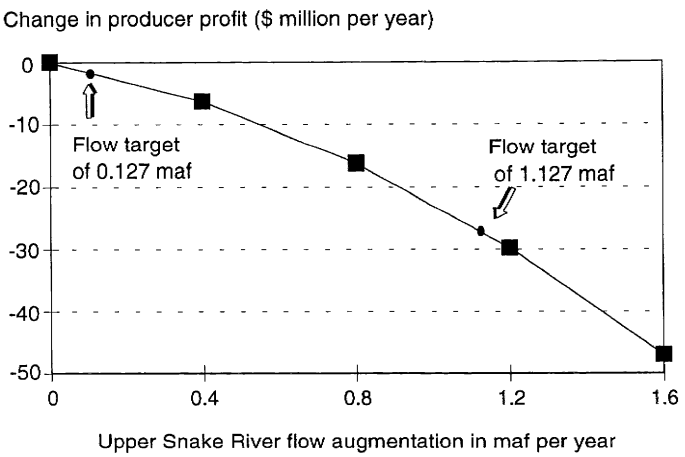
While this analysis focuses on flow augmentation targets proposed by the Northwest Power Planning Council, actual flow augmentation levels may vary depending on final policy considerations and annual water supply conditions. Figure 5 shows the effect on producer profit of annual flow augmentation levels ranging from 0 to 1.6 maf.

Salmon recovery measures would affect the use of agricultural inputs, including cropland allocation and use, irrigation water, and labor. In scenarios involving a major reduction in irrigation water supply, producers respond by significantly reducing acreage in irrigated alfalfa, sugarbeets, and dry beans, while increasing acreage in irrigated barley and dryland wheat, alfalfa, and barley.

Figure 5

Reduction in producer profit in Upper Snake River Basin from irrigation water supply reductions

Achieving a flow augmentation target of 1.127 maf would reduce profit in the Basin by $27 million per year.



Secondary Effects on the Regional Economy

The direct impacts on agricultural production and agriculturally related industries result in various secondary effects in other sectors of the Pacific Northwest economy. These impacts have a relatively minor effect on total economic activity in the Pacific Northwest, producing changes in total annual income (wages, profits, and rents) of less than 0.1 percent from a base of $163 billion (fig. 6). This occurs even under scenarios that generate the largest decreases in agricultural profit. Scenarios involving the major reduction in irrigation water supply (1.127 maf of flow augmentation) initially reduce agricultural jobs by almost 2,700 (out of 166,000 jobs in agriculture) and total jobs by 5,500 (out of 4.9 million jobs) (fig. 7). The reservoir drawdown strategy induces investment in irrigation pump stations and water diversion screens, which creates up to 1,500 new short-term jobs in the region.[8] One-third of these new jobs are created near the Lower Snake River in southeastern Washington.

The Upper Snake regional economy, consisting of southern Idaho and eastern Oregon, is directly affected by reductions in irrigation water supply (figs. 8, 9). The minor reduction (0.127 maf of flow augmentation) causes relatively small declines in income and employment. However, the major reduction reduces total income by $83 million per year, or slightly over 0.6 percent. Total employment declines by almost 1 percent, or 4,100 jobs. Employment in agriculture declines by almost 7 percent, or 2,500 jobs. If producers receive financial compensation for the major water supply reduction, then 500 jobs are added to the service sector; total job losses thus would equal 3,600.

In general, unemployment from salmon recovery would lessen over time as some displaced workers locate new employment. An average displaced worker in the Pacific Northwest takes an estimated 24 weeks to secure another permanent job (Swaim, forthcoming).[9]

Figure 6

Changes in income in the Pacific Northwest economy, alternative recovery scenarios

Agricultural income, under all scenarios, declines less than 2 percent; total economywide income, less than 0.1 percent.

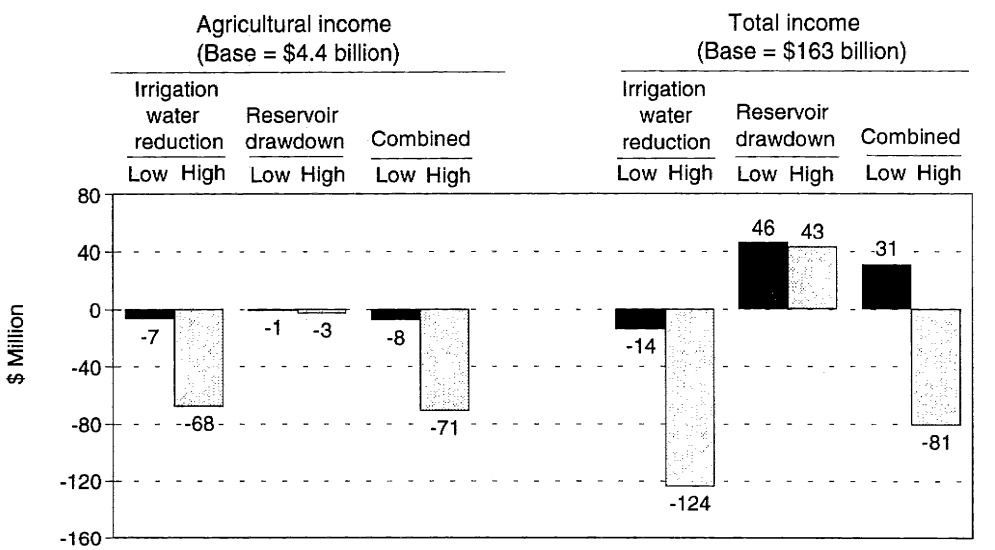


Figure 7

Changes in employment in the Pacific Northwest economy, alternative recovery scenarios

Agricultural employment, under all scenarios, declines less than 2 percent; total employment, less than 0.1 percent.

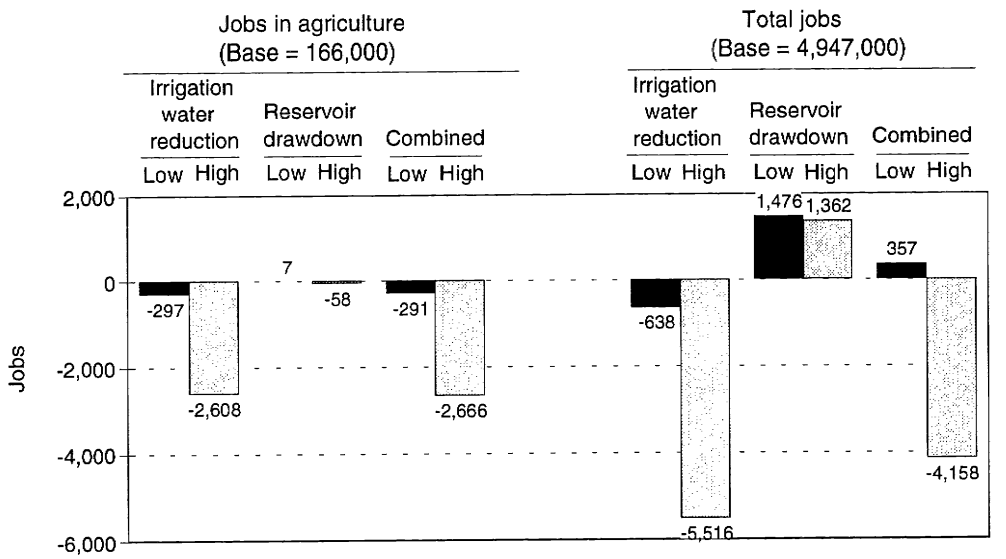


Figure 8

Changes in income in the Upper Snake regional economy, low and high irrigation water reduction scenarios

Agricultural income, under the high-level reduction, declines less than 4 percent; total income, less than 1 percent.

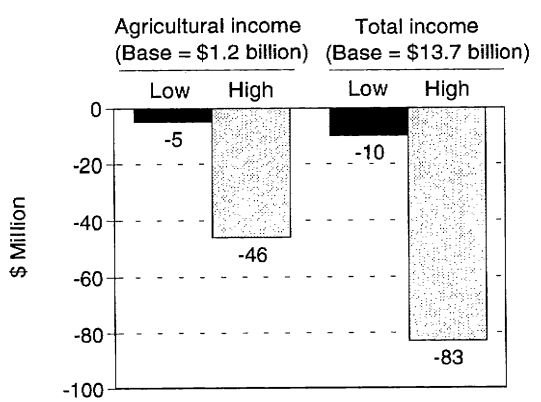
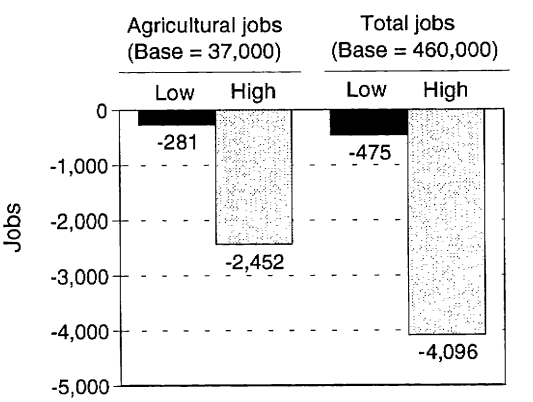


Figure 9

Changes in employment in the Upper Snake regional economy, low and high irrigation water reduction scenarios

Agricultural jobs, under the high-level reduction, decline about 7 percent; total jobs, less than 1 percent.



Potential Benefits of Salmon Recovery

Public resource use results in benefits to the economy of both a market and nonmarket nature. Market benefits include sales of goods and services. Nonmarket benefits can be divided into two general categories: use values and nonuse values. Use values consist of *consumptive* uses, such as fishing or hunting, and *nonconsumptive* uses, such as bird watching. Existence value is an example of a nonconsumptive use. It is the value a person holds for simply knowing that something exists, even if that individual may never use or see that good. For example, individuals may derive benefits from knowing that wild salmon stocks are preserved.

Several benefits may be created by recovery of the ESA-protected salmon runs and by general improvements in the Columbia River Basin salmon fishery. These include increased harvest revenue in the commercial fishing sector, improvements in recreational fishing, and higher levels of nonconsumptive use values. In addition, restoration of the salmon fishery should reduce future conservation expenditures of Federal and non-Federal agencies.

This study reports selected impacts of salmon recovery on the fishing and recreational sectors, including: (1) the potential positive effects of improvements in salmon populations on inriver commercial and recreational fishing, and (2) the potential negative effects of reservoir drawdown on recreational activity at the four Lower Snake River dams. The effects on ocean fishing and nonuse values for Columbia Basin salmon are not quantified due to lack of data.

Inriver Commercial and Recreational Fishing

Inriver salmon recovery measures should help to increase Columbia Basin salmon populations. These increases, in turn, translate into benefits to commercial and recreational fishing through an increase in harvest levels. However, the precise relationship between recovery measures and fish populations is uncertain. For example, the link between river flow velocity and juvenile salmon survival, while expected to be positive, is open to scientific debate.

Potential positive effects associated with salmon fishing, assuming hypothetical increases in salmon populations ranging from 1 to 8 percent, include:

- Changes in annual revenue from mainstem Columbia River commercial fishing harvest range from $40,000 for a 1-percent increase in harvest to $350,000 for an 8-percent increase.

- Increased annual recreational benefits from sport fishing on the Columbia and Snake Rivers range from $60,000 to almost $490,000 (1- and 8-percent increase in salmon harvest).

- Increased annual spending for goods and services by fishermen range from over $30,000 to almost $270,000 (for 1- and 8-percent increases).

Reservoir Drawdown and Recreation

Reservoir drawdown at the four Lower Snake River dams in southeastern Washington would restrict recreation at these sites. Two drawdown periods were analyzed, 2 months and 4.5 months.

Potential negative effects associated with recreation at drawdown sites include:

- Annual losses to boaters, swimmers, campers, and day users range from $2.9 million (2-month drawdown) to $9.7 million (4.5-month drawdown).

- Secondary effects include annual losses from decreased visitor days. Losses range from $1.5 million to $5.1 million (2-month and 4.5-month drawdown periods).

These estimates do not consider substitution across recreation sites, activities, and time periods. Substitutions would tend to mitigate the long-term impact of drawdown.

Summary

This study analyzes the effects of two proposed salmon recovery measures: irrigation water reductions in the Upper Snake River Basin and reservoir drawdown in the Lower Snake River Basin. These two measures are among the options being considered to improve inriver salmon migration. Other proposed recovery measures (for example, habitat restoration, juvenile fish barging, and harvest restrictions) are not considered in this study.

Reservoir drawdown and irrigation water supply reductions would likely have the largest impacts on Pacific Northwest agriculture of the recovery measures currently under consideration. A main finding of this study, however, is that impacts of these measures on Pacific Northwest agriculture would be relatively small. This finding holds true for both the primary impacts on agricultural crop production and income, and the secondary income effects on the entire Northwest economy. In particular, reservoir drawdown would have little regionwide effect under drawdown durations evaluated here.

Larger relative impacts may occur within a smaller geographic entity. In the Upper Snake River Basin (southern Idaho and eastern Oregon), a major reduction in irrigation water diversions to achieve flow augmentation of 1.127 maf per year would have moderate effects on agricultural production and income at the basin level. These effects could be partially mitigated through monetary compensation for affected producers or improved water management.

Net employment impacts are limited for the Northwest region, but could be more significant at the local level. In the Upper Snake Basin, reductions in irrigation water use to meet the 1.127-maf target could reduce agricultural employment by almost 2,500 jobs and total employment by approximately 4,100 jobs. In the Lower Snake Basin, reservoir drawdown could increase total employment by almost 1,500 jobs in the short term due to capital investment for irrigation infrastructure.

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Footnotes

1. This report is prepared in response to a congressional request of the U.S. Department of Agriculture to analyze the impact of potential Columbia River Basin salmon recovery measures on the agricultural economy and related rural economy of the Pacific Northwest. The report addresses only selected economic issues related to salmon recovery, even though recovery efforts will likely affect all economic sectors of the Pacific Northwest. A longer version of this study, which will be available later in 1994, describes in detail the analysis reported here.

2. Other potential adjustments were not examined. These include adoption of improved irrigation technologies and water management practices; surface water supply adjustments caused by interseasonal variation in streamflow and storage conditions; groundwater pumplift effects resulting from declining aquifers; and livestock impacts due to habitat restoration.

3. For this study, a numerical range of impacts on agricultural input costs and availability were developed as representative of major policy proposals on salmon recovery.

4. The effect of reservoir drawdown and irrigation water supply reductions on juvenile salmon survival is uncertain. As a biological issue, analysis of these relationships is not a component of this study.

5. Under the ESA, National Marine Fisheries Service will develop formal recovery plans for the threatened or endangered salmon runs.

6. Reservoir drawdown may also require modification of some irrigation pump stations to maintain irrigated production. Expenditures on pump modifications are incorporated in the analysis of secondary economic effects (p. 6).

7. Flow augmentation levels of 0.127 maf and 1.127 maf (from reduced irrigation water use) correspond to the the Northwest Power Planning Council proposal for 0.4 maf and 1.4 maf of increased river flow (from all water users). Achieving a certain flow augmentation target requires a higher level of irrigation diversion reduction. In the model applied in this analysis, irrigation diversion reductions of 0.239 maf and 2.125 maf are required to augment Snake River flows by 0.127 maf and 1.127 maf.

8. This capital investment induces a one-time creation of 1,500 jobs, primarily in manufacturing, construction, and engineering services; these are not permanent jobs. This statistic is interpreted as the labor-time equivalent of 1,500 jobs required to modify irrigation pumps and install water-diversion screens, assuming that the tasks could be completed in 1 year.

9. On average, rural workers take 10 weeks to find their next job; in particular, rural service workers take 7 weeks. However, the next job may only be temporary, resulting in a subsequent period of unemployment. Therefore, the total period of unemployment from displacement to the next permanent job is 24 weeks.

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