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Water Allocation in the Klamath Reclamation Project

Brief # 3

Energy Pricing and Irrigated Agriculture in the Upper Klamath Basin

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The conflict over water allocation in the Upper Klamath Basin encompasses many important, complex, and difficult questions. One aspect of the situation, energy pricing, has come under increased scrutiny in connection with relicensing of the Klamath River hydropower operations, which is scheduled to take effect in 2006.

At issue are the prices that Upper Klamath Basin irrigators pay for energy under a 1956, 50-year contract with the energy provider and hydropower operator—now PacifiCorp. Under the terms of that long-term contract, irrigators within the Klamath Reclamation Project pay about one-tenth the price paid by other Oregon and California farmers served by PacifiCorp and one-fifth to one-eighth the price charged by other power companies serving farmers in Oregon. In addition, Project farmers do not pay standby fees of $15 to $19 per horsepower of pumping capacity, and they are not charged for line extensions to new pumping sites.

Oregon farmers outside the Project but within the Upper Klamath Basin enjoy low energy rates (87 percent lower than rates for other farmers served by PacifiCorp) and an exemption from standby fees, but not free line extensions.

The origins of these contractual arrangements date back to 1917, when PacifiCorp's predecessor, Copco, negotiated a contract with the U.S. Bureau of Reclamation for construction and operation of Link River Dam at the outlet of Upper Klamath Lake. In exchange for the rights to operate hydropower facilities on the Klamath River, Copco agreed to build the Link River Dam but convey the dam's ownership to the Bureau of Reclamation. The terms of the agreement included providing energy to irrigators at a long-term "contract rate" that currently is one-tenth of the rate charged to other PacifiCorp irrigators.

In light of the conflicts over limited Klamath Basin water supplies for agricultural, environmental, tribal, recreational, and commercial and sport fishing uses, questions have arisen about the effects of these low energy prices on agriculture in the region and, in particular, about the impact that higher energy pricing would have on the viability and scale of irrigation. Key questions include:

- Would irrigated agriculture continue to be economically viable at higher energy prices?
- How would the elimination of these contract power rates alter the demand for irrigation water?
- Might the elimination of low power prices alleviate water conflicts?

The present analysis does not attempt to address questions about the justification for the current, contracted energy prices. Differential

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pricing and contracts of this nature are common in both the private and public sectors, as with rent-controlled apartments, airline ticket pricing, and differences in power rates, for example, between residential and industrial customers. Moreover, electric utilities are regulated private companies, whose pricing rules must be approved by government, and dozens of different pricing schedules apply to different classes of customers.

Nevertheless, the relicensing of PacifiCorp's hydropower operations, and any renewal of power rate agreements for Klamath irrigators, will take place within the current legal, political, and social setting—one that differs greatly from the situation 50 years ago. The elimination of the current low energy price arrangement is only one of a number of possible outcomes from the current relicensing process (Klamath Water Users Association, personal communication, April 28, 2004).

In the Oregon State University–University of California report on Klamath water allocation,[1] only brief mention was made of the effects of energy pricing on farm profitability. A rough calculation of the average differentials in power cost per acre between Project irrigators and non-Klamath irrigators suggested that the difference was not large relative to the net income generated for the Project overall (OSU–UC report, p. 378). This brief discusses this issue in greater detail.

Per-acre energy costs without low energy prices

In order to assess the impact of changes in energy prices on farm profitability, we need to compare the current contract energy rates per irrigated acre with those charged to other Oregon and California irrigators. Current power rates for irrigators on the Oregon portion of the Project (including delivery and other components) are 0.6¢/kWh (kilowatt hour); comparable rates for nearby non-Project irrigators are 0.75¢/kWh. For other irrigators in Oregon, the PacifiCorp rate is 5.696¢/kWh; for other irrigators in California, it is 6.318¢/kWh (http://www.pacificorp.com/Navigation/Navigation4428.html).[2]

Oregon irrigators served by some other power companies pay lower rates than PacifiCorp's non-Klamath customers. For example, Umatilla Electric Cooperative charges irrigators in Umatilla, Morrow, and Union counties 4.17 to 4.70¢/kWh, and Idaho Power in Ontario charges 3.06¢/kWh (http://www.idahopower.com/aboutus/regulatoryinfo/tariffPdf. asp?id=75&.pdf).

Given the wide range of crops, soils, pumps, irrigation types, and lift requirements, it is difficult to evaluate the effect of current contract power rates on a particular irrigated plot in the region. However, there are several approaches to estimating how a change in energy price will affect typical irrigation costs, and hence the economics of farming generally.

First, we can use data on total energy consumption and total acres irrigated to compute the average cost per acre under current and alternative pricing. Second, we can look at similar irrigated areas in locations where standard energy charges apply. Third, we can estimate the energy required for a given pumping system to pump an acre-foot of water, and then apply that requirement to the volume of water needed for each crop rotation to find the total energy requirement and cost.

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[1]Braunworth, Jr., W.S., Welch, T., and Hathaway, R. eds. *Water Allocation in the Klamath Reclamation Project, 2001: An Assessment of Natural Resource, Economic, Social, and Institutional Issues with a Focus on the Upper Klamath Basin,* SR 1037 (Oregon State University and the University of California, 2002).

[2]Under a contract between the Tulelake Irrigation District and the U.S. Fish and Wildlife Department, excess water is pumped from Tule Lake to Lower Klamath Lake through a 6,600-foot tunnel in Sheepy Ridge. This process provides flood control to the basin, and is the primary source of water for the Lower Klamath National Wildlife Refuge. The pumping cost is about $50,000 annually at the special off-peak drainage power rate of 0.2¢/kWh. Since this pumping activity differs from irrigating privately cultivated lands and serves a public purpose that benefits the entire basin in direct and indirect ways (including the national wildlife refuges), any change in the power rates or cost allocation for this activity may be negotiated separately from any proposed changes in the power rates paid by individual irrigators. As a result of this unique situation, we do not evaluate how changes in energy prices might affect the costs of this activity.

Estimates based on energy consumption data

The first component of energy cost is direct payment for energy. Under current pricing schedules, Upper Klamath Basin irrigators paid PacifiCorp $880,000 in 2000 (McCarthy 2002), a year with slightly higher than average energy consumption. These energy costs are concentrated among the sprinkler-irrigated lands (between 175,000 and 200,000 acres), where energy use is highest. (For the approximately 250,000 flood-irrigated acres, energy costs may be zero or negligible.)

If we assume this $880,000 energy bill (which includes costs incurred by centralized pumping stations such as those operated by irrigation districts), this cost represents an average of between $4.50 and $5 per acre. Some farmers pay only an annual minimum based on their pump's horsepower (e.g., $6 per horsepower for the first 5 years for pumps less than 90 horsepower, $3 per horsepower after that). For some irrigators, this payment could amount to $256, or $3 to $6 per acre, depending on the acreage irrigated (Lynn Long, Klamath Water Users Association, personal communication).

Given exemptions from standby fees and line extension charges, the above figures represent the total payments for energy by farmers. Thus, a 900 percent increase in power rates from a starting point of $4 to $5 per acre suggests per-acre energy costs of $40 to $50 for sprinkler irrigation. Of course, costs for individual farms vary by crop, crop rotation, and technology.

The average annual regional energy consumption from 1997 to 2001 was 127 million kWh (McCarthy 2002). At the Oregon standard agricultural price of 5.696¢/kWh, this energy would cost irrigators $7.22 million (compared with less than $1 million at current rates), or an average of $36 to $41 per acre for 175,000 to 200,000 sprinkler-irrigated acres. This figure represents an increase of $32 to $36 per acre compared to current pricing. Increases for water-intensive crops such as alfalfa would be higher. Increased energy costs for the region as a whole would amount to more than $6 million per year.

The second component of energy pricing is the standby fee, or "standard fee," which is based on the horsepower of each farmer's pumping capacity. The current rate for irrigators in Oregon outside the Klamath Basin is $9/kW, or about $6.75/horsepower. If applied to the Klamath Basin, these annual charges could average an additional $3 to $5 per acre per year, depending on the pump size and number of acres irrigated.

The third component of energy pricing involves line extensions. If paying the full cost of line extensions, farmers likely would request line extensions only if the financial benefits were greater than the cost (which could be quite high for some operators).

The continued viability of agriculture in the region is unlikely to be driven by the cost of line extensions. Indeed, requests for line extensions might decline dramatically or stop altogether. Therefore, we will set aside the question of line extensions under future pricing schedules and focus on the direct costs of energy and pumping capacity.

Taken together, standard energy charges and standby fees for Oregon are estimated at $35 to $50 per acre for pressurized sprinkler irrigation, compared to only $3 to $6 per acre in the Upper Klamath Basin under the current pricing schedule.[3]

However, in order to accurately estimate how the elimination of current contract energy pricing would affect per-acre energy costs, we must consider how the price increase would affect energy use. With a possible 900 percent increase in the price of energy, we expect farmers to consume less energy per acre. With the imposition of an annual standby charge based on pumping capacity, farmers also are likely to consider ways to minimize these charges. Finally, if farmers are

[3]For a small but significant number of acres (perhaps 2,000 acres), diesel or propane pumps are used rather than electric pumps (Lynn Long, personal communication). These pumps are easily moved, but are more expensive to operate.

charged the full cost of line extensions, requests for line extensions certainly would decline. Indeed, there might even be a reduction in the number of pumping sites since the higher energy charges and standby fees might induce some farmers to switch from sprinklers back to flood irrigation (although water quality requirements on return flows imposed under the Clean Water Act may inhibit switching to flood irrigation (Greg Williams and Eldwin Sorensen, Northwest Farm Credit Services, personal communication, April 2004).

All of these factors suggest that the actual cost increases would be less than the above estimates, which do not take account of the ways farmers can be expected to economize on energy as it gets more expensive. The responsiveness of farmers' energy consumption to energy price (what economists call the "price elasticity of demand") has been estimated in a number of economic studies (see, for example, Conners, Glyer, and Adams 2003), indicating that a reduction in energy consumption can be expected. Thus, the above estimates of increased costs should be viewed as "upper bounds" reflecting a situation where farmers do not reduce their energy consumption as the cost of energy rises.

Estimates based on energy costs in other areas

In other parts of Oregon (e.g., along the Deschutes River in Jefferson County and in northeast Oregon), irrigators pay between five and nine times as much for energy as farmers in the Klamath Reclamation Project and from four to nearly eight times as much as Klamath irrigators outside the Project.

Information on irrigation energy costs throughout Oregon also is found in the crop enterprise budgets produced by the Oregon State University Extension Service (http://oregonstate.edu/Dept/EconInfo/ent_budget/). For alfalfa grown in central Oregon (Jefferson, Crook, and Deschutes counties) and eastern Oregon (Baker, Wallowa, and Union counties) using surface water for irrigation, pumping costs have been estimated at $25 per acre (see EM 8606, EM 8604).

In the case of potatoes and mint grown in north-central and eastern Oregon using groundwater (EM 8460, EM 8602), pumping costs are estimated at $60 per acre due to the lift involved. (Some potatoes in the Hermiston area are irrigated with water lifted 500 to 600 feet from the Columbia River.) These figures from other parts of Oregon provide estimates of irrigation pumping costs that are both higher and lower than the range of estimates for the Upper Klamath Basin.

Estimates based on an engineering approach

We also can take a more technical approach to estimating irrigation energy costs, based on the energy requirements for a given pumping system per acre-foot of water and on the water application levels for each crop and representative crop rotation.[4] Most of the pumping cost is associated with pressurizing water into sprinkler systems at between 45 and 70 psi (pounds per square inch). Flood irrigation frequently involves little pumping and very low pumping costs. Water applications range from 20 to 36 acre-inches for crops grown in the Upper Klamath Basin.

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[4]Pumping cost, c, is computed as $c = p * E$, where E is the energy consumed in kWh, and p is the price per kWh of energy. E is computed as $E = t * kw$, where t is the time in hours and kw is kilowatts per unit time. The rate of energy consumption is $kw = q * tdh/3{,}960$, where q is the pumping rate in gallons per minute and tdh is the "total dynamic head." Total dynamic head, tdh, is the sum of lift, head loss, and the pressure at the pump in psi multiplied by 2.306. The hours of pumping, t, necessary to apply the required acre-inches of water, d, is computed as $(d * 27{,}180)/(q * 60)$. Combining these formulas gives us $c = p * (27{,}180 * d * tdh)/(60 * 3{,}960)$. Lift and head loss are assumed to sum to 15 feet. Motor and pump efficiency is assumed to be a combined 0.7. Assumptions are based on typical values for the technologies used in the region. (Sources: Marshall English, professor and Extension irrigation specialist, Bioresource Engineering Department, Oregon State University; Lynn Long, Chair of the Power Committee, Klamath Water Users Association; Kerns Irrigation; Klamath County Soil and Water Conservation District; Thompson Pumping).

Under current pricing in the Klamath Project, these formulas generate electricity cost estimates of between $3 and $6.25 per acre for crops grown on Class II and III soils. For a given piece of land following a typical crop rotation, however, the average annual electricity cost ranges from $4 to $5 per acre. The range narrows because potatoes—the crop with the highest energy costs—are typically grown only 2 years out of 10.

If the price of energy were increased from 0.6¢ to 5.693¢/kWh, the costs for representative crop rotations on these lands would increase to an estimated $38 to $45 per acre per year. This represents an increase of $34 to $40. Crop-specific costs run from $28.50 for cereals to $60 for potatoes. Alfalfa and pasture costs are estimated at $44 per acre per year. Although some pasture occurs in rotation with higher value crops, most pasture is grown on Class IV and V soils and is flood irrigated; thus, electricity costs most often are negligible, although in some cases drainage pumps are used to remove excess water from these lands.

To summarize, two of the three approaches to estimating potential energy costs suggest that costs to Upper Klamath Basin farmers who sprinkler irrigate would be in the range of $38 to $50 per acre per year under power rates currently charged by PacifiCorp to non-Klamath irrigators, compared to $3 to $6 under current contract rates.[5] The other approach, which looks at per-acre energy costs in other parts of Oregon, finds examples that are both higher and lower than this $38 to $50 range.

Although these estimates do not take full account of the ways that farmers are likely to reduce energy consumption if it becomes much more expensive, they are remarkably close to estimates from the U.S. Department of Agriculture's Economic Research Service. Based on comprehensive national data collection and analysis, the USDA/ERS estimates irrigation energy costs in the western U.S. for electric pumping to average $44 per acre (U.S. Department of Agriculture).

Farm profits without low energy prices

How would energy costs based on standard prices affect farmers' costs and profitability in the Upper Klamath Basin? At one level, we can compare energy costs to the total cost of production (fixed and variable costs), which varies from $200 per acre for Class V lands (primarily pasture) to an average (over a 10-year rotation) of more than $600 per acre for Class II lands where row crops typically are grown in rotation with alfalfa.

Based on standard statewide rates, energy costs would represent between 6.3 and 22.5 percent of total per-acre costs. Under current contract rates, energy costs amount to less than 1 percent of production costs on average.

Of greater interest, however, is the impact that higher energy costs would have on farm profits, and hence on the viability of farming. "Farm profit" refers to the difference between total revenue and total cost, where all costs are taken into account, including inputs, water, labor, district charges, returns for the farm operator, and land.

One way to estimate changes in farm profitability is to estimate expected changes in land rental rates or land prices. The reason is that, except where other nonagricultural uses of land compete with farming, the cost of land is determined primarily by farm profitability. Both rental rates and land values can be expected to reflect the profitability of farming (revenue in excess of all costs) and of the return to landowners who allow others to farm their land.[6]

Variations in rental rates (or, equivalently, an annualized measure of land values) for

[5] For comparison purposes, Idaho farmers growing similar crop rotations (potatoes, alfalfa, grains) incur costs of $30 to $45 per acre (Bob Smead, account manager for irrigation at PacifiCorp, personal communication, September 19, 2003).

[6] Land values will diverge from this relationship if nonagricultural demands for land (e.g., recreational or residential uses) compete with agricultural uses. Otherwise, land rental rates and land prices (expressed on an "annualized" basis) should be consistent.

different land classes reflect this fact. Class II and III farmlands in the Klamath Reclamation Project rent for between $75 and $130 per acre over a typical crop rotation, depending on the soil class and productivity (Klamath County Tax Assessor 2001). When used for highly profitable row crops, rents for these lands can range from $200 to $300 (Braunworth et al. 2002). Also consider the land rental rates in the Project versus those for Jefferson County, Oregon ($60 to $90 per acre, also averaged over a multiyear crop rotation). The disparity in rates between the two areas reflects differences in farm profitability due to cropping patterns, soils, climate, and energy costs.

Farmers generally are willing to rent a given piece of land at a given price only if they expect that, after paying all other costs, their profits will cover the rental price. If farmers cannot break even at a given land rental rate, market pressures will cause the land rental rate to adjust downward.[7]

As a result, we cannot assume that land rental costs would remain constant in the face of changing crop prices or input costs. This conclusion is supported by many detailed economic studies and economic theory: changes in farm costs or revenues tend, eventually, to end up being capitalized into land prices and rental rates.

If the costs of farming were to increase by $40 per acre in the Klamath Project due to higher energy costs (a central estimate based on both the energy consumption data and the engineering estimates above), farmers would be reluctant to pay current land rental rates. Landowners, of course, would prefer not to reduce rental rates, but if farmers could not break even at the current rates, pressure would build for lower rental rates (in cases where the renter pays the power costs). These downward pressures on rental rates (or farm profitability) would also lower land prices and thus reduce the value of landowners' assets. In cases where landowners pay for power, the rental rate may not decline, but the impact on landowners' incomes and land prices is likely to be the same.

To estimate how higher energy prices would affect the land rental rates (or annualized land values) for irrigated land in the Upper Klamath Basin, we subtract the estimated annual energy cost increases (for sprinkler irrigation) from the current estimates of land values/rental rates for each location and soil class. These adjusted annual land values are presented in Table 1 (page 7).[8]

Profits on Class II and Class III lands

With these changes in power charges, rental rates (or annualized land values) for sprinkler-irrigated Class II lands in the main Project areas (including most of the Upper and Lower Lost River Valley areas) are estimated to decline to between $74 and $104 per acre per year, with one exception. Estimates are lower for the "West of 97 to Keno" area, where rental rates were lower initially. In the case of Class III lands, adjusted rental rates range from $23 to $62 per acre, again with one exception.

These results suggest that the profits accruing to landowners using sprinkler irrigation would decline significantly with a change in energy pricing, but farming would not become unprofitable in the Project or on most non-Project lands in the Upper Basin. We estimate that the loss of current contract energy pricing

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[7]Land sale prices will tend to reflect these same relationships, with the price of land representing the discounted present value of expected future annual profits (whether from rental income or own-use). In some areas, however, demand for "lifestyle" or "hobby" farms may cause land prices to diverge from values that reflect only farm profits.

[8]These reductions in land values and landowner income would have some additional "ripple effects" on the regional economy due to reduced spending by landowners. Property tax revenues in Klamath County also would be adversely affected by declining land prices. Bear in mind, however, that immediately after the 2001 irrigation curtailment, land prices declined significantly compared to the pre-2001 levels used in the current analysis. Since then, however, land values (reflected in land rental rates) have increased above their pre-2001 levels (Don Ringold, Klamath County Tax Assessors Office, personal communication, June 2004). These changes seem to reflect both increased certainty about water deliveries to farmlands and recent opportunities to lease or sell water to publicly-funded water transfer and water banking programs.

Table 1. Estimated land rental values with elimination of current low energy prices (for sprinkler-irrigated lands only).[a, b]

	Net revenue per acre if sprinkler irrigated (by soil class)				Total irrigated acres	Sprinkler-irrigated acres	Non-Project acres	Sprinker pasture/hay acres
	Class II	Class III	Class IV	Class V				
Upper Klamath Lake and above	—	—	—	—	179,000	58,000	173,000	57,000
Fort Klamath Valley	—	2	-13	-28				
Modoc Point to Chiloquin	38	2	-13	-28				
Sprague River Valley	—	8	-7	-34				
North Country	—	-7	-7	-37				
Upper Lost River Valley	—	—	—	—	84,000	50,000	44,000	46,000
Langell Valley	74	35	-7	-30				
Bonanza-Dairy	74	35	-7	-30				
Poe Valley	98	26	2	-28				
Swan Lake Valley	74	35	-7	-30				
Lower Lost River Valley and other Project lands	—	—	—	—	184,000	85,000	32,000	50,000
Merrill-Malin area	98	23	2	-28				
Midland-Henley-Olene	98	26	2	-28				
Lower Klamath Lake	98	56	2	-40				
Malin Irrigation District	104	62	8	-34				
Shasta View District	104	29	8	-34				
West of 97 to Keno	38	2	-13	-28				
Tule Lake	98	50	8	—				
Total acres	**51,000**	**161,000**	**183,000**	**30,000**	**447,000**	**193,000**	**249,000**	**153,000**

[a]Expected energy cost increases have been subtracted from the recent rental rate estimates for each class and location for irrigated lands (net of the value corresponding to nonirrigated land). Sprinkler irrigation is assumed for purposes of these estimations, even though only about 43 percent of irrigated lands are sprinkler irrigated based on the above data.

[b]Class IV and V lands are dominated by pasture and hay production, and they include both flood and sprinkler irrigation.

would raise costs by an average of $40 per sprinkler-irrigated acre in the Project and that these costs likely would be absorbed by landowners. (Cost increases outside the Project are assumed to be slightly less given the higher current non-Project energy prices.)

These estimated rental rates are similar to the range reported for Jefferson County ($60 to $90 per acre), where energy prices are much higher than the prices paid in the Upper Klamath Basin (Jefferson County Assessor, 2003). The Jefferson County land rental rates highlight the fact that higher energy prices have not kept farmers in other parts of Oregon from irrigating highly productive farmlands.[9]

Profits on Class IV and Class V lands

In the case of Class IV and V lands, sprinkler-based irrigated agriculture may become unprofitable in most cases when power costs increase by $40 per acre. Table 1 indicates that all areas where Class IV and V lands are sprinkler irrigated are vulnerable to a loss of profitability. Many of these lands are concentrated in the Sprague River area, the Swan Lake Valley, and Langell Valley. The Class IV and V lands currently under sprinkler irrigation amount to about 153,000 acres based on data from the Natural Resources Conservation Service (Terry Nelson, personal communication). Approximately 65,000 of those acres are outside the Project.[10]

The number of farm acres in these areas that might face a loss of profitability would depend on irrigation lift requirements, the need to use sprinkler irrigation (e.g., where sloped or uneven fields could not be flood irrigated effectively), and restrictions from the Clean Water Act for switching to flood irrigation. Some farms may be able to convert to controlled flood irrigation; others may not. Conversion to flood irrigation may be impeded by uneven ground. A significant portion of these lands are currently irrigated with groundwater. Recent attention to this issue suggests that increased reliance on groundwater may have contributed to a decline in groundwater levels (Milstein, 2004).

If some portion of these Class IV and Class V sprinkler-irrigated lands became unprofitable to irrigate, consumptive use of water for irrigation would decline. For example, one-fifth (30,000 acres) of these Class IV and V sprinkler-irrigated lands represent about 7 percent of the total irrigated acres in the Upper Basin but only about 3.5 percent of the net income from irrigated agriculture. The consumptive use on these 30,000 acres of pasture and hay is about 75,000 acre-feet, or about one-quarter of the irrigation reductions imposed in 2001.[11]

Potential changes in agricultural practices

In addition to reductions in land prices and rental rates, some changes in agricultural practices could be expected if current contract energy prices were eliminated. The proportion of lands planted to water- and energy-intensive crops likely would decline relative to non-water-intensive and non-energy-intensive crops. The shift toward high-pressure sprinkler irrigation likely would slow, whereas the introduction of energy-conserving technologies likely would accelerate. Indeed, some irrigators in the Klamath area already have shifted or made plans to switch to low-pressure nozzles, smaller pumps, or variable-frequency drives.

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[9]The short-run financial effects of a large increase in energy prices will vary among farm enterprises, depending on the timing, advanced notice, and suddenness of any changes in energy prices.

[10]In a few instances, the incentives to irrigate may not be based solely on demands for commercial agriculture, but are related to residential or “lifestyle farm” demand. In these cases, an increase in energy prices may not affect irrigation in the same way.

[11]In some wetland areas with subsurface water, however, cessation of irrigation may not reduce the “consumptive use” of water since native vegetation potentially could consume water at rates similar to cultivated crops such as irrigated pasture. However, many of the acres vulnerable to a loss of profitability seem to be higher elevation lands, where slopes and uneven ground make flood irrigation impossible, rather than low-lying wetlands.

A shift from sprinkler irrigation to flood irrigation might be an option in areas where "laser leveling" can ensure uniform applications for high-value crops. However, Clean Water Act requirements may limit this option. Note that a decline in the use of high-pressure sprinklers is not expected to significantly lower overall irrigation efficiency or increase water diversions since the aggregate irrigation efficiency for the Project already is greater than 95 percent (and indeed these remaining return flows contribute to wildlife habitat in the refuges.)

An opposing trend, however, is underway in the region in response to a special authorization in the 2002 Farm Bill, which has allocated $50 million of public funds to the Upper Klamath Basin to promote irrigation efficiency (primarily adoption of sprinkler technologies, but also including some laser-leveling for controlled flood irrigation). These funds typically finance three-quarters of the cost of sprinkler technologies purchased by eligible farmers in the area, thereby increasing the prevalence of energy-intensive sprinklers.

While these changes are unlikely to "free up" additional water because of the already-high aggregate irrigation efficiency in the Project (mentioned above), any future increase in energy prices would add significant production costs for those farmers who take advantage of this program. Thus, continued use of the newly acquired equipment may be discouraged.

Conclusions

Overall, the analysis above indicates that most of the irrigated lands in the Upper Klamath Basin (and in particular those lands within the Klamath Reclamation Project) are highly productive and would continue to be profitable to irrigate under energy prices and fees currently paid by farmers in other parts of Oregon or northern California. Indeed, the viability of agriculture in the region does not depend on the current low energy prices, although these prices provide significant financial benefits to landowners and owner-operators in the region.

If energy prices were to increase to rates comparable to rates paid by PacifiCorp's irrigation customers outside the Klamath area, we estimate the returns to landowners would decrease by about $40 per acre per year on those acres that are, and would continue to be, sprinkler irrigated. Farmers could be expected to conserve energy in a number of ways, such as using low-pressure sprinklers, more energy-efficient pumps, and laser-leveling to increase the efficiency of controlled flood irrigation.

The analysis suggests that some of the 193,000 acres that currently are sprinkler irrigated might become unprofitable if energy prices rise, and that the lands most vulnerable are among the 213,000 acres of Class IV and Class V lands, although the exact number and their location would be difficult to predict. Two-thirds of the sprinkler-irrigated pasture and hay acres are located outside the Project, and these acres represent consumptive use of about 250,000 acre-feet of water.

A loss of profitability on some of these lands could lead to a reduction in irrigation diversions. Water bank or water transfer opportunities might become more attractive for some irrigators who might face significantly higher pumping costs. Depending on how future water shortages are addressed, use of a water bank or other transfer mechanism has the potential to facilitate lower cost solutions to the region's water conflicts, thereby reducing potential harm to the region's overall agricultural economy.

References

Braunworth, Jr., W.S., Welch, T., and Hathaway, R., eds. 2002. *Water Allocation in the Klamath Reclamation Project, 2001: An Assessment of Natural Resource, Economic, Social, and Institutional Issues with a Focus on the Upper Klamath Basin*, SR 1037 (Oregon State University and the University of California). http://eesc.oregonstate.edu/agcomwebfile/edmat/html/sr/sr1037/sr1037.htm

Conners, J.D., J.D. Glyer, and R.M. Adams. 2003. "Some further evidence on the derived demand for irrigation electricity: A dual cost function approach." Water Resources Research 25:7, pp. 1461–1468.

Idaho Power Web site. http://idahopower.com/aboutus/regulatoryinfo/tariffPdf.asp?id=75&.pdf

Jefferson County Assessor. 2003. 2003 Farm/Ranch Report (Madras, OR).

Klamath County Tax Assessor. 2001. Klamath County Assessor's Certified Farm Use Study, 2001–2002 (Klamath Falls, OR).

Klamath Water Users Association, personal communication, April 28, 2004.

Long, Lynn. Klamath Water Users Association, personal communication.

McCarthy, J. 2002. "Ratepayer Rip-off" (Oregon Natural Resources Council, Portland). http://www.onrc.org/programs/klamath/RatepayerRipOff.pdf

Milstein, M. "Klamath wells deep in trouble." The Oregonian. Monday, May 3, 2004, page 1.

Nelson, Terry. USDA Natural Resources Conservation Service, personal communication.

Oregon Natural Resources Council press release, December 11, 2002. http://www.onrc.org/press/053.powersubsidies.html

Oregon State University Extension Service. Enterprise budgets. http://oregonstate.edu/Dept/EconInfo/ent_budget/

PacifiCorp Web site. http:www.pacificorp.com/Navigation/Navigation4428.html

Ringold, Don. Klamath County Tax Assessors Office, personal communication, June 2004.

Smead, Bob. PacifiCorp, personal communication, September 19, 2003

U.S. Department of Agriculture/Economic Research Service. Online data. http://www.ers.usda.gov/data/westernirrigation/summaryofresults.htm.

Williams, Greg and Sorensen, Eldwin. Northwest Farm Credit Services, personal communication, April 2004.

For more information

Braunworth, Jr., W.S., Welch, T., and Hathaway, R. eds. *Water Allocation in the Klamath Reclamation Project, 2001: An Assessment of Natural Resource, Economic, Social, and Institutional Issues with a Focus on the Upper Klamath Basin*, SR 1037 (Oregon State University and the University of California, 2002).

Jaeger, William K. *Brief #1: The Value of Irrigation Water Varies Enormously Across the Upper Klamath Basin,* EM 8843-E (Oregon State University, 2004).

Jaeger, William K. *Brief #2: Potential Benefits of Water Banks and Water Transfers,* EM 8844-E (Oregon State University, 2004).

The above publications are available online at http://eesc.oregonstate.edu

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