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Outcomes

What Actually Happened in 2001?

A Comparison of Estimated Impacts and Reported Outcomes of the Irrigation Curtailment in the Upper Klamath Basin

William K. Jaeger

Beginning in February 2002, data on economic outcomes in 2001 in the Upper Klamath Basin became available. These data include crop acreage and production, farm sales, and employment. They reflect *all* of the changes that occurred in 2001, not just those due to irrigation curtailment on the Klamath Reclamation Project. Some of these data are preliminary and subsequently may be revised, but they represent the best available data on what actually occurred in the Upper Klamath Basin in 2001—as distinct from estimates of the *expected* impacts based on economic models.

This chapter presents some of these "after-the-fact" data on economic outcomes in the Project and the Basin and compares them to estimated impacts based on economic models (Chapters 12, 13, and 19). Neither these reported data nor model estimations can provide a precise measure of the economic impacts of the irrigation curtailment, since both may reflect measurement errors or omissions. Nevertheless, likely reasons for the differences between the impact estimates and the reported economic data can, in some cases, be identified and quantified. Thus, by comparing the reported data and model estimates, and by taking account of other factors that affected the Project and the regional economy in 2001, we are able in this chapter to better explain how events related, and unrelated, to the irrigation curtailment shaped the outcomes in 2001. In doing so, we draw on model estimates and reported data, as well as other information, to estimate a set of "inferred impacts" of the irrigation curtailment.

As in the other economics chapters of this report, this chapter is limited to examining the short-run economic impacts on the Project of the irrigation curtailment, as well as their repercussions throughout the regional (Upper Basin) economy. As explained in Chapter 10 ("Preface to Economics") and elsewhere, this limited focus should not be taken to imply that agricultural interests are paramount, nor that the value of water allocated to other uses (such as environmental and tribal interests, tourism, or commercial and recreational fishing) is unimportant. We also do not try to quantify the potential long-run impacts of events in 2001. Finally, it should be recognized that quantitative assessments of aggregate impacts frequently obscure the circumstances of individuals, many of whom may have been affected in ways far different than those suggested by the total or average effects. Finally, the values presented below are only estimates and should not be interpreted as exact measures of economic loss or impact.

Reasons for differences between model estimates and reported outcomes

Reported data on economic outcomes can be expected to differ from the estimated effects of irrigation curtailment presented in previous chapters, which are based on economic models. The reasons for these differences fall into three groups: individual responses, public responses, and factors unrelated to the irrigation curtailment. Each is discussed below.

Individual responses

Economic models intended to estimate the impact of a specific event (such as irrigation curtailment) may overstate the impact of that event because it is very difficult to anticipate all of the ways that resourceful individuals will act to minimize the adverse effects of the event. For example, Project growers drilled many new irrigation wells in 2001. In Oregon alone, the number of private wells approved in 2001 was sufficient to provide water for 20,500 acres. Chapter 2 ("Klamath Reclamation Project") reports that overall in the Project, new wells may have provided water equivalent to 15 to 20 percent of previous years' surface water diversions for agricultural and wildlife refuge use. By contrast, in the model of Project irrigation in Chapter 12 ("Crop Revenue"), groundwater pumping was assumed to occur only at average historical levels of about 25,000 acre-feet. In fact, actual groundwater pumping was about triple historical levels, resulting in irrigated acreage in 2001 that exceeded the model estimations.

Many other types of responses by growers would have been nearly impossible to predict. For example, a mint grower in Tulelake was able to divert wastewater from a potato processing plant onto his fields in order to keep the plants from dying, and a potato packing operation bought potatoes from outside the region in order to fulfill its contracts.

These kinds of hard-to-predict responses occur at the regional level as well. As a result, input-output models may overstate the impact on revenue of an adverse shock to the regional economy. They also are not designed to account for the additional costs incurred by individuals when responding to unexpected shocks. In short, these models are not intended to represent all of the possible actions that individuals may take, or the added costs they may incur, in response to a negative economic shock.

In particular, input-output models make simplifying assumptions about employment, assuming that workers who lose their jobs due to an economic shock will neither earn nor spend income during the period under study. In reality, however, out-of-work farm laborers are likely to seek employment in other sectors or outside the region. The reemployment of these displaced workers, their income, and subsequent spending are not taken into account in input-output models. The possible reemployment of other resources (e.g., capital equipment) also is ignored, as are the effects of idled labor from the affected sector on employment, wages, or sales in other sectors. If estimated impacts of irrigation curtailment on crop production are overstated, these regional responses may compound these effects at the regional level.

Public responses

The second source of divergence between model estimates and reported outcomes involves public responses to the initial event. The events of 2001 began with the curtailment of irrigation deliveries to most of the Project by the Bureau of Reclamation (BOR). Later, the BOR and other federal and state agencies responded to this initial event. Economic models intended to estimate the impact of the initial event will differ from those that include both the initial event and the public responses.

In the case of the 2001 irrigation curtailment, public responses included commitments for $35 to $37 million in federal and state emergency payments to farmers, plus additional amounts made available for well drilling, through crop insurance, and to aid other members of the affected communities. (Actual payments may have differed slightly, as reported in Chapter 13, "Regional Economic Impact"). Commitments for direct payments to farmers and landowners included:

- Compensation for crop losses under the Klamath Basin Water Conservation Program, in which $20 million was distributed to eligible landowners or growers at $129 per acre (covering 95,944 acres or about one-half of the Project)
- Payments to farmers for groundwater they supplied to the Project (BOR funds of $2.2 million for 65,000 acre-feet of water)
- A federally funded demand-reduction program whereby landowners and growers were paid, based on a sealed bid process, to leave their land idle ($2.76 million paid on 16,500 acres, averaging $167 per acre)
- Payments to growers from the State of California ($3 million to Project irrigators at $37 per acre over 81,000 acres; $1.2 million for weed control, livestock feed, and purchases of uncut marginal grain)
- Payments reimbursing farmers' expenses for seed to plant cover crops ($1.2 million) on roughly 35,000 acres
- Payments under the Noninsured Crop Disaster Assistance Program (USDA-NAP) to eligible landowners, tenants, or sharecroppers (total payments expected to reach between $3 million and $6 million)
- Property tax reductions in Klamath County (approximately $0.5 million)
- Crop insurance payments under USDA's Risk Management Agency crop insurance program ($2.4 million on 50,000 acres)

In addition to these cash payments to farmers and landowners, about $10 million in expenditures and commitments were made for wells and community support programs. Examples include public employment and assistance to families ($3.8 million in California) and development of irrigation wells ($5 million in California and a $2-million appropriation and loan program in Oregon).

In addition, the BOR made a midseason release of 40,000 acre-feet of surface water to the Project.

As indicated below, economic models that estimate only the impact of the irrigation curtailment will generate much higher estimates of impact than models that also attempt to reflect public and private responses. When one considers all of the actions and reactions related to the irrigation curtailment in 2001, including those by government agencies and nongovernmental organizations, the impact on the regional economy is likely to have been somewhat reduced, with some of the costs shifted to state and federal taxpayers.

Unrelated factors

The third source of difference between estimated impacts and reported outcomes involves changes that are unrelated to the curtailment of water deliveries. Examples include changes in commodity prices, expansion or contraction in other sectors of the economy, and unusually favorable or unfavorable weather. Key changes of this kind in 2001 included high beef prices for a second straight year, a rise in potato prices, and a decline in peppermint oil prices. There also was significant contraction in the wood products sector and in construction.

Economic models that generate estimated impacts generally assume that nothing else in the economy changes. If changes do occur, they could raise or lower the actual impact. For example, a price increase for a particular crop could raise the value of the foregone opportunity to sell at the new price.

Typically, economic models use recent prices (prices from a "typical year" or an average over a recent time period). By contrast, the reported data on gross farm sales for both Klamath County and the Tulelake Irrigation District (TID) use 2001 prices. These 2001 data are compared to the data from prior years, which reflect the prices that were observed during those years. Thus, depending on the question being asked, both approaches can be useful. For example, we sometimes want to know the impact of a given action when holding all else constant (so as to not confuse price effects with other effects). In such a case, we would use the previous year's prices or perhaps an average price from the past few years. The reported changes in crop revenues, on the other hand, reflect both quantity changes and price changes in 2001. Thus, these data would accurately reflect the impact of the irrigation curtailment only if no other confounding changes occurred (for example, weather, pests, or price changes induced by the irrigation curtailment).

The first two types of divergence (caused by the omission of private and public responses from the model) tend to produce an overstated estimate of the impacts of an event such as an irrigation curtailment. Changes in the economy unrelated to the irrigation curtailment could have either a positive or negative effect on impacts.

Estimating inferred impacts

In short, it is not possible to measure the "actual impacts" of the 2001 irrigation curtailment directly. All of the methods we might use have shortcomings. For example, a comparison between reported outcomes in 2001 with those in 2000 would reflect the actual impact only if there were no unrelated changes that affected the economy (and if there were no measurement errors in the reported data). By contrast, the revised model estimate of impacts from Chapter 13 ("Regional Economic Impact") reflects a scenario that includes some, but probably not all, of the public and private responses. Moreover, these model estimates do not take account of the effects of price changes in 2001.

Given these shortcomings, our understanding of what actually happened in the Upper Klamath Basin in 2001 as a result of the irrigation curtailment may best be served by simultaneously appraising and comparing the data on reported outcomes with the model estimates. In effect, we are trying to solve a puzzle. We have some of the pieces, but not all. We have some data on economic outcomes, but these data reflect all of the changes that occurred in 2001, not just those attributable to the irrigation curtailment. We have initial and revised estimated impacts, but they may reflect biases and omissions, and in most cases they have used past prices rather than current 2001 prices to value changes in agricultural production. We also have information on some of the unrelated changes that occurred in 2001, but not all of them.

Although there are pieces missing from this puzzle, the pieces we do have enable us to describe a rough picture of the economic story, or inferred impacts from the irrigation curtailment. By inferred impact we mean a measure of the impact of the irrigation curtailment that is based on an interpretation of three types of data:

- Reported economic data for 2001
- Estimates from several economic models
- Information on specific "unrelated changes" that occurred in 2001

To the extent that we can identify and quantify the impacts of specific unrelated changes, we can come somewhat closer to (1) identifying the impacts of the irrigation curtailment and associated responses, and (2) reconciling the reported data with the estimated impacts. In the following sections, we use this approach to examine impacts of the irrigation curtailment on irrigated acreage, gross crop revenues, net farm revenues, regional agricultural production value, agricultural employment, and total regional employment.

Table 1. Project irrigated acreage—predicted impacts, reported outcomes, and inferred impacts, 2001.

	Initial estimated impact[a]	Revised estimated impact[b]	Reported outcome[c]	Inferred impact[d]
Change in Project irrigated acreage				
Acres	–170,000	–112,000	–102,338	–102,338
Percent (%)	–86	–57	–53	–53

[a]Assumes only historical levels of groundwater pumping.

[b]Reflects observed increases in groundwater use.

[c]Includes acres receiving full irrigation from either Project or non-Project sources (including wells) compared to previous 5 years. Excludes 95,400 acres that received only midseason partial irrigation.

[d]In this case, inferred impact equals reported outcome because it is unlikely that unrelated factors affected acreage.

Agricultural estimates, outcomes, and inferred impacts

Overall, the data on reported economic outcomes in the Upper Klamath Basin in 2001 indicate that both the agricultural sector and the regional economy fared better than most observers expected. This result can be attributed to a combination of private and public responses, as well as to factors unrelated to the irrigation curtailment.

Project irrigated acreage

Starting from the ground up, BOR data for the Project in 2001 indicate that crops were grown with full irrigation (using BOR and private water) on slightly less than half (47 percent) of the normal irrigated acreage. In other words, irrigated acreage was reduced by 53 percent (Table 1). Burke (Chapter 12, “Crop Revenue”) initially estimated that only 14 percent of normally irrigated land would be cultivated (a reduction of 86 percent), but this scenario did not anticipate the large increase in public and private groundwater irrigation.

In the case of acreage irrigated on the Project, the data for 2001 were collected by the BOR, and they represent the best available data on irrigated acreage. Errors may exist, but these data most likely were affected only by changes related to the irrigation curtailment or responses to the curtailment. With these data in hand, the economic models were revised to estimate the impact of the irrigation curtailment (and responses) on revenues, income, and employment.

Project gross crop revenues

To estimate the impact of irrigation curtailment on gross crop revenues, we have two sources of reported data and two kinds of economic models. All four of these approaches have shortcomings, but taken together they provide a range of values that represents the best available estimations.

The first approach relies on reported data for Klamath County (which includes all of the Oregon portion of the Project) and the Tulelake Irrigation District (TID) in California. The second approach is based on the 2001 BOR acreage report for the Project. The third and fourth are based on economic models. Each is discussed below.

First, we have data on gross crop production values for Klamath County and the TID. About 90 percent of the Project falls within these two areas. Although gross crop revenues for Klamath County also include some non-Project irrigated areas as well as some nonirrigated areas, nearly 80 percent of crop revenues in Klamath County are from the Project. Thus, we expect these data to represent the best available estimate of general trends in crop revenues in 2001.

In Klamath County, crop production values declined by $24.4 million in 2001 compared to the average for the previous 5 years, a reduction of 34 percent (Table 2). In the TID, crop production value declined by $23 million, or 57 percent. Together, these data show a reduction of $47.4 million from the average of $111 million over the previous 5 years (Table 2). However, only 90 percent of the Project lies within these two areas. If we assume that the remaining 10 percent of the Project experienced reductions in gross crop revenue similar to Klamath County and the TID, the total reduction for the Project would be about $52 million (Table 3).[1]

Our second approach for estimating the change in gross crop value is based on comparing the BOR's 2001 and 2000 acreage reports for the Oregon portion of the Project. In 2001, there were 56,242 fully irrigated and partially irrigated harvested acres (54,472 acres irrigated or preirrigated at 100 percent and 1,770 partially irrigated acres). Using the change in acres harvested between 2000 and 2001, and applying average yields and prices for 1996–2000, we can estimate the change in gross crop revenues for the Oregon portion of the Project. Only

[1]This method may overstate growers' revenue losses to the extent that drought conditions also reduced revenues in non-Project areas.

Table 2. Changes in gross agricultural production value in 2001, Klamath County, Oregon, and Tulelake Irrigation District.

	Gross production value ($ million)		
	Average 1996–2000	2001	Change in 2001
Klamath County			
Grains	8.50	3.34	–5.16
Hay and forage	35.50	22.16	–13.38
Field crops	17.04	7.29	–9.76
Specialty crops	7.31	3.37	–3.93
Nondisclosed crops	2.61	10.39	+7.77
All crops	**70.99**	**46.55**	**–24.44**
Change (%)	—	—	–34.40
Livestock	53.22	75.06	+21.84
All crops and livestock	124.20	121.60	–2.60
Change (%)	—	—	–2.10
Tulelake Irrigation District			
All crops	**39.97**	**16.90**	**–23.00**
Change (%)	—	—	–57.00
Total crop production value	**111.00**	**63.84**	**–47.44**
Total gross agricultural production value	**164.17**	**138.89**	**–25.60**

Note: Figures in this table may differ slightly from those in other chapters due to differences in data sources and crop categories. Columns may not sum exactly due to rounding.

Sources: (1) Oregon State University Extension Service, Oregon Agricultural Information Network (OAIN) database (http://ludwig.arec.orst.edu/oain/SelReport.asp). Crops are classified according to the OAIN Agricultural Commodity list. Nondisclosed crops include those not reported separately in order to protect growers' confidentiality. (2) Tulelake Irrigation District annual crop reports.

harvested acres are included. We assume normal yields in 2001 only for those acres that were fully irrigated; for those receiving less than full irrigation, an 80 percent reduction in yield is assumed. This approach produces an estimated reduction in gross crop revenues of $26.8 million for the Oregon portion of the Project. When combined with the data from the TID (a $23-million reduction), and adjusting for the 10 percent of the Project not included in either Oregon or the TID, the estimated reduction in gross crop revenue is $54 million (Table 3).[2]

The third and fourth approaches are based on economic models that simulate the impact of irrigation restrictions on crop revenues.[3]

The third approach is based on the economic-hydrologic model presented in Chapter 13 ("Regional Economic Impact"), which in turn is based on the model described in Chapter 12 ("Crop Revenue") by Burke. This model involves a detailed representation of the hydrology of the Project. When the model is used to reflect (approximately) the irrigated acreages reported by the BOR (Table 1), the revised impact estimate on gross crop revenue is –$38 million, as shown in Table 3 (assuming a 57 percent reduction in irrigated acreage).

The fourth approach is based on the economic model in Chapter 19 ("Water Allocation Alternatives") by Jaeger. This model reflects a detailed differentiation of lands in the Project according to soil class and crop rotation. When irrigated acreage is limited to the 102,000 acres that received full irrigation in 2001 (according to the BOR), this model indicates a change in gross crop revenues (–$37.5) that is nearly identical to the $38 million estimated by models in Chapter 12 and Chapter 13. Thus, both economic models produce nearly identical estimates, which are somewhat lower than those produced by the two methods based on reported data.

Thus, these four approaches yield a range of estimated reduction in gross crop value of –$37.5 to –$54 million. None of these approaches takes account of unrelated factors, such as commodity price changes, that occurred in 2001. We now turn to this topic.

Price changes in 2001

As indicated above, potato and hay prices were higher in 2001 than in recent years. Other crops, including peppermint oil and alfalfa, experienced price declines in 2001. If we use "normal prices" (from recent years) to estimate changes in gross revenues from the irrigation curtailment, the losses suffered by farmers may be understated in the case of potatoes and hay, but overstated in the case of mint and alfalfa.

In most years, one might expect such price changes to offset each other so that the presumption of "normal prices" produces a reasonably accurate estimate of losses. In 2001, however, this seems not to be the case, primarily due to unusually high prices for fresh potatoes in late 2001 and early 2002. Potatoes in the Project typically are half fresh and half processed, with an average price between $4.50 and $5.00 per hundredweight (cwt). Because of the $9.00-per-cwt price (when averaged over the marketing period) for fresh potatoes following the 2001 season, the average price for 2001 is estimated to be $7.50 per cwt, or about $2.75 higher than in typical recent years.[4] Given a decline in potato harvests of 5 million hundredweight (based on the data in Chapter 8, "Crop Production"), the $2.75 price increase suggests that an additional $14 million in revenue might have been generated had potatoes been produced at their normal levels.

Additional losses are estimated due to price increases for hay and oats, but they are partially

[2]This method may overstate growers' revenue losses to the extent that some growers were able to shift some higher value crops to non-Project lands. In that case, the reduction in crop revenues on Project lands will overstate the total reduction in crop revenues accruing to Project growers. There is some anecdotal evidence that such shifts did occur to some extent.

[3]These two approaches may understate growers' revenue losses because they assume that the available water is used "optimally," that is, applied to the highest value lands and crops. Since neither surface water nor groundwater was always available in proximity to the highest value crops or lands, this maximum value was unlikely to have been achieved.

[4]The potato market is highly variable and complex. The price estimates used in this analysis were arrived at in consultation with Don Micka, Malin Potato Co-Op, Inc. (Micka 2002).

Table 3. Project gross crop revenues—predicted impacts, reported outcomes, and inferred impacts, 2001.

	Initial estimated impact[a]	Revised estimated impact[b]	Reported outcome[c]	Inferred impact[d]
Change in Project gross crop revenues				
$ million	–74.2	–38	–52 to –54	–48 to –64
Percent (%)	–75	–39	–53 to –55	–49 to –65

[a]From Chapter 12 ("Crop Revenue") and Chapter 13 ("Regional Economic Impact"); assumes only historical levels of groundwater pumping.

[b]Reflects observed increases in groundwater use applied to the two initial impact models.

[c]Based on data for Klamath County and Tulelake Irrigation District (Table 2). These two areas include 90 percent of the Project.

[d]A measure of the impact of the irrigation curtailment that is based on an interpretation of three types of data: (1) reported data on what actually occurred in 2001, (2) estimates from economic models in Chapters 12, 13, and 19, and (3) information on price changes in 2001.

offset by price declines for onions, mint, alfalfa, wheat, and barley. The net result from considering all of these price changes suggests that the loss in gross crop revenue in 2001 was $10 million greater than loss estimates produced by the four methods above, none of which takes account of how price changes affected the value of foregone production in 2001. If we adjust the estimates to account for these price changes, the estimated impact on gross crop revenues increases to between $48 and $64 million.

Thus, based on these four methods for estimating changes in gross crop revenues, and adjusting for price effects, we conclude that the inferred impact of the irrigation curtailment on Project gross crop revenues lies somewhere between $48 million and $64 million (Table 3).

Project net farm revenues

Reductions in net farm revenue (net income) are of particular interest because this indicator most closely reflects the financial loss to irrigators and landowners. Reported data on net farm income are difficult to obtain in general and are not available for 2001 at this time. Net earnings for the kinds of agriculture practiced in the Project typically are between 10 and 30 percent of gross farm revenues, depending on the crop, land productivity, and the way in which land rents are accounted for. In Chapter 19 ("Water Allocation Alternatives"), net revenue estimates are computed based on land price differentials. The weighted average for the Project was estimated at $80 per acre, or 18 percent of gross revenues.

For the current analysis, however, these long-run net revenue values are inappropriate because they do not take account of the "fixed costs" incurred by growers who are confronted with an unexpected, short-run curtailment of irrigation. As explained in Chapter 19, the net revenue (NR) generated by an acre of irrigated land equals total revenue (TR) minus variable cost (VC) and fixed cost (FC). Thus, under normal circumstances the irrigator expects to earn NR = TR – VC – FC. The unexpected loss of water denies the farmer revenues TR and allows the farmer to avoid variable costs VC. The farmer is left without NR, but must continue to pay fixed costs FC. Thus, the difference between water delivery and no water delivery is a net loss (NL), which is equal to the sum of the lost net revenue and the fixed costs that still must be paid. Algebraically, we write this as –(NR + FC). We also can think of this loss as being equal to the difference between variable cost (costs avoided when not cultivating) and total revenue (revenues foregone when not cultivating), or NL = –(TR – VC). These two ways of defining net loss will produce the same result if the components (VC, FC, TR, NR) are the same.

If production involved zero fixed costs, the short-run and long-run values of water should both equal NR. But because fixed costs are an integral part of agriculture in the Upper Klamath

Basin, and because the water shortage that occurred in 2001 was short-run and unanticipated, the short-run measure of loss is considerably higher than NR, and it is the most relevant to assessing the overall cost of irrigation curtailment.

The model and analysis used in Chapter 19 ("Water Allocation Alternatives") includes a detailed representation of gross crop revenues, fixed costs, and variable costs associated with each crop and cropping rotation for each soil class in each portion of the Project. The estimated short-run losses, or reductions in net farm revenues, are based on these data. Compared to the long-run average net revenue of $80 per acre, the short-run loss per acre when fixed costs are included[5] (e.g., equipment, buildings, insurance, property taxes), more than doubles, to an average value in the Project of $178. (See Chapter 19 for explanations and especially Table 5 for loss estimates across location and soil class.)

Using the approach developed in Chapter 19, but with the revised figures on acreage identified above, the reduction in gross crop revenues resulting from the irrigation curtailment is estimated to be –$46 million. The change in net revenues is estimated at –$13 million (28 percent of gross revenues). If we assume that the affected farmers and farm laborers were unable to find other employment in 2001, then we would include these reductions in income as part of the loss estimate, raising the figure to –$19 million (41 percent of the change in gross crop revenues).[6]

The relationship between net revenues and gross revenues varies, depending on whether labor is considered a variable cost or a fixed cost and on whether losses are calculated by adding net revenues and fixed costs or by subtracting variable costs from total revenues (if these components have been estimated and thus are not exactly consistent with the algebraic expressions discussed above).[7] These two algebraic approaches, applied to the data available, produce average values for the change in Project net crop revenues (loss) that are 39 percent and 33 percent of total revenues, respectively (when labor costs are excluded). When labor costs are included, the two approaches produce measures of loss that are 49 percent and 43 percent of gross revenue, respectively. The ratio of loss to total revenue is higher for some higher value lands in some locations due to differences in the crops grown.

Given the variations in revenues and costs across the Project, the average short-run losses tend to fall between 40 and 60 percent of the change in gross revenue. Based on this range, the change in net crop revenues for the Project in 2001 would have been between –$15 million and –$32 million (when the change in gross crop revenue is assumed to be between –$38 million and –$54 million).[8] See Table 4 (following page).

Changes in net Project revenues in 2001 were affected by a number of factors that are not captured by these loss estimates. We can take account of three of these factors and make adjustments to the above estimates. First, expenses for additional groundwater pumping were incurred by growers on an estimated 72,000 acres. (This acreage does not include preirrigated acres, but does include all acres irrigated with groundwater, whether public or private). Operating costs for groundwater pumping vary widely, but may range from as low as $2 per acre to $10 per acre (including depreciation of capital), based on figures in Chapter 2 ("Klamath Reclamation Project"). The depths from which groundwater had to be pumped in 2001 may allow us to rule out the low end of this range. In 2001, the BOR purchased groundwater

[5]Derived from crop enterprise budgets.

[6]Even if some farmers and farmworkers found other employment, their earnings may have been lowered and the costs of finding alternative employment may have been considerable.

[7]Actual losses might be greater due to added expenses for groundwater pumping, cover crops, and extra maintenance for clearing canals of vegetation. Actual losses might be lower because crop enterprise budgets tend to reflect relatively high fixed costs based on conservative assumptions regarding the rate of depreciation, cost of leased land, etc.

[8]These estimates of reductions in gross crop revenue exclude the $10 million effect of price changes discussed above. When computing the relationship between gross and net revenues, we do not want to include the price effects because they affect both gross and net losses. In other words, no farm-level costs are associated with crop price increases.

in the Project for $25 to $40 per acre-foot from 24 growers who had private wells (an average of $32.50 per acre-foot). Erring on the conservative (high) side, we will assume that costs incurred by growers were between $20 and $35 per acre-foot. For the entire 72,000 acres that received groundwater irrigation in 2001, an additional 144,000 acre-feet of water would be required to provide consumptive use of 2 acre-feet per acre.[9] Using this quantity and range of costs, we calculate supplemental groundwater pumping costs to be between $2.9 and $5 million.[10]

Second, we want to adjust these estimates to take account of the price changes in 2001 discussed above. This adjustment adds an additional $10 million to the net losses to growers.

Third, some growers received indemnity payments from Risk Management Agency crop

[9]Application rates on individual fields will necessarily exceed the 2 acre-feet per acre of consumptive use. However, the return flows of water into ditches and canals and their reuse by other irrigators in the Project typically result in an overall irrigation efficiency of nearly 100 percent (all water applied contributes to crops' "consumptive use"). As a result, using 2 acre-feet of groundwater per acre is a reasonable approximation.

[10]A number of irrigators invested in new wells in 2001, only some of which benefited from public financing such as subsidized loans from the State of Oregon. The Oregon Water Resources Department (OWRD) approved applications for 89 wells in the region (Chapter 2, "Klamath Reclamation Project"). The per-acre costs utilized above assume normal amortization of these investments; however, there is some question whether future use of these wells will generate enough benefits to cover their initial investment cost. The OWRD indicated in 2001 that the drought permits for these wells would be converted to permanent permits, as was done following droughts in the early 1990s. Depending on how public and private wells are used in the future, these investments may end up representing a significant loss or a significant gain to irrigators in the area.

Table 4. Estimated changes in net farm revenues from the 2001 Project irrigation curtailment ($ million).

Change in gross crop revenues		**–38 to –54**
Change in net farm revenues (40 to 60 percent of gross revenues)		**–15 to –32**
Adjustments		
Groundwater pumping costs	–2.9 to –5	
Price change losses	–10	
Risk Management Agency payments (private crop insurance with partial government subsidy)	+2.4	
Cover crop costs[a]	–1.2	
Total adjustments	–11.7 to –13.8	
Total change in net farm revenue		**–27 to –46**
Emergency payments		
Federal and state emergency programs	+29.2	
Noninsured Crop Disaster Assistance Program (Farm Services Agency)	+4 to +6	
Cover crop payments[a]	+1.2	
Property tax reduction	+0.5	
Total emergency payments		**+35 to +37**
Overall change in net farm revenues[b]		**+10 to –11**

[a]Cover crop costs are included as a separate, exceptional cost borne by growers, but also are included as a government payment because they were reimbursed under a federal program.

[b]The low end of the range is found by combining the smallest (or most negative) figures for net farm revenues and emergency payments. The high end of the range is found by combining the highest (most positive) figures.

insurance, mainly for barley, wheat, and potatoes. These government-subsidized payments exceeded $2.4 million (Paul 2002). After all of these adjustments, the change in net revenue is estimated at –$27 to –$46 million (Table 4).

Combining the aggregate estimated losses with the government's disbursements of $35 to $37 million in emergency payments, the net effect is between +$10 million and –$11 million (Table 4).[11] It is important to recognize, however, that the disbursement of emergency payments does not eliminate the costs of the irrigation curtailment; rather, these costs are shifted from irrigators to taxpayers. Indeed, the initial reductions in farm income due to the irrigation curtailment represent a loss to both farmers and taxpayers since lower farm incomes imply reductions in those irrigators' income tax payments. Similarly, the emergency payments received by irrigators are taxable, so portions of them will be returned to government.

Validation of loss estimates

These loss estimates are based on many components and assumptions. It is reasonable to ask whether they are accurate and represent a reasonably good measure of total economic damages on the Project. To validate or "ground truth" these estimates, we can compare them to estimates from other comparable agricultural settings. The Supreme Court has ruled that estimates of the marginal economic value of water may be used as the basis for awarding damages in cases where irrigation water is withheld or diverted (*Kansas v. Colorado,* No. 105, 2000).

The loss estimate of $27 to $46 million in 2001 corresponds to an affected area of 102,388 acres (the Project acres that did not receive full irrigation). Given an average consumptive use of 2 acre-feet of water per acre of land, this represents a loss in the range of $132 to $225 per acre-foot of water used by crops. To state these values per acre-foot of water *applied* (as opposed to water used), we assume an average application rate of 3 acre-feet per acre. The result is a value of $88 to $150 per acre-foot of water.

These values seem to be well within the range of estimates from a variety of other agricultural settings. For example, as noted in Chapter 19 ("Water Allocation Alternatives"), market transactions in the Klamath Basin and in other parts of Oregon suggest short-run values of water ranging from $23 per acre-foot of consumptive use (based on contracts by Oregon Water Trust) to $150 per acre-foot (based on land leases in Klamath County, Todd 2002). Recent contracts for lease lands on the national wildlife refuges near the Project indicate per-acre-foot values between $26 and $42.

In a study of the potential value of water to produce alfalfa, pasture, and wheat in the John Day region of Oregon, the BOR found that water was worth between about $15 and $35 per acre-foot of applied water per year (when adjusted by an index of crop prices since the time of the study; U.S. Bureau of Reclamation 1985). By contrast, other estimates for higher value crops such as sugarbeets and vegetables range from about $110 to $190 per acre-foot of applied water in Arizona (in 2001 dollars; Kelso et al. 1974; Martin et al. 1979). Finally, in *Kansas v. Colorado*, Kansas estimated its historical losses at $129 to $233 (in 1997 dollars) per acre-foot of applied water.

Overall, then, the estimates presented in this chapter seem to fall within the range of other estimates of the marginal value of water, as evidenced by market transactions, economic studies, and relevant court cases. The current estimates fall toward the higher end of that range, partially due to the impact of high potato prices in 2001–2002. This factor alone accounts for nearly $70 of the $132 to $225 loss per acre-foot of water.

[11]The midpoint of this range, –$0.5 million, is very close to the estimate of "direct income" reductions based on the input-output model (when also taking account of fixed costs) developed in Chapter 13 ("Regional Economic Impact"). Their estimate is about –$0.8 million when loan-financed expenditures on new wells are omitted, and +$1.4 million when these expenditures are included. Because these estimates are based on different models and data—and even slightly different definitions of income or loss—we would not expect the resulting figures to be identical. However, neither should we expect to see large differences between them.

The distribution of losses and compensation

The evidence presented above suggests that federal and state government responses to the irrigation curtailment offset a significant share of the aggregate financial losses resulting from the irrigation curtailment. This analysis says little, however, about the loss or compensation for individual farms or for households that depend indirectly on Project agriculture for their livelihood. Our analysis indicates that many farms suffered substantial losses, while some received payments in excess of their losses.

For example, a landowner expecting to receive $250 per acre for leasing land received no income from prospective tenants in 2001, and the $129 per acre in federal emergency payments covered only about one-half of that loss. Even in California, where irrigators received an additional $37 per acre, total payments did not cover the losses suffered on lands where high-value crops such as potatoes or alfalfa would have been grown.

Moreover, federal payments went to landowners in most cases, not to the growers who had planned to lease or sharecrop the land. In such cases, tenants had neither irrigable land to farm nor a share of the emergency payments. Although some of these growers may have found other work, others surely did not. Many farmworkers also found themselves unemployed and left the area to look for work. By contrast, well drillers experienced high demand for well and pump installations, reportedly resulting in higher rates for their services.

Consider the differences in compensation under varying circumstances for a grower who farms 400 acres of Project land. If the land is Class II and Class III, and the grower owns the land, federal emergency payments of about $50,000 ($129 per acre) likely would be insufficient to cover losses averaging $274 per acre for Class II soils and $173 per acre for Class III soils ($109,600 for a 400-acre operation on Class II soil), based on loss estimates in Chapter 19, "Water Allocation Alternatives"). For Class IV and V soils that typically rent for $50 per acre, however, a grower's income might have been $30,000 higher from emergency payments than it would have been under a typical lease arrangement.

The divergence between losses and payments was compounded by overlap between various independently administered programs. For example, the BOR purchased about 65,000 acre-feet of groundwater for $2.2 million from growers with wells (at an average of $32.50 per acre-foot). This total payment was distributed among 25 participants in the program, but two recipients together received 40 percent of the total. A number of individuals took considerable risk, however, by drilling wells (at a typical cost of $50,000) that may not produce water or may not prove valuable in the future.

A few growers benefited in multiple ways from emergency programs. Growers report that in some cases irrigators were paid for groundwater and in turn were able to have a portion of the water applied to their own land. Additional payments, for example under the Noninsured Crop Disaster Assistance Program, were made independent of compensation from other sources. The Noninsured Crop Disaster Assistance Program is one program under which sharecroppers and leasers may be eligible for compensation. Payments under several of these programs were made in a relatively timely fashion, yet the distribution of total emergency payments left many individuals without full compensation.[12]

Long-term consequences

Finally, the estimated losses reported here do not include long-term effects such as the dissolution of trained crews, displacement costs for farm laborers, and the restoration of weed-choked canals. Nor do they account for the uncertain future payoffs from public and private well development in 2001.

[12]A local tax accountant who serves many Project irrigators estimates that 30 to 40 percent of irrigators had an excellent year financially, 20 percent had an average year, and the remaining 40 to 50 percent suffered considerable financial loss (Rusth 2002).

Table 5. Regional agricultural sales—predicted impacts, reported outcomes, and inferred impacts, 2001.

	Initial estimated impact	Revised estimated impact	Reported outcome	Inferred impact[a]
Change in regional agricultural sales				
Percent (%)[b]	–20[c]	–9[d]	–2.1[e]	–13 to –17

[a]A measure of the impact of the irrigation curtailment that is based on an interpretation of three types of data: (1) reported data on what actually occurred in 2001, (2) estimates from several economic models, and (3) information on specific "unrelated changes" that occurred in 2001

[b]No dollar value is shown since reported data (Klamath County only) would not be comparable to the values for initial and revised estimates and inferred impacts, all of which are for the three-county region.

[c]Impact on total agricultural sales, excluding state and federal emergency payments and loan-financed wells. Assumes only historical levels of groundwater pumping.

[d]Impact on total agricultural sales, excluding state and federal emergency payments and loan-financed wells. Reflects observed increases in groundwater use.

[e]Reported gross farm sales for Klamath County compared to previous 5 years. The omission of dehydrated food products from this measure, compared to the initial and revised estimated impacts, which include it, has a negligible effect on the comparison of percentage changes.

Given the large year-to-year fluctuations in farm prices, the financial stress of the 2001 events will depend, for some irrigators, on recent and future price patterns. For fresh potato growers, the 2001 irrigation curtailment came during a year of high prices following a year when prices were very low. The inability of growers to take advantage of high prices in 2001 may cause long-term financial distress. By contrast, growers who also produce livestock (approximately two-thirds of Klamath County farms, according to the 1997 *Census of Agriculture* for Klamath County) benefited from 2 very good years in 2000 and 2001. High livestock prices raised the value of livestock production in Klamath County by nearly $22 million, or more than 40 percent, in both 2000 and 2001, compared to the previous 5-year average.

Similarly, the analysis here and elsewhere in this report has not attempted to quantify the impacts of the irrigation curtailment, positive or negative, on the current and future abundance of fish and other species, nor on the economic sectors and communities who benefit from those species.

Regional agricultural production value

Gross farm production value in Klamath County declined only slightly, by $2.6 million (2.1 percent), in 2001 compared to the average for the previous 5 years (Table 2). This overall change, however, reflects a sharp decline in crop production value (–$24.4 million compared to the average during the previous 5 years) and a $21.8-million increase in livestock production compared to the same period.

The high value of livestock sales was due partly to favorable prices, which already existed in 2000. When livestock sales are compared only to 2000, however, there was a small decline in Klamath County compared to a small increase for Oregon overall. This difference may result from "distress sales" in which livestock owners sold animals earlier than planned (and at lower-than-optimal weight) due to the unavailability of adequate pasture or to offset low crop earnings. Indeed, average price per head in Klamath County declined by 5 percent in 2001, compared to an increase of 3.5 percent in other counties in Oregon. Distress sales in the livestock sector in 2001 can be expected to reduce inventories and future sales to some degree.

The initial regional impact model from Chapter 13 ("Regional Economic Impact") estimated a 20 percent reduction in agricultural production value (–$82 million), as shown in Table 5. When the model was revised to reflect acreage reported in the 2001 BOR report, the estimated impact was reduced to –9 percent (–$37.5 million). Neither of these figures includes state and federal emergency payments and purchases. The inferred impact of the irrigation curtailment on regional agricultural production value (including processing industries) is determined to be between –$48 and –$64 million. (This value equals the inferred impact on gross crop revenues from Table 3, which includes the reduced value of forage produced and hence includes impacts on the livestock sector.)

These figures represent an inferred impact for the irrigation curtailment of between –13 and –17 percent of agricultural production value (Table 5), which contrasts with the much smaller percentage reported change for Klamath County agriculture (–2.1 percent). These contrasting figures suggest that the higher value of non-Project agriculture, especially livestock sales, accounts for the small overall reported change despite the sharp decline in Project crop revenues.

Agricultural employment, reported data

The reported agricultural and agriculture-related employment in Klamath County declined by 147 jobs, or 11 percent, in 2001 compared to 2000. This corresponds to a 6 percent decline in total wages paid in "covered" agricultural and agriculture-related employment (jobs covered by unemployment insurance). Covered payrolls in establishments engaged in crop production declined by 12 percent, while establishments involved in livestock saw payrolls increase by 14 percent. Not all of the contraction can be attributed to the irrigation curtailment. For example, 38 jobs were reported lost in vegetable wholesaling because of closure and downsizing of potato sheds due to preexisting market conditions (Sicard 2002f).

These agricultural employment data are for Klamath County only and do not include the portions of the Upper Klamath Basin in Modoc and Siskiyou counties of California. Nor do they include "noncovered" employment, which includes many farmworkers. Reliable data on total agricultural employment (including noncovered employment) are not available at the county level, but noncovered farmworkers and sole proprietors clearly were seriously affected by the irrigation curtailment. Based on partial evidence from several sources, Kevin Sicard of the Oregon Employment Department suggests that perhaps 300 individuals from these two groups, and their families, were adversely affected.

Regional economic outcomes

In light of the smaller-than-expected decline in Project crop revenues, the high level of gross farm sales in Klamath County, and $45 to $47 million in emergency payments and other public expenditures, we can expect that the regional economy in 2001 did better than initially expected—due to the combined effects of these and other private and public responses and to factors unrelated to the irrigation curtailment.

Regional employment

The irrigation curtailment seems to have had only a modest effect on total employment in the regional economy in 2001. In Klamath County, total employment declined in 2001 by 470 jobs, or about 2 percent, compared to 2000. In Modoc County, employment grew by 3.7 percent; in Siskiyou County, employment declined by 1.7 percent. For the three counties combined, total employment fell by 946 jobs, a decline of 2.3 percent (Sicard 2002d; California Employment Development Department 2002).

These data are compared to the estimated impacts from Chapter 13 ("Regional Economic Impact" in Table 6. The initial impact estimate from Chapter 13 ("KPOP" scenario) was for 1,956 fewer jobs (a decline of 3.3 percent), while the estimate based on the revised scenario ("KPOP with response") was for a decline of 440 jobs (–0.7 percent). This large difference is due to inclusion in the revised scenario of the reported increase in groundwater irrigation as well as the government emergency payments.

For economy-wide variables such as regional employment, it is very difficult to identify and account for all of the related and unrelated factors that may have affected the regional economy. The irrigation situation in 2001 in the

Table 6. Regional employment—predicted impacts and reported outcomes, 2001.

	Initial estimated impact[a]	Revised estimated impact[b]	Reported outcome[c]	Inferred impact[d]
Change in regional employment				
Jobs	–1,956	–440	–946	unknown
Percent (%)[e]	–3.3	–0.7	–2.3	unknown

[a]From the input-output model in Chapter 13 ("Regional Economic Impact"), based on initial estimated acreage.
[b]From the input-output model in Chapter 13 ("Regional Economic Impact"), based on revised acreage.
[c]Based on the change in total employment in Klamath, Modoc, and Siskiyou counties between 2000 and 2001.
[d]There are too many unknown variables to allow estimation of an inferred impact for regional employment.
[e]Percentage changes differ between impact models and reported outcomes in part due to different baselines.
Sources: California Employment Development Department and Oregon Employment Department

Upper Klamath Basin attracted a great deal of media and political attention and many visitors. This activity may have had a positive effect on the overall economy, especially services. The infusion of emergency payments and other public disbursements also would have a positive effect, as would the continued high revenues in the livestock sector. Unlike the difference between the estimated and reported Project acreage or gross revenues, there are too many unknown variables to allow us to produce an inferred impact in this case.

In Klamath County, nearly all of the decline in employment in 2001 was due to factors unrelated to the irrigation curtailment, according to Sicard. The decline is attributable to two significant events: contraction in the lumber and wood products sector (a loss of 190 jobs) and contraction in the construction sector (a loss of 420 jobs) due to completion of several large construction projects (Sicard 2002a, c). Of the nonfarm job losses in Klamath County in 2001, Sicard attributes only 24 of those jobs to the drought and irrigation curtailment (Sicard 2002d), a reduction of 0.1 percent.

It would be misleading to suggest that the only ripple effects of the irrigation curtailment were those caused by changes in Project revenues. The curtailment had dramatic effects on people's expectations and on their confidence in future water availability and economic stability. A heightened sense of uncertainty about one's economic circumstances may lead consumers to behave with caution and to alter or restrain their spending practices. Such psychological effects could affect the local and regional economy in ways that are not yet apparent from available data.

Other economic outcomes

In addition to the outcomes reported above pertaining to the general level of regional economic activity, other direct, short-run economic consequences include the effect of irrigation curtailment on the production and allocation of energy. The water cutoff had a positive financial effect on PacifiCorp relative to what would have occurred under normal operation of the Project. (The drought, on the other hand, had an adverse effect on PacifiCorp, reducing the company's energy production by 25 percent of normal.) PacifiCorp supplies the BOR and Project growers with electricity to pump irrigation water at very low rates resulting from a long-term government contract ($0.003 to $0.006/kwh, or 80 to 90 percent below current market rates). The 2001 Biological Opinions had three effects on PacifiCorp.

First, energy demand for irrigation was reduced by about 45 percent based on comparisons of Project and non-Project demand. (Project demand typically was 40 percent higher than non-Project demand in the years prior to 2001; it was 22 percent lower in 2001.) As a result, PacifiCorp was able to sell this power to other customers. Given the very high market rates for power in the spring and summer of 2001 (around $0.2/kwh during the relevant period) and the drought, which reduced PacifiCorp's power generation and forced the company to buy power at market rates to meet obligations to customers, this reduction in Project demand for energy represented considerable cost savings for PacifiCorp.

Second, PacifiCorp is obligated by contract to install line extensions to well and pump sites in the Project at no cost to irrigators. Given the sharp rise in groundwater development in 2001, this requirement represented a significant additional cost to PacifiCorp.

Third, the irrigation curtailment resulted in additional stream flows in the Klamath River, which generated additional electricity for PacifiCorp. The increase in stream flow in the summer of 2001 due to the irrigation curtailment is difficult to estimate precisely, but it may have been as high as 100,000 acre-feet. This amount of additional water is likely to have generated as much as 75,000 MWh of power given the average generation rates at that time of year. Given the drought conditions and very high energy prices at that time, coupled with PacifiCorp's lack of additional generating capacity to meet its obligations to its regulated customers, this additional power likely represented a significant financial gain for PacifiCorp. Taking these three effects together, the curtailment of irrigation on the Project likely had a sizable net positive financial impact on PacifiCorp.[13]

Other economic outcomes arising from the irrigation curtailment, such as those resulting from changes in aquatic habitats in 2001, cannot be measured at this time. Changes in economic activities such as recreation and tourism or commercial and sport fishing are more difficult to evaluate for two reasons. First, there is considerable scientific uncertainty about the effects of the changes in water levels that occurred in 2001 on populations of fish and other species. Second, any possible effects of changes in fish and wildlife populations on the economic circumstances of individuals and communities are likely to occur in the future.

Conclusions

Our understanding of the economic changes that occurred in the Upper Klamath Basin in 2001 is based on a combination of recently available economic data and revised impact estimates based on models. We cannot fully separate the changes due to the irrigation curtailment from those due to unrelated events. We have some data on economic outcomes—but these data reflect all of the changes that occurred in 2001, not just those attributable to the irrigation curtailment. We have estimated impacts with and without specific public and private responses, but these estimates may involve omissions or errors that over- or understate the facts.

We also have information on some of the unrelated changes that occurred in 2001, but not all such changes. Thus, there are pieces missing from this puzzle, but the pieces we do have enable us to describe a rough picture of the economic story.

The analysis above suggests that the 2001 irrigation curtailment carried a high economic cost and that a large portion of that cost was shouldered by taxpayers. Many groups within the region incurred considerable economic losses, including farmworkers, tenant farmers and sharecroppers, and agricultural input suppliers. Many landowners and owner-operators also suffered considerable economic hardship. On the other hand, these groups benefited to some extent from government emergency programs, and in some cases payments exceeded individuals' direct losses.

In the aggregate, net losses on the Project are estimated to be between $27 and $46 million. Total government emergency payments were

[13]PacifiCorp staff contributed to and reviewed this analysis (Bornemeier 2002; LaBriere 2002), including quantitative estimations placing the net overall gain to PacifiCorp as high as $20 million.

between $35 and $37 million. These two figures, however, should not be added together as a measure of total cost to society. The losses on the Project were losses to the local economy *and* to the national economy. The emergency payments, by contrast, were transfers from one group (taxpayers) to another (irrigators and landowners). Thus, they represent income changing hands rather than wasted resources or forgone opportunities.[1]

The availability and eligibility for public emergency programs played an important role in separating those who were at least partially compensated for their losses from those who were not. The evidence suggests that groups closely tied to agriculture in the Project, but who did not receive public compensation for their losses, suffered the most as a result of the irrigation curtailment. These groups include farmworkers, tenants, sharecroppers, and agricultural input suppliers.

For the region overall, agricultural outcomes were better than originally expected based on the initial model estimates. The main reasons were additional private and publicly funded groundwater pumping, emergency payments and other public appropriations, and higher prices for livestock and potatoes.

The public response contributed toward a significant increase in the amount of land that was irrigated, and it also mitigated the financial costs for many growers. These responses came at a high cost to taxpayers, however. Indeed, the estimated $45 to $47 million government cost is nearly double the income generated on the entire Project (about $25 million including farm labor income) in a typical year.

There should be little doubt that the approach taken in 2001 to respond to water scarcity arising from drought and ESA requirements does not represent a desirable or sustainable model for responding to future water shortages. In future years, or in other agricultural communities facing water shortages, it is doubtful that governments will provide the level of response observed in the Project in 2001. Hence, it is incumbent upon all parties interested in finding lower cost solutions to conflicts over water to seek ways to avoid a repeat of the events of 2001. Creating the institutions necessary to allow for flexible, market-based responses to water shortages could dramatically reduce the risks, costs, and disruptions associated with shortages. For example, the cost of the irrigation curtailment in 2001 is estimated to have been *five* times higher than it might have been if water markets or water banks had been available to irrigators in the Upper Klamath Basin. (See Chapter 19, "Water Allocation Alternatives," for a detailed analysis of these issues.)

The long-term impact of the events of 2001, on irrigators as well as on fishers, tribes, and other groups, is impossible to predict. In large part, future consequences will depend on the institutional changes that are made in response to the events of 2001.

Table 7 (following page) summarizes the findings discussed in this chapter.

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[1]These government transfers (emergency payments) and other public expenditures may generate an additional cost to society depending on how they are financed (e.g., raising taxes, public borrowing, or reductions in other public programs). Given the degree of substitution and comingling among sources and uses of government funds, however, any claims about the size of this added "distortionary" cost would be entirely speculative.

Table 7. Summary of estimated impacts, reported outcomes, and inferred impacts in the Upper Klamath Basin, 2001.

	Initial estimated impact	Revised estimated impact	Reported outcome	Inferred impact
Project level				
(A) Change in Project irrigated acreage				
Acres	–170,000	–112,000	–102,338	–102,338
Percent (%)	–86	–57	–53	–53
(B) Change in Project gross crop revenues				
$ million	–74.2	–38	–52 to –54	–48 to –64
Percent (%)	–75	–39	–53 to –55	–49 to –65
(C) Change in Project net farm revenues				
Loss in net crop revenues ($ million)	–33 to –37.5	–15 to –32	not available	–27 to –46
Gain from emergency payments ($ million)	—	—	+37 to +35	+37 to +35
Overall change ($ million)	—	—	not available	+10 to –11
Regional level				
(D) Change in regional agricultural sales				
Percent (%)	–20	–9	–2.1	–13 to –17
(E) Change in regional employment				
Total employment	–1,956	–440	–946	unknown
Percent (%)	–3.3	–0.7	–2.3	unknown

(A) Change in Project irrigated acreage: Initial estimate (from Chapter 12, “Crop Revenue”) assumes only historical levels of groundwater pumping. Revised estimate reflects observed increases in groundwater use. Reported outcome includes acres receiving full irrigation from either Project or non-Project sources (including wells) compared to the average for the previous 5 years. Inferred impact equals the decline in reported irrigated acreage. None of these figures includes lands irrigated only during the midseason release.

(B) Change in Project gross crop revenues: Initial estimate is from Chapter 12 (“Crop Revenue”) and Chapter 13 (“Regional Economic Impact”) and assumes only historical levels of groundwater pumping. Revised estimate reflects observed increases in groundwater use applied to the two initial impact models. Reported outcome is based on data for Klamath County and the Tulelake Irrigation District (TID) as reported in Table 2. These two areas include more than 90 percent of the Project. Inferred impact reflects the entire range of estimates that reflect reported irrigated acreage, including those based on models and those based on reported data.

(C) Change in Project net farm revenues: Initial impact estimate is from Chapter 19 (“Water Allocation Alternatives”). Revised impact estimates are based on the inferred impacts on gross crop revenues reported on line B, which reflect reported acreage. These figures also account for crop insurance payments and additional outlays for groundwater pumping and cover crops.

(D) Change in regional agricultural sales: Initial and revised estimated impacts are from Chapter 13 (“Regional Economic Impact”), excluding state and federal emergency payments. Initial estimate assumes only historical levels of groundwater pumping. Revised estimate reflects observed increases in groundwater use. Reported outcome equals gross farm revenues for Klamath County compared to previous years. (No dollar value is shown because reported data for Klamath County only would not be comparable to the values for initial and revised estimates and inferred impacts, all of which are for the three-county region.) Inferred impact reflects the inferred impact on gross crop revenues (from line B), which includes the reduced value of forage produced and hence includes impacts on the livestock sector.

(E) Change in regional employment: Initial and revised estimates are from the input-output model in Chapter 13 (“Regional Economic Impact”) for the initial and revised irrigated acreage. Reported outcome is based on the change in total employment in Klamath, Modoc, and Siskiyou counties between 2000 and 2001. There are too many unknown variables to produce an inferred impact.

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