Impact of Federal Acreage Limitation Policy on Western Irrigated Agriculture

Charles V. Moore

Long-Run Average Cost Curves were developed for 18 Federal irrigation districts indicating in general a constant cost industry. Conclusions were that Interior's acreage limitation policy would cause no appreciable loss in economic efficiency nor an increase in food costs. Implementation of full-cost water pricing to recapture Federal subsidies would greatly reduce the amount of water demanded and significantly impact production of forages and other high water using crops.

The Reclamation Act of 1902 ushered in the most expensive land settlement program in the history of the United States. Prior land settlement acts, The Homestead Act of 1862, The Timber Culture Act of 1873, The Desert Land Act of 1877, The Timber and Stone Act of 1878 and The Carey Act of 1894, all had as a major objective the opening of the public domain for settlement purposes. But the Reclamation Act of 1902 was the first act with a concomitant commitment for large public investment in the development of irrigation works, a vital input in an arid region if large-scale, stable settlement opportunities were to be realized.

Water greatly enhances the productivity and thus the market value of arid lands. Since water developed under these projects was to be provided to both public and private lands free of interest, a significant subsidy was apparent from the beginning. The Act contained several antimonopoly and antispeculation clauses including a residency requirement; foremost was the clause limiting ownership of land receiving Federal water to 160 acres per owner. No limit was ever placed on ownership of land not receiving Federal project water nor has a limit ever been placed on the leasing of land from qualified owners. Over the years, the magnitude of the subsidy has grown as interest rates have increased. The repayment period has been gradually lengthened to 40 and in some cases 50 years and the water districts came to be charged according to their ability to pay rather than for the full costs.

From the very beginning, Federal irrigation water development has generated heated arguments polarizing the electorate. Congressional debate over the 1902 Act took on a regional flavor with easterners opposing the income transfer inherent in western water development through taxation of the more populated East. Proponents of the 1902 Act flavored their rhetoric with phrases such as, "settlement opportunities would be created for people who are without homes," and, its purpose "to furnish homes for the homeless and farms for the farmless" [WPRS]. It was this appeal to the Act's social promise which finally won the day.

In 1980 when a series of bills was introduced in Congress to modify the original Act, the debate took on a different tone, albeit one that still mirrored the original public discussion. No longer was the debate over to build or not to build water projects in the West since few feasible projects still remained on the drawing boards. Rather, the

Charles V. Moore is an Agricultural Economist, NED, ERS, USDA, stationed at the University of California, Davis. This paper summarizes work conducted for BOR, U.S. Department of Interior as part of its EIS on Acreage Limitation. The assistance of many individuals in USBR and ESS is acknowledged; Gerald L. Horner, Daniel J. Dudek, Phillip Doe made several helpful comments on an earlier draft. Any errors of interpretation are the responsibility of the author.

argument of Federal project water users was for loosening the acreage limitation based on the allegations that larger farms were more efficient and continued application of ownership limits would raise the cost of food, cause large acreages to eventually be abandoned and inevitably increase the use of pesticides causing increased pollution to the rivers and streams of the West. At the other end of the spectrum, supporters of retaining acreage limits at or near their existing level put forth arguments based on equity and fairness considerations usually citing statements made by the drafters and supporters of the original Act.

It is interesting that neither of the polarized groups in the more recent debates spent much time or effort in supporting measures which would, in essence, do away with the subsidy.[1] The heart of the dispute seems not to revolve around how large the subsidy has become but rather around who should be the recipients. Should the subsidy and the opportunity to farm in a Federal water project be distributed as widely as possible, as the small farm proponents advocate, or should the distribution of subsidies be based on the prior distribution of wealth (land) allowing economic forces alone to select the ultimate beneficiaries?

Objectives

The objectives of this report are (1) to present the relative economic efficiency of different size and types of farms, (2) to analyze their ability to generate incomes (net cash flow), (3) to evaluate the trade-offs between economic efficiency and viability as defined in objectives 1 and 2, and (4) assess the possible impact of eliminating subsidies through full-cost water pricing.

Procedures

To accomplish this task, 18 irrigation districts receiving Federal water were selected for detailed study. This was not a random sample, but rather the districts were chosen so that they embraced the entire range of farms (size, type and per acre income) found in the area served by Bureau of Reclamation (BOR). Individual enterprise and farm budgets were then prepared for each of these districts in consultation with local farmer panels, Cooperative Extension Service and Universities.

Specific assumptions used in developing enterprise and farm budgets are as follows: *Prices* — Water Resources Council normalized commodity prices were used to determine prices received by farmers in each state. These prices were assumed constant for all farm sizes. *Yields* — district crop yields were based on the most recent three-year average yields for irrigated crops.[2] *Input Costs* — costs of production inputs were set at area average 1978 levels. *Interest Rate and Capital Costs* — actual 1978 Production Credit Association and Federal Land Bank rates in the area were used to determine interest charges on operating capital, machinery and land investments. Based on typical PCA and FLB down payment requirements averaging 20 percent in each area and loan life (5 to 7 years on equipment and 30 years on land and improvement) amortized loan payments were calculated in order to arrive at estimates of net cash flow. For the static budgets a typical crop mix and machinery complement for each farm size[3] was specified by a panel of local growers working with a project research assistant and the local agricultural extension agent, The crop mix varied by farm size if this reflected conditions within an individual irrigation project.

Financial Viability

Annual net cash flow before taxes to unpaid family labor, management and equity

[1]Seckler and Young proposed water pricing as an alternative to administrative regulations.

[2]No data was available on yield by farm size.

[3]The machinery complement could have been optimized with respect to a crop mix in the L.P.; however, the existing complement was considered reasonably efficient and therefore the most useful for representing the fixed plant in the short run.

was used as a measure of farm financial feasibility in this study.[4] Net cash flow is the cash available for family living expenses, after cash production expenses, principal and interest payments on land and machinery loans have been deducted from gross crop sales.

That is:

	Gross Farm Sales
Less:	Cash Production Expenses
Equals:	Gross Margin (Cash)
Less:	Amortized Loan Payments on Land, Improvements and Equipment
Equals:	Return to Family Labor, Management & Equity (cash flow)

The bottom line in the above formula provides one measure of the economic viability[5] of a farm. The assumptions used to determine the bottom line in the study are based on Interior's Proposed Rules and Regulations, which state that land ownership by an individual is limited to 160 acres and farm operations in excess of this must be leased, up to a limit of 480 acres. Family organizations of four or more people could farm up to 960 acres receiving Federal project water of which not more than 640 acres could be owned [USDI]. Land in excess of legal entitlement must be sold as its "excess" land value. This land value is the appraised value today if the project had never been built.[6]

[4]Self-employment and individual income taxes can affect viability but were not considered in this study.

[5]Nonmonetary factors are also important, since viability also depends on what the family needs or wants. For these reasons, a satisfactory cash flow may differ from one family to another and from one region to another.

[6]USBR appraisals of excess land value are based on the current market price of comparable lands outside the district with credit given for clearing, leveling, capital improvements, permanent crops, and the contribution of nonproject water supplies if any are present. All land up to 320 acres was assumed to be owned. For the 640 acres and 1,280 acre farm the balance of the farm was assumed to be leased. All dryland was assumed to be owned.

Cash returns to unpaid labor, management and equity were estimated for four farm sizes, 160 acres, 320 acres, 640 acres and 1,280 acres based on a typical crop mix for each district where field crops were dominant. Cash returns for three farm sizes, 40 acres, 80 acres and 160 acres were estimated for the three of the 18 projects in which perennial crops (fruit trees) dominate.

Two net cash return estimates were made for each farm size analyzed: First, the net return for a beginning farmer purchasing excess land under terms of commercial lending sources in 1978; and second, the net return for an existing farm operator. Existing farm operators were assumed to have purchased land at an earlier time and at a lower price and mortgage interest rate and to enjoy, therefore, a much higher equity position because of land value appreciation.

In the "existing farmer" analysis, it was assumed that land was purchased in 1958 based on an average turnover rate of 2.5 percent, i.e., 40 years. Thus the average farm has been owned 20 years. Average owners equity for each state was taken from [USDA] and ranged from 74 to 94 percent.

Empirical Results

Results of this analysis are presented in Table 1 for all 18 case-study districts. The net cash flow for beginning farmers purchasing excess land in the 18 districts varies widely. For instance, returns to unpaid labor, management and equity on 160 acre field-crop farms range from a negative $8,200 in the Milk River Project in Montana to a positive $19,600 in the Elephant Butte District in New Mexico. As farm size increases, a higher proportion of the total farm labor is paid a cash wage; therefore in many cases, cash flows appear more favorable to the smaller farm sizes. This is especially true in districts where economies of size are not large and excess land values are relatively close to current market land prices.

In comparing new and existing farm operators, the latter, with their assumed high owner equity and lower mortgage interest rates, show a much more favorable cash flow.

TABLE 1. Return to Unpaid Family Labor, Management and Equity, 1978.

District	State	160 acre farm		320 acre farm		640 acre farm		1,280 acre farm	
		Beginning[a]	Existing	Beginning[a]	Existing	Beginning[a]	Existing	Beginning[a]	Existing
		dollars							
Field crops									
Black Canyon	ID	−6,600	9,400	−1,200	28,000	−7,700	27,000	39,800	84,800
Columbia Basin East District	WA	12,800	26,400	25,700	53,200	31,300	78,600	78,500	150,300
Elephant Butte	NM	19,600	34,900	44,500	69,300	65,400	101,400	117,200	174,200
Farwell	NB	−2,600	14,000	−4,600	33,200	2,600	44,000	16,300	64,900
Glenn-Colusa	CA	8,700	22,900	10,100	36,000	17,500	48,500	−16,800	24,100
Goshen	WY	3,500	17,900	13,000	36,100	11,200	46,500	25,800	75,000
Grand Valley Gravity District	CO	600	7,800	−3,000	12,900	−5,600	17,000	12,500	40,100
Imperial (light soil)	CA	2,700	18,900	1,700	34,800	14,100	50,700	65,900	114,500
(heavy soil)		−2,700	3,800	−7,700	5,800	−11,300	4,200	1,400	22,300
Lower Yellowstone	MT	3,600	18,700	17,500	41,800	38,500	66,900	95,700	132,200
Altus-Lugert	OK	−7,100	17,700	−9,600	38,000	−18,000	63,200	−10,100	101,000
Milk River Malta District	MT	−8,200	12,600	−2,900	35,847	−12,700	51,300	−36,200	82,300
Moon Lake (high area)	UT	−800	6,500	2,000	15,100	9,700	26,400	14,900	38,300
(low area)		−100	9,200	4,500	19,000	12,900	31,300	23,500	48,500
Truckee-Carson	NV	11,600	12,900	37,100	41,000	63,200	69,600	99,300	109,100
Welton-Mohawk	AZ	9,900	26,600	27,400	53,500	18,200	48,600	17,600	53,300
Westlands (with pump)	CA	10,800	10,600	15,900	15,600	29,300	33,100	109,400	125,800
(without pump)		14,400	13,200	25,000	20,500	36,500	38,200	116,600	131,000
		40 acre farm		80 acre farm		160 acre farm			
		Beginning	Existing	Beginning	Existing	Beginning	Existing		
		dollars							
Perennial crops									
Coachella	CA	13,900	26,500	17,100	42,100	16,000	58,400		
Goleta	CA	42,700	73,800	81,300	142,900	155,000	277,300		
Oroville-Tonasket	WA	36,700	55,600	63,600	99,100	107,800	178,400		

[a]Beginning farm operator is assumed to have purchased up to 320 acres of excess land.

Returns to unpaid labor, management and equity for existing farmers on the 160 acre farms are positive for all projects and range from $7,800 in Grand Valley of Colorado to $34,900 in Elephant Butte District in New Mexico. Under the assumptions used to describe the existing farm operator, annual cash flows tend to increase as farm size increases.

In the three districts dominated by perennial crops, cash flows are positive in all farm sizes, for beginning and existing farm operators alike.

Farm net cash flows therefore vary widely across the 18 case-study districts and are heavily dependent on the equity position of the farm operator. Thus, the policy maker is faced with the task of placing an arbitrary single-size limitation on an industry quite heterogeneous in its performance.

Economies of Farm Size

Linear programming was used to develop short-run average cost curves (SRAC). This technique selects the profit maximizing combination of crops subject to the supply of high value cropland, water and the machinery complement developed for the representative farm budgets analyzed in the previous section. Land costs but not unpaid labor cost were included to obtain the planning curve faced by different participants.

Land was priced at two levels in each district both supplied by BOR appraisers. First the "Excess Land Value", and second the current market value. Thus, a beginning farm operator purchasing excess land would face an entirely different cost structure than either one who had purchased land at the current market value of one who had purchased land at an earlier time but whose opportunity cost is the current market value. One concern of policy makers was the viability of new entrants purchasing land at excess land values. A concern here was that these new entrants not be induced into investing in a nonviable enterprise. Thus excess land values were used to generate the average total cost curves presented in this analysis[7] and will be used subsequently in estimating economic rents.

Crop activity possibilities in the linear programming models were the same as those specified in the farm budgets reported in Table 1. High value speciality crops were constrained to the same proportion of land as used in the typical farm budgets to avoid possible price depressing levels of production.

Long-run average cost curves were then estimated by tracing an envelope of the SRAC for each project. [For additional detail and discussion, see Madden; Carter and Johnston; and Miller, Rodewald and McElroy, who also used this approach.]

The results of the linear programming analysis are presented in Figures 1, 2, 3 and 4. All 18 LRAC exhibit a rapidly declining average cost per unit of output up to the point where gross farm sales exceed $100,000 and in most districts the LRAC drop below the breakeven level of $1.00 of total cost per $1.00 of gross sales.

Use of gross sales as a measure of farm output means that commodity prices were used as weights to derive a dollar common denominator. This was done so that comparisons could be made between projects. In reality, however, commodity prices fluctuate and therefore the LRAC could be expected to shift up and down over time. The critical characteristic of these LRAC is their general shape, not their position on the graph. The relative "flatness" of the curves after crop sales reach the $150,000 to $200,000 range is their most important attribute for acreage limitation policy.

Most of the LRAC exhibit a constant or flat average cost once farm output exceeds the $150,000 to $200,000 range. A limited number exhibit a slightly increasing average cost at larger outputs since the cost of managerial and supervisory labor increases faster than

[7]Short- and long-run average cost curves under alternative land cost assumptions are presented in a forthcoming report, *Structure and Performance of Western Irrigated Agriculture: With Special Reference to the Acreage Limitation Policy of the U.S. Department of Interior*, C. V. Moore, D. L. Wilson, and T. C. Hatch, Giannini Information Series, University of California.

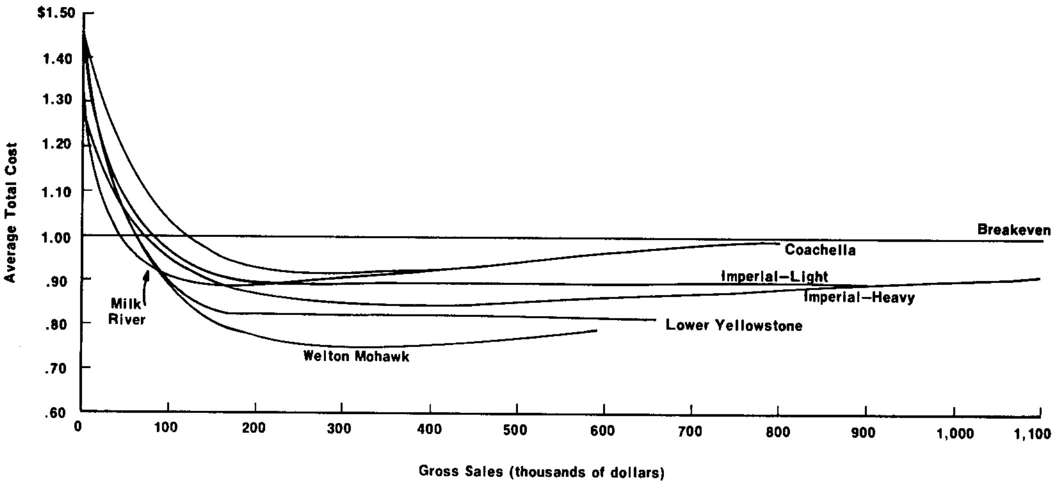

Figure 1. Long-Run Average Cost Curves, Excess Land Value, Lower Colorado and Upper Missouri Regions, 1978.

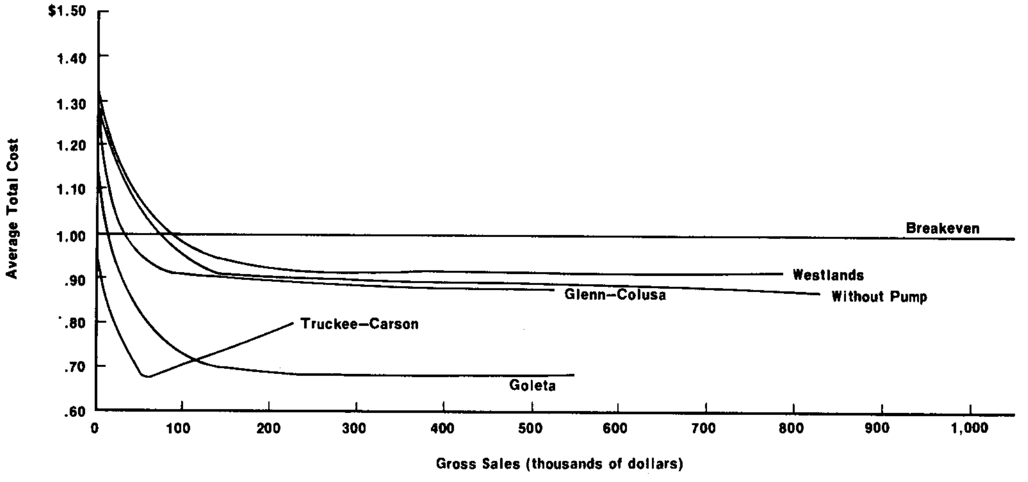

Figure 2. Long Run Average Cost Curve, Excess Land Values, MidPacific Region, 1978.

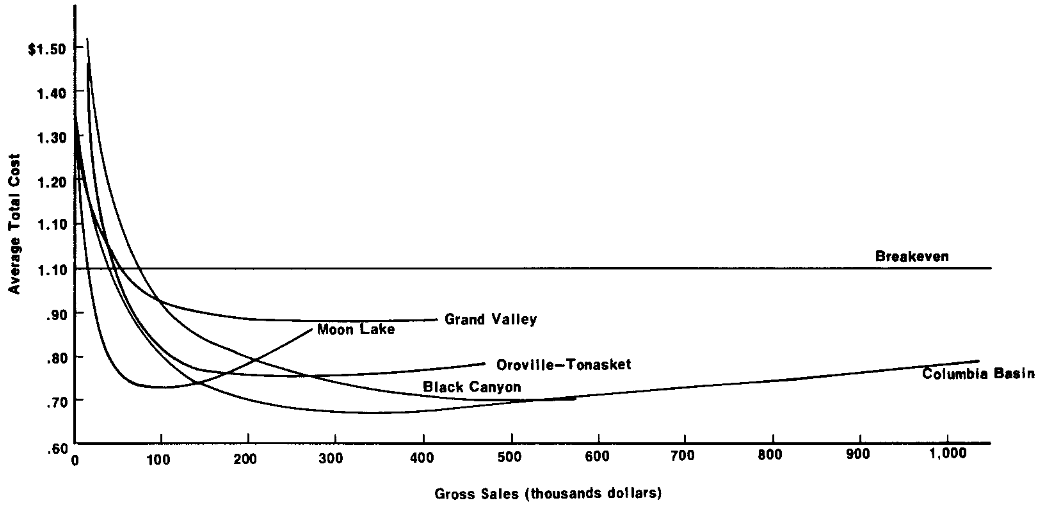

Figure 3. Long Run Average Cost Curve, Excess Land Values, Upper Colorado and Pacific Northwest Regions, 1977.

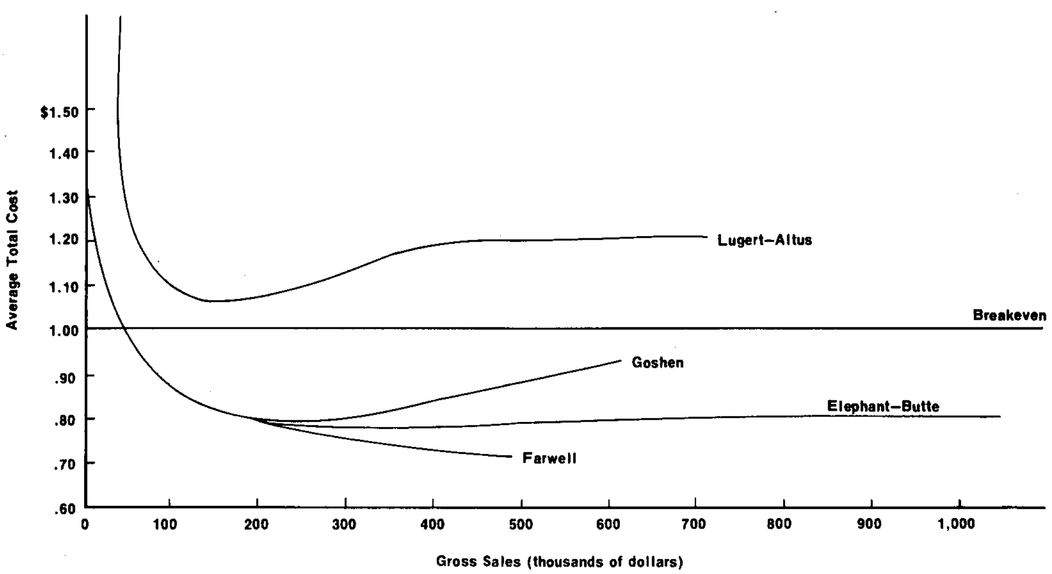

Figure 4. Long Run Average Cost Curves, Excess Land Value, Lower Missouri and Southwest Region, 1978.

technical economies of size. Hired supervisory labor by farm size was included as a fixed cost. A small number of LRAC exhibit a slightly decreasing average cost over the entire range of output.

Acreage to Achieve Specified Efficiency

A major question raised by any acreage limitation policy is, how much economic efficiency is lost, if any, by a decision to reduce the size of existing farms through the enforcement of ownership and farm operating size limitations? In other words, how large must a beginning farmer be in order to achieve a reasonable level of efficiency. Table 2 presents the approximate acreage and gross crop sales required to achieve 95 percent and 98 percent (105 and 102 percent) of the minimum average total cost derived from the economies of size analysis.

The data in Table 2 indicate that, except for the tree fruit districts which require even smaller acreage, 95 percent of the maximum economic efficiency can be achieved by a farm size in the 300 to 450 acre range and a gross crop sales in the $75,000 to $150,000 range.

A somewhat larger acreage is required to achieve 98 percent of potential economic efficiency. For most of the case-study districts this level of efficiency is achieved at or below 900 acres with most of the districts in the 320 to 640 acre range and gross crop sales in the $150,000 to $300,000 range.

Minimum Acreage to Achieve Specified Incomes

The amount of money available to the farm family after production expenses and debt service is one measure of farm viability. This is especially important to the beginning farm-

TABLE 2. Approximate Irrigated Crop Acreage and Gross Sales to Achieve 95 and 98 Percent of Minimum Long-Run Average Costs, Beginning Farmer, Excess Land Value, 1978.

	95 percent		98 percent	
District	Acres	Sales	Acres	Sales
Black Canyon	740	$250,000	900	$315,000
Coachella	30	150,000	40	200,000
Columbia Basin East District	380	210,000	520	290,000
Elephant Butte	410	284,000	440	305,000
Farwell	680	300,000	1,000	390,000
Glenn-Colusa	580	320,000	620	345,000
Goleta	22	71,000	40	130,000
Goshen	420	155,000	550	205,000
Grand Valley	320	83,500	900	153,000
Imperial — light soil	300	90,000	375	150,000
heavy soil	890	400,000	1,350	490,000
Lower Yellowstone	645	110,000	735	155,000
Altus-Lugert	170	85,000	200	95,000
Milk River	350	110,000	570	150,000
Moon Lake	450	55,000	475	64,000
Oroville-Tonasket	75	220,000	78	230,000
Truckee-Carson	220	50,000	275	60,000
Welton-Mohawk	300	180,000	320	230,000
Westlands — with pump	420	360,000	510	440,000
without pump	152	100,000	500	400,000

er. Table 3 presents the minimum crop acreage required to achieve three levels of cash flow ($10,000, $15,000 and $20,000) based on the linear programming analysis and excess land values.

Under the assumptions of this study only one district, Altus-Lugert, requires more than 960 acres to achieve a cash flow of $20,000. Most of the remaining districts require crop acreages in the range of 150 to 320 acres to achieve a return to unpaid labor, management and equity of $20,000 annually. Nonmonetary considerations and off-farm income are also important determinants of family farm viability. In 1978, the national average net income per farm operator family was $22,866. Of this amount, $12,829 was earned off-farm. The national average net farm income on a basis comparable to that shown in Table 3 was $10,037.

Risk

The LRAC presented in Figures 1 through 4 are static in nature. Year-to-year fluctuations in prices, yields and input costs will cause these curves to shift up and down. To estimate the relative riskiness of production in each district and therefore the expected stability of these curves over time, the total variance and coefficient of variation of gross income was estimated for the minimum average total cost crop mix for each district.[8] These data were estimated using Tintner's Variate Difference Method applied to a time

[8] A time series of district average gross incomes (price times quantity) was developed using district crop reports. Using the equation for combining variances a total variance for each district was calculated.

TABLE 3. Minimum Crop Acreage Required to Achieve $10,000, $15,000 and $20,000 Annual Cash Return to Unpaid Family Labor, Management and Equity; Optimized Crop Mix Under Excess Land Value, Beginning Farmer, 1978.

District	10,000	15,000	20,000
		dollars	
Black Canyon	280	400	620
Coachella	38	77	150
Columbia Basin East District	100	125	135
Elephant Butte	40	60	80
Farwell	210	265	310
Glenn-Colusa	120	140	150
Goleta	23	25	30
Goshen	180	200	230
Grand Valley	160	200	300
Imperial — light soil	190	240	260
heavy soil	250	280	310
Lower Yellowstone	215	270	335
Altus-Lugert	a	a	a
Milk River	290	430	525
Moon Lake	255	330	400
Oroville-Tonasket	23	26	29
Truckee-Carson	140	160	275
Welton-Mohawk	160	175	210
Westlands — with pump	160	180	210
without pump	150	170	180

[a] Not possible to achieve this return under assumed prices and yields.

series of prices, yields and gross incomes. The results are presented in Table 4. In general, the fruit growing districts show the highest risk in relation to expected gross income. Among the field crop districts, Elephant Butte grows a high proportion of speciality crops while Glenn-Colusa is predominantly a rice growing area where wet weather at planting or harvest time can significantly affect yields. Again, the policy maker is faced with setting a limit on acreage in an industry not only heterogeneous in expected income but in the variability about that income as well.

Full-Cost Pricing of Project Water

Most of the controversy over Federal acreage limitation policy centers around who is to receive the large subsidies associated with Federal water projects. A logical question is, what would happen if all or part of the subsidy was eliminated by recapture through higher water charges to landowners and operators?

In examining these questions, U.S. Department of Interior's definitions for full cost and subsidy were used [USDI]. That is, "*full cost* of irrigation water includes all construction costs allocated to irrigation plus all operation and maintenance cost deficits with interest charged on both. The irrigation *subsidy* equals the unpaid full costs net of the present worth of future payments" [USDI] (see Table 5).

TABLE 4. Relative Risk of Gross Income by District.

District	State	Total variance	Coefficient of variation
			percent
Field crops			
Black Canyon	ID	134.1	4.3
Columbia Basin East District	WA	488.3	4.7
Elephant Butte	NM	13,560.1	19.6
Farwell	NB	194.5	6.1
Glenn-Colusa	CA	4,175.3	15.8
Grand Valley	CO	28.4	2.5
Imperial — light soil	CA	3,960.8	8.6
heavy soil		2,840.3	9.5
Lower Yellowstone	MT	573.0	7.8
Altus-Lugert	OK	432.4	15.3
Milk River	MT	103.6	14.9
Moon Lake — high area	UT	13.0	3.4
low area		43.6	4.4
Truckee-Carson	NV	170.4	5.8
Welton-Mohawk	AZ	1,199.0	6.5
Westlands — with pump	CA	5,481.7	12.9
without pump		4,314.2	12.3
Perennial crops			
Coachella	CA	50,963.1	5.8
Goleta	CA	378,052.8	20.8
Oroville-Tonasket	WA	279,904.4	36.0

TABLE 5. Increase in Land Values Due to Project Water and Estimated Subsidy Per Acre.

Project	Estimated subsidy per acre[a]	Excess land value per acre[d]	Current market land price per acre	Increase per acre in land value[f]
	dollars			
Oroville-Tonasket, WA	417	1,500	1,550	50
Black Canyon #2, ID	762	1,200	1,600	400
East Columbia Basin, WA	1,619	850	1,500	650
Goleta, CA	1,378[b]	15,500[e]	17,500[e]	2,000
Truckee-Carson, NV	931	410	1,800	1,390
Glenn-Colusa, CA	101	1,200	1,700	500
Westlands, CA	1,422[c]	550	1,500	950
Coachella, CA	1,000	1,450	2,000	550
Welton-Mohawk, AZ	1,786	1,245	2,600	1,355
Imperial, CA	149	1,700	1,800	100
Moon Lake, UT	58	350	750	400
Grand Valley, CO	1,623	600	1,900	1,300
Elephant Butte, NM	363	775	1,800	1,025
Altus-Lugert, OK	675	765	1,200	435
Malta, MT	812	325	600	275
Lower Yellowstone #1, MT	507	750	1,300	550
Farwell, NB	1,466	1,100	1,200	100
Goshen, WY	416	605	1,250	645

[a]Retroactive to year of initial construction in 1978 dollars.
[b]Average for entire Cachuma Project.
[c]Average for San Luis Unit.
[d]Includes value of land and irrigation improvements except irrigation pumps.
[e]Includes value of mature avocado grove.
[f]Measured as the difference between current market land price and excess land values.
Source: USBR appraisers [WPRS].

The agricultural value of land[9] is the discounted present value of the expected stream of future net income. Thus any increase in irrigation water costs would be expected to have a depressing effect on land prices. If the preproject (excess) land value is measured by its market value today without the benefits of the project, then the difference between excess land value and current market price should represent the land market's estimate of the present value of the economic rent due to the project. Further, if the project benefit/cost ratio is exactly 1.0, land value enhancement (capitalized economic rent) should just equal Interior's calculated unpaid full cost since both land values are affected by tax policy and inflation. Under this situation, recapture of the project subsidy through full-cost pricing should force the market price for land down to its excess land value. Table 5 displays information on both land value enhancement and the calculated subsidy for all 18 case-study districts.

Farm owners and operators may not be able to capture the full amount of the calculated subsidy. If the *ex post* benefit/cost ratio of a project is less than 1.0 either due to errors in estimating benefits or cost overruns, the full amount of the income transfer may not be received by landowners and operators.

There are, therefore, two measures of the income transfer to an irrigation project.

[9]Market price of agricultural land may greatly exceed the agricultural value due to inflation, capital gains tax policy and the intrinsic value placed on land by some buyers as a store of value.

First, the calculated one based on the costs and interest rates used by Interior. Second, the land buyers estimate of the economic rents as reflected in his bid price for project land as compared to the appraised value of the same land without the project. As shown in Table 5, only seven of the 18 districts show enhanced land values greater than the calculated subsidy. In other words, in 11 of the districts the amount of the economic rents actually captured by landowners through value enhancement was less than society's investment in that land as indicated by the calculated subsidy. Two hypotheses can be made: First as indicated earlier, the *ex post* benefit/cost ratio may have been less than 1.0. Second, there may be oligopsony power in the land rental market which allows a few large lessees to capture a potion of the project subsidy. That is, if ownership was atomist in turn leasing to a few very large lessees, the market power of the latter could allow them to capture a portion of the economic rent.

Faced with large increases in water prices, farm operators would be expected to make two types of adjustments to mitigate the impact of full-cost water charges: (1) shift to more water conserving technologies to improve on-farm irrigation efficiencies and (2) adjust the crop mix to crops with a higher return per unit of water.[10]

Using the basic model from the economies of size estimations, additional irrigation technologies for each crop were specified and parametric water prices run. Results of this analysis for 17 irrigation districts provided (1) the optimum quantity of irrigation water at each water price in $5 per acre-foot increments, (2) the optimum combination of crops, the optimum irrigation technology for each possible water price and (3) the level of farm income at each water price.

[10]Lin, Dean and Moore have shown that producing crops with a higher return to water also involves accepting a greater income variability and, therefore, business risk. Thus, risk averse producers are forced to move out along their E-V frontier in order to mitigate higher water costs, although utility may be decreased.

The impact of full-cost pricing can be demonstrated by using Westlands Water District of California as an example. The derived demand curve for irrigation water was obtained by parameterizing water price in four farm size L.P. models. The weighted average water use per acre was obtained by weighing each farm size by the proportion of land in that farm size interval. The results are presented in Figure 5.

The vertical dotted line indicates the 1972-76 average farm headgate delivery by the district. The asterisk indicates the 1978 average cost per acre-foot of $15.80. These results indicate that at 1978 water charges, Westlands farm operators could productively use more water than can be delivered under their existing water supply contract. The full-cost price of water for Westlands has been estimated by USDI at $67.56 per acre-foot. Obviously from the derived demand curve if all water was charged at this price only about 0.5 acre-feet per acre would be demanded, and a large acreage would be left fallow because crop returns no longer would cover variable costs except for a limited acreage of high value tomatoes.

An alternative to charging for all water at the full-cost price would be to create a two-tiered price structure with a base supply charged at the current subsidized rate and a second price tier which charges full cost for any water used in excess of the base supply, as was suggested by Seckler and Young. Using Interior's Proposed Rules and Regulations farm size limit of 960 acres as the base supply, full cost could be charged for any water purchased in excess of the 2,438 acre-foot historic allotment for a 960 acre farm. As an example, L.P. runs for a 1,280 acre farm indicate that no water would be purchased at the full-cost rate. Farm operators would be expected to scale back to a maximum farm size of 960 acres and turn back leases in excess of that acreage.

Policy Implications

To set a single acreage limit applicable to the wide diversity in farming, climate, mar-

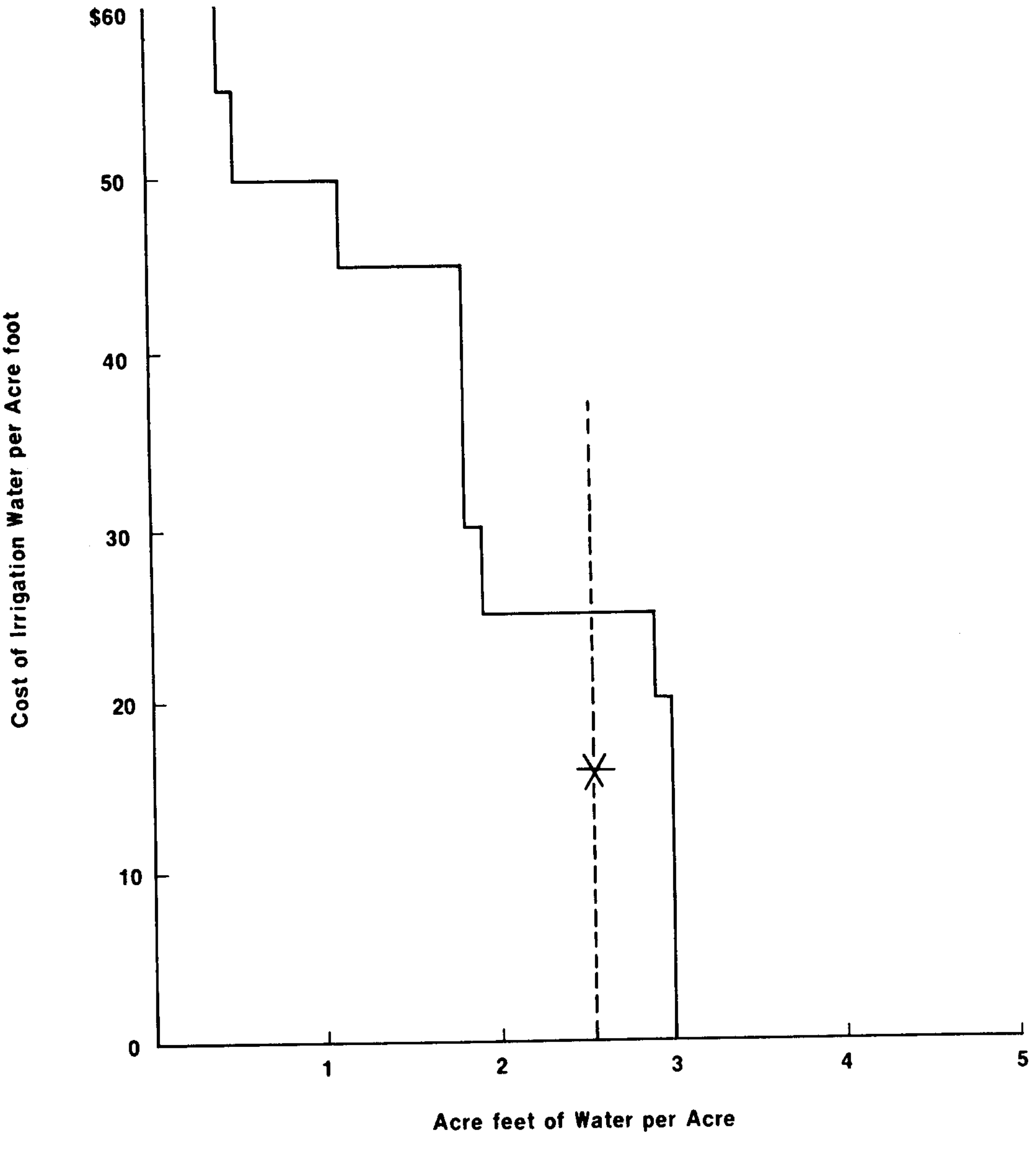

Figure 5. Demand for Irrigation Water, Westlands I (with pump).

kets and soils represented by irrigation districts and contractors served by BOR across the 17 western states is an extremely difficult task.

Three basic policy questions are raised by the proposed acreage limitation rules and regulations; first, what is the loss in efficiency, if any, if existing excess lands are sold to beginning farmers to create new, smaller farms?

The second policy question relates to the equity question of, how widely should the benefits and subsidies of Federal water projects by distributed? Any distribution policy must be subject to the limitation that the annual cash flow from operating the farm must be positive and at a level high enough to make the farm a viable operation. A corollary question then is, what is a viable level of income as measured by the return to operators unpaid labor, management and equity given the opportunities for off-farm employment?

Third, can removal of the *causa belli*, irrigation subsidies, through recapture by means of full-cost pricing, eliminate the need for administrative limitation of farm size and land ownership or would the cure be worse than the disease?

Efficiency

Two points are important in discussing the policy implications of the Long-Run Average Cost curves presented in Figures 1 through 4. First, under 1978 income and cost conditions including excess land values, almost all of the 18 case-study districts show some portion of the LRAC falling below the breakeven level, i.e., showing a positive net income. Second, average costs decrease rapidly as output increases until gross farm sales reach the level of about $100,000. In general, after most of the economies of size are achieved the Long-Run Average Cost curve becomes flat or constant.[11] In the structure literature, an industry with this characteristic would be classified as a constant cost industry.

The policy implications of a constant cost industry are twofold. First, reducing farm sizes to a point to the left of the minimum ATC would have a direct impact on the wealth of current landowners. Costs of production would be raised which in turn would reduce the economic rents to the landowner. This argument is developed in detail in both Miller, Rodewald and McElroy and Hall and LeVeen. Given the farm size limits proposed by Interior and the results shown in Table 2, this impact should be small.

Second, policy makers expressed concern for the possible impact of acreage limitations on food prices. Given that Reclamation Law is applicable to only about one-third of the irrigated acreage in the west, in a competitive industry, market forces would expand output to the point where in long-run equilibrium price equaled minimum ATC. Thus there is no gain in efficiency which might translate into lower food prices from having farms *larger* than those exhibiting minimum average total cost.[12] Stated another way, there is no efficiency loss to society from creating smaller farms out of larger farms if the average total cost for both farm sizes is the same. For the individual farm owner in a constant cost industry, there is still a strong incentive to expand farm size because net farm income increases in proportion to farm size.

If the Average Total Cost curve is increasing (an increasing cost industry) diseconomies of size are present. Under this condition there is an efficiency gain to society from creating smaller farms (at the minimum Average Total Cost) out of larger farms. For the individual farm operator in an increasing cost industry there is still an incentive to expand farm size as long as the long-run marginal cost is below the breakeven level because

[11]Miller, *et al*. and Carter and Johnston, in a review of California studies, found the LRAC to become flat or constant for most types of farms.

[12]This hypothesis was tested using CARM, a California statewide quadratic programming model. State total production and equilibrium prices remained almost constant but the location of some production shifted between subareas.

total net farm income is still increasing. The incentive to expand, however, is less under this situation than under a constant or decreasing cost industry. The data shown earlier in Table 2, acreage required to achieve 95 and 98 percent of minimum average total cost, are heavily dependent on the slope or lack of slope in the LRAC. A wide spread between the acreage for 95 percent of minimum average total cost and 98 percent of minimum average total reflects a flat or constant cost situation. The extreme case is the Westlands Water District which exhibits a very gradual decreasing cost situation over the entire range of the curve. On the other hand a district such as Moon Lake in Utah with a relative steep slope exhibits a narrow spread between the 95 percent and 98 percent level of achievement acreage.

For the 18 case-study districts, presented in Table 2, only 2 exceeded the WPRS proposed acreage limitation of 960 acres at the 98 percent achievement level under excess land values.

Equity

The equity or fairness question stems from the magnitude and distribution of the Federal subsidy to water users. The original Reclamation Act of 1902 had as one of its goals, the widest reasonable distribution of the benefits of Federal water projects. However, taking this goal to its extreme would create a large number of very small farms unable to generate sufficient cash flow to service debt, pay farm expenses and contribute something toward family living expenses. Thus, the equity goal is restricted by the question of farm viability.

In Table 3 the acreage by district required to generate \$10,000, \$15,000 and \$20,000 annual return to unpaid labor, management and equity (cash flow) based on an optimized crop mix and excess land values was presented. Out of the 18 case-study districts, only one was not able to generate an annual cash flow of at least \$20,000 within the upper limit of 960 acres contained in Interior's Proposed Rules and Regulations. Of course as noted earlier, off-farm income is an important contributor to family income and thus viability.

Full-Cost Pricing

Water in Federal irrigation projects is highly subsidized; however, all of this subsidy is not captured by landowners and farm operators. A policy of subsidy recapture through full-cost pricing could produce significant economic effects.

For districts where the construction subsidy per acre exceeds the project benefits captured through increased land values, full subsidy recovery through full-cost pricing would greatly reduce financial viability and could force land values below its value in alternative uses.[13] That is, if full-cost water prices were set in these districts at a level high enough to recapture the subsidy, land values would probably fall to a level below the excess land value and landowners would be worse off than if the project had never been built.[14]

Districts where project benefits captured by landowners and operators exceed the subsidy would probably observe a decline in current market land values (on nonexcess land) but land market prices would still exceed the excess land values.

To the extent that increased water charges induce farm operators to invest in more water conserving practices and technologies, water use per acre would be reduced. The water thus conserved could be used in a wide range of uses including: irrigating additional land within the district or in other districts, instream uses for recreation, fish and wildlife; or left in storage for year-end carryover and peak power generation. Increased water conservation may also help mitigate local drainage problems.

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[13]Long-term contractual obligations could force land values below the "excess value" even if no water was purchased.

[14]Miller, *et al.* [p. 23] present a more detailed development of this problem.

A large increase in water costs would cause significant shifts in the district crop pattern. Acreage of many forage crops; alfalfa hay, native hay and irrigated pasture would probably decline. This in turn, would probably trigger changes in the local livestock economy due to increased market prices for forage and roughages. Up to a point, irrigated food and feedgrains would replace these forages in the crop pattern. In areas with sufficient rainfall, dryland crops would replace irrigated crops.

Conclusion

Both the equity and the efficiency goals are clouded by the problem of apparently inefficient projects. That is, *ex post,* some of the projects, on a purely economic efficiency criteria (seven out of 18) should not have been built or portions of the project should not have been included within the service area. However, these projects were built and people were induced to invest in irrigation improvements.

Interior's Proposed Rules and Regulations [USDI] appears to seek a compromise between equity and efficiency by (1) retaining the ownership limit at 160 acres per adult owner and (2) placing a limit on the total acreage owned and leased at 960 acres per farm. The ownership limit continues the 79 year policy of distributing the subsidy as widely as practicable. The limit on operating unit size of 960 acres appears to recognize the efficiency argument that more than 160 acres would be required in order to achieve most of the potential economies of size. Placing any upper limit on the size of operating units implies that (1) imperfect land rental markets could allow lessees to capture a portion of the subsidy and that the distribution of projects cannot be controlled by only limiting ownership, (2) increasing the number of farming units in a fixed land area creates more possibilities for new farmers to enter farming and (3) allows existing small farms to expand to a more efficient size.

In this era of diminished public sector funding, a two-tiered, full-cost pricing scheme which recaptures and returns to the Treasury the land values enhancement due to the project may be both a politically and economically viable alternative to administrative regulation.

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