An Examination of Cash Flow and Conventional Net Income Measures for Evaluating the Economic Viability of Farms of Varying Size

David Holland and Douglas Young

This study examines the question of income adequacy as it relates to the broader issue of an economically viable farm size in the Columbia Basin of Washington State. The issue is especially relevant because of possible limitations on farm size resulting from enforcement of the 1902 Reclamation Act. Income estimates derived under two alternative accounting frameworks — the standard economic accounting method and the after-tax cash flow accounting method — were examined. Findings were that the after-tax cash flow accounting framework was more appropriate for examining the income adequacy aspect of the viability issue as it incorporated the effect of federal income taxes and farmer's equity, both of which are important determinates of income levels. Using the after-tax cash flow accounting framework, the after-tax cash flow for a representative 320 acre farm was found to range between $16,858 and $42,670 depending upon the profitability of the selected crop rotation.

There are conflicting beliefs as to the economic viability of smaller farm units. Recently, these conflicting beliefs have given rise to a sharp public debate over likely impacts of strict enforcement of the Bureau of Reclamation's 160 acre limitation. When, in August 1977, the Secretary of the Interior called for the enforcement of limits on ownership of land irrigated by Bureau of Reclamation projects as mandated in the 1902 Reclamation Act, the reaction of many agricultural spokespersons was strongly negative. For example, a Washington State Department of Agriculture official was quoted, "If they go through with it, it might mean that the family farmer will have to take a job in town to make ends meet. . . Just what kind of living do you think you could make on 160 acres?" [*Lewiston Morning Tribune*, August 23, 1977].[1] On the other hand, organized groups of agricultural workers, small farmers, and others such as the California-based National Land for People organization have argued that 160 irrigated acres per person were quite adequate for earning a living. Those taking the latter position also argue that in view of the substantial public subsidy to Bureau of Reclamation projects, irrigated land should be spread among as many family farmers as possible [*National Land for People Newsletter*, October 1977].

Within the administration itself, there was apparently intense discussion of the proposal. In a statement released to the press within a week of Secretary Andrus' an-

David Holland is Associate Agricultural Economist and Associate Professor and Douglas Young is Assistant Agricultural Economist and Assistant Professor, Washington State University. Washington State University C.A.R.C. Scientific Paper No. 5660.

[1]Confusing the acreage limitation on size of ownership per person with size of farm operation can be misleading. Under current law both man and wife, as well as children, are eligible to own 160 acres each. Thus, the size of farm operated by a representative family could legally be much larger than 160 acres.

nouncement, President Carter indicated that the original legislation was probably somewhat outdated and that to proceed immediately with enforcement would be unwise. Early in 1978, Secretary Andrus announced that the government would not appeal a court ruling that an environmental impact statement must be prepared on his Department's proposal. It was estimated that it would take about a year to complete the environmental impact statement. Thus, any move to break up large land holdings on federally irrigated projects would be delayed at least that long. In September 1979, although the environmental impact statement was not complete, the Senate passed a bill (S 14) which would increase the acreage limit to 1280 acres and eliminate the residency requirement [*Congressional Quarterly*, September 29, 1979]. Action on this legislation by the House was not expected until the 1980-81 congressional session. Clearly, strong political pressures are being exerted, on one hand, to obtain strict enforcement of existing acreage limitations and, on the other hand, to increase the acreage that can be owned legally. Each side holds strong feelings about the economic viability, or lack thereof, of smaller farm units, and each side bases their beliefs on what they consider to be sound evidence.

In view of the central role of ownership limitations in public irrigation development, and the conflicting beliefs about economic viability of alternative size units, objective information on income by farm size is clearly needed. The purpose of this paper is to examine two alternative approaches to obtaining this information. A major Bureau of Reclamation irrigation development project, the 500,000-acre Columbia Basin Project in Washington State, is used as an example.

More specifically, the objectives of this paper are:

1. to compare the relationship between farm size and net income indicated by an after-tax cash flow accounting approach to that indicated by the standard economic accounting approach;
2. to examine the sensitivity of farm net income to variation in those parameters having most immediate policy relevance, namely acreage limitations and land prices.

Economic Viability and Alternative Income Concepts

The issue of the economic viability of a farm unit has many components. Two of the major components are income adequacy and ability to withstand risk. That is, can the farm generate an average income that is adequate for family living needs and can the farm survive the instability inherent in agriculture? Each of these major components will be influenced in varying degrees by such factors as the level of operator equity, variability of both yields and output prices, access to credit, access to profitable markets, opportunities for off-farm employment, and the availability and use of appropriate technology for a given farm size.

The component of viability that is given exclusive attention in this paper is adequacy of income from farm sources. Although results are presented for recent years of high, low, and average prices, no explicit assessment of farm survivorship probability is claimed. Instead, the main point of the analysis is that in order to properly investigate the income adequacy aspect of the "viability issue," it is essential to use a concept of net income corresponding to the cash flow actually available to meet family living expenses. Although the focus on adequacy of expected income from farm sources, and how that measure is influenced by accounting techniques, addresses only one component of the viability question, getting this fundamental conceptual issue right is the logical first priority in designing appropriate research on the viability question. Subsequent work of value on the survivorship probability component will depend as much (or more) on collecting good field data over farm size on factors such as off-farm income opportunities as on incorporating stochastic prices and yields in a farm income model.

The after-tax cash flow income concept, which will be described at length in the next section, differs significantly from the economist's conventional measure of net returns to owner-operator's labor and management. The conceptual validity of computing net returns to owner-operator's labor and management for evaluating relative economic efficiency is not questioned. By subtracting the full opportunity cost of all land, capital, and hired labor resources employed in the farm unit, and allocating the residual return to the farmer's labor and management, it is possible to make judgements about whether the farmer's labor and management are employed in their "highest and best use." If they are not, the usual conclusion is that aggregate economic efficiency and societal welfare could be improved by reallocating resources into their highest and best uses. Unfortunately, past studies [U.S. Department of Agriculture 1978] have sometimes attempted to develop implications for both economic efficiency *and* economic viability from a single set of budgets based exclusively on the standard economic accounting approach. This analysis demonstrates that using the above approach for viability analyses introduces a systematic negative bias in the indicated income generating capacity of smaller and lower income farm units.

Model and Data

To investigate the implications of using alternative accounting concepts to measure income adequacy, a simple multiple-year nonstochastic farm income simulation model was constructed [Young, Holland, Payne, and Pirnique]. The simulator generated both the after-tax cash flow and the economic net return to owner-operator's labor and management over a 15-year time horizon. Using prices and yields representative of the 1973-1977 period, results were generated for a large number of farm sizes, crop rotations, and other business variations [Holland, Young, Pietsch, and Rostamizadeh]. Expected crop yields, output prices and production costs, as measured in real 1977 dollars, remained constant throughout the 15-year simulation. The procedure of denominating costs and returns throughout the 15-year period in constant 1977 dollars does not assume the absence of general price inflation, but only that any price inflation occurs equally over all inputs and outputs. This inflation does not show up in the income projections because future incomes have already been adjusted for inflation through the use of real 1977 dollars throughout as the unit of measurement.

In an attempt to make the results of the two accounting approaches as comparable as possible, identical variable production expenses and general farm overhead charges were used for each method. Neither approach imputed a cost to management or to farm labor assumed to be available up to 200 hours per month.

A sample printout of the simulation results is presented in Appendix Table A1. Reference to this printout should aid in understanding the discussion below outlining the differences between the two net income concepts. Section A of the printout lists the data input for the sample farm. Sections B, C, D, and E trace the computation of the after-tax cash flow income. Section F lists the process by which economic net returns to owner-operator's labor and management are computed by the standard economic accounting approach.

The standard economic approach accounted for opportunity costs of fixed and quasi-fixed factors by deducting interest charges on the average value of machinery investment, the average value of irrigation system investment, and the current market value of the land investment (see Table 1). Depreciation on machinery and irrigation systems was assessed on a straight-line basis. Federal income taxes were ignored. Given the nonstochastic nature of prices and yields, computed annual net returns to owner's labor and management under the standard economic accounting approach did not vary over the 15-year time horizon assumed for the study. Consequently, these results are

TABLE 1. Interest Rates and Financing and Investment Assumptions

Interest rates used in conventional economic accounting approach

A. Average machinery investment: 11%

B. Average irrigation system investment: 11%

C. Total land investment: 9%

Financing and investment assumptions used in after-tax cash flow accounting approach

A. Machinery
1. Average 10-year life of machines with zero salvage value
2. Replace 10% of the machinery complement each year
3. Purchase machinery with a 25% downpayment, 11% interest, and a 5-year repayment period

B. Irrigation System
1. Rill (furrows and siphon tubes) irrigation system is assumed
2. Average 15-year life of the system with zero salvage value
3. Irrigation system is purchased with 25% downpayment, 11% interest, and a 7-year repayment period

C. Land
1. Market Land Price: $1,500/acre
2. Excess Land Price: $350/acre
3. Land is purchased assuming an initial equity position of 25%, a 9% interest rate, and a 25-year repayment period

presented in a single row in Section F of Appendix Table A1.

In contrast, the after-tax cash flow accounting approach deducted *actual* interest and principal payments on land, machinery, and irrigation system investments, assuming typical financing arrangements for these assets in the study area (see Table 1). In addition, the simulator subtracted annual federal income and social security tax payments in calculating net income under the after-tax cash flow framework. Federal tax rates for 1977 were used, assuming a family of four taking the standard deduction. Investment credit and maximum accelerated depreciation were taken on machinery and irrigation system investments.

Due to the varying composition and level of principal and interest payments, depreciation deductions, and federal income taxes, annual after-tax cash flow under this approach varied over the 15-year period (see last column of Section C of Appendix Table A1). Average annual after-tax cash flow was computed as the undiscounted arithmetic mean of after-tax cash flow over a 15-year period, as illustrated by the circled quantity in Section E of the printout. Future year cash flows were not discounted in computing the average after-tax cash flow in order to keep this figure conceptually comparable to the income estimate generated by the standard economic accounting approach.

In summary, after-tax cash flow differed from the economic net return to owner's labor and management primarily in two respects:

(1) no charge was included for the opportunity cost associated with the farmer's initial equity in his land, which was assumed equal to 25% at year zero;

(2) federal income and social security tax payments were subtracted. Interested readers are referred to section D of the printout for detail on the tax computation process.

A major tenet of this study is that the after-tax cash flow net income concept is superior to the economic net return to owner-operator's labor and management concept for investigating economic viability in relation to farm size. The cash flow approach more accurately reflects the income flow actually available to meet living expenses of the farm owner and his family. It incorporates the following two inescapable real world realities: first, federal income taxes must be paid; and second, the "returns" to equity in fixed factors accrue to the owners of those factors, not to some impersonal manifestation of the factors. An initial 25 percent land equity position, as assumed in this study, is probably close to the typical equity position for a beginning farmer in the Columbia Basin today, given current land financing requirements and land value appreciation trends.[2]

Commodity prices used in this analysis were those which prevailed during the highest price year (1974), lowest price year (1977), and the 1973-77 average for wheat, alfalfa, sugar beets, and potatoes [U.S. Department of Interior]. These four crops were the top revenue producers in the Columbia Basin over 1973-77 and accounted for approximately two-thirds of the Basin's crop acreage. Costs and yields were representative of average management practices and current technology in the study area and are summarized in Tables 2 and 3. Cost estimates, representing 1977 levels, were drawn from a number of recent Washington State University enterprise budgets [Gossett and Pietsch; Kezis, Pietsch, and Holland; Willett, Pietsch, and Brown]. Income estimates were generated for the two crop rotations presented in Table 2. The wheat-potato rotation was the most profitable rotation for the area, as determined by earlier mathematical programming analyses [Kezis]. However, controversy surrounds the long-run agronomic viability of a pure wheat-potato rotation in the study area. Many Columbia Basin farmers consider this rotation too intensive for sound land management. Potatoes also vary greatly in profitability from year to year, thereby limiting their acceptability to farmers and lenders unable or unwilling to bear high levels of risk. In the "standard" rotation, which included alfalfa, potatoes, sugar beets, and wheat, the percentage of land in potatoes was substantially reduced. The "standard" rotation reflected the average land use pattern among these four crops in the Columbia Basin during the 1973-77 period [U.S. Department of Interior].

Total machinery investment per farm unit is a critical factor in studies of the income producing potential of different farm sizes. In this study, farm sizes of 160, 320 and 640 acres were examined. For the 640-acre farm size, the 1977 (new) value of a full complement of harvest and preharvest machinery as reported in recent enterprise budgets was used [Kezis]. Investment per acre in machinery on the 160-acre farm was assumed to exceed machinery investment per acre for the 640-acre farm by 47 percent. Machinery investment per acre on the 320-acre farm was assumed to exceed machinery investment per acre for the 640-acre farm by 27 percent. These proportions were derived from the most recent farm survey covering machinery investment practices in the Columbia Basin [Whittlesey and Umberger].[3] The resulting

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[2]Of course, some farmers will be renters rather than owners. Under the equity position and financing assumptions of this study, annual land payments for owners amount to $115 per acre. Assuming other factors were equal and abstracting from tax considerations, cash renters paying $115 or less per acre per year would receive cash incomes equal to or greater than those reported in this study for owners. A 1976 survey found that cash rents for land to grow sugar beets in the Columbia Basin averaged $102 per acre [U.S. Department of Agriculture, 1976]. Lower valued crops would be expected to merit lower land rents, whereas potatoes would be expected to merit slightly higher rents.

[3]On the basis of the Whittlesey and Umberger survey, which included a sample of 92 Columbia Basin farms, the value of machinery investment *per acre* on farms averaging 182 and 359 acres exceeded that on farms averaging 672 acres by 47 percent and 27 percent, respectively. This empirical basis for establishing machinery investment on farms of varying sizes is considered a substantial improvement over the synthetic firm approach. The latter approach was used in a recent mathematical programming analysis of economies of farm size in the Columbia Basin [Kezis]. In that study, assumed per acre machinery investments on 160- and 320-acre units were approximately 200 percent and 70 percent higher, respectively, than on 640 acre units. Such exaggerated excess machine capacity on smaller units could be expected to bias the results relating to both economic viability and economies of size against smaller units.

TABLE 2. Price, Yield and Land Use Assumptions

Price and Yield Assumptions[a]

Crop	1973-77 Average Yield/Ac.	1973-77 Average Price/Unit	1974 Price/Unit	1977 Price/Unit
Wheat	79.2 Bu	$ 3.57/Bu	$ 4.50/Bu	$ 2.65/Bu
Alfalfa	5.5 Tons	$58.40/Ton	$54.00/Ton	$47.00/Ton
Sugar Beets	24.9 Tons	$28.27/Ton	$48.29/Ton	$18.91/Ton
Potatoes	23.5 Tons	$56.20/Ton	$72.00/Ton	$47.20/Ton

Crop Rotation Assumptions

Wheat-Potato	Standard (1973-77 average)[a]	
50% Wheat	33% Wheat	11% Potatoes
50% Potatoes	43% Alfalfa	13% Sugar Beets

[a]Source: U.S. Dept. of Interior, Bureau of Reclamation. *Crop Report Summary Sheets*, Columbia Basin Project, Ephrata, Washington, 1973-1977.

TABLE 3. Characteristics of Hypothetical Columbia Basin Farms

	160 Acre		320 Acre		640 Acre	
Category	W-P	Standard	W-P	Standard	W-P	Standard
Acres Irrigated	152	152	304	304	608	608
Variable Cost Excluding Hired Labor ($)	48,528	24,103	97,057	48,237	194,113	96,427
Annual Hired Labor Cost ($)	3,146	194	12,249	4,122	28,925	14,792
Farm Overhead Cost ($)	3,520	3,520	7,040	7,040	14,080	14,080
Total Cost of Irrigation System ($)	17,534	17,534	35,068	35,068	70,136	70,136
Total Cost of Machinery Complement ($)	62,060	91,560	107,240	158,200	168,880	249,130

machinery investments for the three farm sizes and the two rotations are presented in Table 3.

All farm sizes and rotations were assumed to use rill irrigation. Rill irrigation was considered most appropriate for a study focusing on viability because rill irrigation has a much lower initial cost than a sprinkler system, and is thus more accessible to low equity farmers.[4] Only 152 of each 160 acres were assumed to be irrigated; the remaining eight acres were assumed to be in roads, farm buildings, and other noncrop use.

[4]An earlier report [Holland, Young, Pietsch, and Rostamizadeh] presents projected income for five different irrigation systems: rill, side-roll sprinkler, center pivot sprinklers without corner coverage, center pivot with mobile corner catchers, and center pivot with solid set corners.

TABLE 4. After Tax Cash Flow and Economic Net Return to Labor and Management by Farm Size, Assuming $1,500 per Acre Land Price, 25% Initial Land Equity, and 1973-1977 Average Output Prices

	160-Acre		320-Acre		640-Acre	
Acct. Method	Wheat-Potato	Standard	Wheat-Potato	Standard	Wheat-Potato	Standard
After-tax Cash Flow	27,556	9,590	42,670	16,858	66,220	27,532
Economic Return to Labor and Management	32,727	4,607	62,245	9,563	127,484	23,472

Results

Accounting Systems Comparison

Income estimates by farm size under each accounting approach and crop rotation are summarized in Table 4. The results assume 1973-77 average crop prices, a land price of $1,500 per acre, 25 percent initial land equity, and the other assumptions detailed in Tables 1-3. For the high income wheat-potato rotation, the standard economic accounting approach generates a higher average income estimate than does the after-tax cash flow accounting approach over all farm sizes. For the lower income standard rotation, the cash flow accounting approach generates a higher estimated income than does the economic approach over all farm sizes.

There are two reasons why the after-tax cash flow accounting approach results in a higher income figure on relatively low income (standard rotation) farms, but not for the relatively high income (wheat-potato rotation) farms: 1) nondeduction of the opportunity cost associated with the farmer's 25 percent land equity in the after-tax cash flow accounting approach, and 2) the progressive nature of federal income taxes.

Farms using the standard rotation earned relatively low incomes and incurred relatively low tax liabilities. For these farms, the nondeduction of interest on the owner's land equity more than offset relatively low income tax payments. The result was a higher net income estimate under the after-tax cash flow accounting than under the standard economic accounting approach where, of course, interest on owner's full land equity was deducted. On the other hand, for farms growing the wheat-potato rotation, relatively large federal income tax liabilities more than offset the nondeduction of interest on initial land equity under the cash accounting approach. For these farms, cash flow accounting net incomes were lower than economic accounting net incomes.

Carefully reviewing Table 4 should make it clear that using the standard economic accounting approach to obtain a picture of farm family well-being introduces a systematic error. On lower income farms, a category that includes most small farms, the standard economic accounting approach underestimates net income actually available for family living expenses. Just the opposite occurs in the case of larger and higher-income farms.[5]

[5]Two qualifications should be attached to these statements. First of course, they assume the operator has significant initial equity (25 percent in this study) in his land. Second, the after-tax cash incomes reported here, especially on larger units, may be somewhat underestimated because the simulator, due to its nonstochastic nature, was not able to capture the full potential to offset large income tax liabilities in good years by timely purchases of capital equipment and operating inputs and optimum timing of product sales. In other words, average income tax payments computed by the model may be higher, especially on larger units, than one would find in the real world with prudent investment and tax management.

The results in Table 4 reveal clearly different pictures from the two accounting frameworks of income potential for low-income smaller units. A 160-acre unit growing the typical standard rotation in the Basin and receiving 1973-77 average prices and yields was projected to generate economic net returns to owner's labor and management of only $4,607 per year. But estimated after-tax cash flow income actually available to support family living expenses was $9,590 per year. A family growing the same rotation on a 320-acre unit, the upper limit on ownership for a husband and wife under existing law, received an estimated $16,858 after-tax cash flow, whereas standard economic accounting revealed only 57 percent of that figure as returns to labor and management. The after-tax cash flow accounting approach, which is proposed as the appropriate approach for analyses of the adequacy of expected income aspect of the "viability" issue, provides a much more optimistic appraisal of the viability of 160- or 320-acre units. Official studies, however, have generally used the standard economic accounting approach exclusively [e.g., U.S. Department of Agriculture, 1978].

The Impact of Price Variation

The estimates summarized in Table 5 reveal income ranges associated with output price movements over the 1973-1977 period. As previously indicated, the standard economic accounting approach tends to overestimate income available for family living expenses in high income situations and underestimates the same figure in low income or loss situations. Both approaches predicted negative income in the low price year of 1977 for the standard rotation. Larger units showed more negative after-tax cash flows than smaller units. For the more profitable wheat-potato rotation, even the smallest farm size was able to generate positive after-tax cash flow in the year of lowest prices. Based on the information in Table 5, even the low equity 160-acre farms, if they were successfully growing a wheat-potato rotation, were able to generate after-tax cash flows that would be adequate by most measures. Farms of sizes up to 640 acres growing a smaller proportion of potatoes were likely to experience after-tax cash flow problems in periods of low output price.

Divestiture of Excess Lands

Table 6 presents estimates of net income for farms of 160, 320, and 640 acres assumed to be created by divestiture of excess lands. Under existing federal law, "excess lands" must be disposed of at "pre-project" (dry land) price, which in the Columbia Basin was estimated to average $350 per acre. Of course, the opportunity to obtain low priced land must *a priori* increase the income of purchasers of farm units of any size. The estimates in Table 6 quantify this increase. Of particular interest is the increased after-tax cash incomes of the smaller units and the bearing these increases have on the economic viability issue. For 160-acre units growing the standard rotation, average after-tax cash flow increases by 118 percent, from $9,590 in Table 4 to $20,896 in Table 6, if land is available at $350 per acre.

Table 6 also shows another facet of the contrast in net income estimates generated by the alternative accounting approaches. The standard economic approach allocates a return to land based on its opportunity cost which, of course, is determined by the market. Thus, even though the settler on "excess lands" may pay only $350 per acre, the value of the land resource under the economic approach remains at $1500, the current market price. Consequently, economic accounting estimates remain unchanged between Table 4 and Table 6. The after-tax cash flow accounting perspective, on the other hand, reflects the reduced land payment that would result from new farms being established through divestiture. It therefore represents a superior framework for measuring impacts on farm family well-being arising out of land prices that could result from reform based on enforcement of federal reclamation law.

TABLE 5. After-Tax Cash Flow and Economic Net Returns to Labor and Management by Farm Size Assuming $1,500 Per Acre Land Price and 25% Initial Land Equity

	160-Acre		320-Acre		640-Acre	
	Wheat-Potato	Standard	Wheat-Potato	Standard	Wheat-Potato	Standard
	1973-1977 Average Prices					
After-Tax Cash Flow	27,556	9,590	42,670	16,858	66,220	27,532
Economic Return to Labor and Management	32,727	4,607	62,245	9,563	127,484	23,472
	1977 (Low) Prices					
After-Tax Cash Flow	13,496	−5,577	21,355	−10,296	33,579	−17,512
Economic Return to Labor and Management	11,116	−11,291	19,021	−22,232	41,037	−40,102
	1974 (High) Prices					
After-Tax Cash Flow	44,058	22,526	68,610	36,574	107,516	57,132
Economic Return to Labor and Management	66,544	22,785	129,878	45,917	262,750	96,141

TABLE 6. After Tax Cash Flow and Economic Net Return to Labor and Management by Farm Size, Assuming $350 Per Acre Land Price, 25% Initial Land Equity, and 1973-77 Average Output Prices.

	160 Acre		320 Acre		640 Acre	
Acct. Method	Wheat-Potato	Standard	Wheat-Potato	Standard	Wheat-Potato	Standard
After-Tax Cash Flow	36,453	20,896	58,048	35,922	92,707	58,991
Economic Return to Labor and Management	32,727	4,607	62,245	9,563	127,484	23,472

Summary and Conclusions

Strong conflicting pressures are being placed on policy makers with respect to enforcement of the 160-acre limitation. A major point of argument between those promoting stricter enforcement and those promoting an increase in the size limit centers on whether an adequate living can be made on presently mandated farm sizes.

This analysis, which focused on the Columbia Basin Project in Washington State, found that the answer to this question is sensitive to the analytical approach used to estimate farm net income. With the after-tax cash flow accounting approach, a 160-acre Columbia Basin farm was estimated to return about $10,000 after taxes, assuming a land price of $1,500 per acre, 25 percent operator initial land equity, and 1973-1977 average yields, prices, and cropping patterns. In contrast, net economic returns to owner-operator's labor and management for the same farm, as computed under the standard economic accounting approach, were only about $5,000.

The analysis did not explicitly address the question of whether the hypothetical 160-acre standard rotation farm, or for that matter any other farm size, would have been able to survive income fluctuations during the 1973-1977 period. However, it is clear that such a farm would have encountered a negative after-tax cash flow of approximately $5600 in the low price year of 1977. It seems quite possible that off-farm income, and perhaps some refinancing of land debt based on land value appreciation, would permit survival. Assuming the farm was around for the high price year (1974), its predicted after-tax cash flow would have been approximately $22,500. Had the farm been growing the more profitable wheat-potato rotation, after-tax cash flow was approximately $44,000 in the year of highest price, dropping to approximately $13,500 in the year of lowest price.

When costs and returns were simulated for a farm assumed to be created from the purchase of "excess lands" at $350 per acre, the choice of an appropriate accounting framework was even more clearly highlighted. The standard rotation on a 160-acre farm receiving average prices and yields showed a net income for family living of $20,896 using the after-tax cash flow accounting approach, whereas net returns to owner-operator's labor and management under the standard economic accounting approach were $4,607.

A systematic difference is found in the results of the two approaches as they are used to obtain a picture of farm family well-being. The economic accounting approach underestimates net income actually available for family consumption on smaller farms or lower-income farms. However, on larger or higher-income farms, this approach overestimates net income available to the family.

The after-tax cash flow accounting approach is considered more appropriate for investigating income adequacy as it relates to the public policy question of economically viable farm size. This approach reflects income taxes and the effect of the farmer's beginning equity position in fixed assets, both of which are important determinants of viability in the real world.

While the analysis in this paper represents a useful beginning toward appropriately designed research on the viability issue, several important factors were ignored and will require consideration in future work. Both more empirical work and modeling are needed to examine the impact of net income fluctuations induced by variable yields and prices on the economic viability of farm units of varying sizes. Such examinations of resilience to risk should incorporate off-farm income sources, credit reorganization options, and possibilities for expanded self-produced subsistence requirements during lean years to thoroughly address the survival issue. More farm survey work is needed to reveal any systematic differences in actual yield levels, enterprise composition, off-farm employment opportunities, and credit and market access over farm size. Furthermore, more emphasis should be devoted to incorporating differing technologies for farms of varying size in modeling analyses.

Finally, the specific net income estimates and viability appraisals for a given size farm in this study should not be generalized for national policy purposes to other Bureau of Reclamation projects having different climates or soils than those in the Columbia Basin. Researchers are encouraged, however, to analyze the income viability of alternative size farm units in other regions with the after-tax cash flow accounting approach, rather than the standard economic accounting approach.

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APPENDIX TABLE A1

1977 AFTER TAX CASH FLOW DESCRIPTION FOR COLUMBIA BASIN FARM OF 320.0 ACRES:
RILL IRRIG. ; STANDARD ROTATION; 25.0% LAND EQUITY; 1973-1977 AVERAGE PRICES AND AVERAGE YIELDS

A.

CONSTANT INPUT DATA

NUMBER OF YEARS INCOME IS PROJECTED	15.
VALUE OF CONST. MACHNRY INVESTMENT	158200.
LAND DEBT	360000.
COST OF IRRIG.	35068.
INTEREST RATES: LAND	0.090
IRRIG.	0.110
MACHNRY	0.110
REPAYMENT PERIODS: LAND	25.
IRRIG.	7.
LIFE OF IRRIG.	15.
IRRIG. DOWN PAYMENT PROPORTION	0.250
FARM OVERHEAD	7040.
HIRED LABOR COST	4122.
NUMBER OF PERSONAL EXEMPTIONS	4.
NET FAMILY INCOME FROM OTHER SOURCES	0.

CROP INPUT DATA

CROP	ACRES	VARIABLE COST/ACRE	YIELD/ ACRE	UNIT	PRICE/ UNIT
POTATOES	33.5	545.92	23.50	T	56.20
WHEAT	100.3	92.61	79.20	BU	3.57
SUGAR BEETS	39.5	255.97	24.90	T	28.27
ALFALFA	130.7	80.71	5.50	T	58.40

B.

ENTERPRISE RETURNS INFORMATION

CROP	PER ACRE GROSS RETURNS	PER ACRE VARIABLE COSTS	PER ACRE NET RETURNS	PER FARM GROSS RETURNS	PER FARM VARIABLE COSTS	PER FARM NET RETURNS
POTATOES	1320.70	545.92	774.78	44243.44	18288.32	25955.12
WHEAT	282.74	92.61	190.13	28359.21	9288.78	19070.43
SUGAR BEETS	703.92	255.97	447.95	27804.93	10110.81	17694.12
ALFALFA	321.20	80.71	240.49	41980.83	10548.79	31432.04

C.

FARM NET RETURNS CALCULATIONS

YEAR	GROSS INCOME	VARIABLE COSTS+ LABOR	MACHNRY PRINCIPLE PAYMENT	MACHNRY INTEREST PAYMENT	MACHNRY SALES TAX	IRRIG. PRINCIPLE PAYMENT	IRRIG. INTEREST PAYMENT	IRRIG. SALES TAX	FARM OVERHEAD	LAND PRINCIPLE PAYMENT	LAND INTEREST PAYMENT	SOC.SEC.+ FED.INC. TAX	AFTER TAX NET INCOME
1	142388.	52359.	15820.	3915.	791.	11455.	2893.	1753.	7040.	4250.	32400.	1303.	8407.
2	142388.	52359.	15820.	3915.	791.	2984.	2597.	0.	7040.	4633.	32018.	3378.	16853.
3	142389.	52359.	15820.	3915.	791.	3312.	2269.	0.	7040.	5050.	31601.	3720.	16511.
4	142388.	52359.	15820.	3915.	791.	3677.	1905.	0.	7040.	5504.	31146.	4087.	16145.
5	142388.	52359.	15820.	3915.	791.	4081.	1500.	0.	7040.	6000.	30651.	4489.	15742.
6	142388.	52359.	15820.	3915.	791.	4530.	1051.	0.	7040.	6540.	30111.	4906.	15326.
7	142388.	52359.	15820.	3915.	791.	5028.	553.	0.	7040.	7128.	29522.	5357.	14874.
8	142388.	52359.	15820.	3915.	791.	0.	0.	0.	7040.	7770.	28881.	5872.	19941.
9	142388.	52359.	15820.	3915.	791.	0.	0.	0.	7040.	8469.	28182.	6196.	19617.
10	142388.	52359.	15820.	3915.	791.	0.	0.	0.	7040.	9231.	27419.	6534.	19279.
11	142388.	52359.	15820.	3915.	791.	0.	0.	0.	7040.	10062.	26588.	6908.	18904.
12	142388.	52359.	15820.	3915.	791.	0.	0.	0.	7040.	10967.	25683.	7313.	18500.
13	142388.	52359.	15820.	3915.	791.	0.	0.	0.	7040.	11954.	24696.	7743.	18070.
14	142388.	52359.	15820.	3915.	791.	0.	0.	0.	7040.	13031.	23620.	8201.	17612.
15	142388.	52359.	15820.	3915.	791.	0.	0.	0.	7040.	14203.	22448.	8729.	17083.

1977 AFTER TAX CASH FLOW DESCRIPTION FOR COLUMBIA BASIN FARM OF 320.0 ACRES:
RILL IRRIG. ; STANDARD ROTATION; 25.0% LAND EQUITY; 1973-1977 AVERAGE PRICES AND AVERAGE YIELDS

D.

FEDERAL INCOME TAX INFORMATION

YEAR	GROSS INCOME	VARIABLE COSTS +LABOR	INTEREST +OVERHEAD	SALES TAX MACHNRY +IRRIG.	MACHNRY DEPREC.	IRRIG. DEPREC.	PERSONAL EXEMPTION	TAXABLE INCOME	TAX BEFORE CREDITS	IRRIG. +MACHNRY TAX CREDIT	GENERAL CREDIT	SOCIAL SECURITY PAYMENT	FEDERAL INCOME TAX
1	142388.	52359.	46249.	2544.	15820.	8142.	3000.	14274.	2056.	5089.	180.	1303.	0.
2	142388.	52359.	45570.	791.	15820.	3590.	3000.	21258.	3836.	1582.	180.	1303.	2074.
3	142388.	52359.	44825.	791.	15820.	3111.	3000.	22482.	4179.	1582.	180.	1303.	2417.
4	142388.	52359.	44006.	791.	15820.	2697.	3000.	23716.	4545.	1582.	180.	1303.	2783.
5	142388.	52359.	43107.	791.	15820.	2337.	3000.	24975.	4948.	1582.	180.	1303.	3186.
6	142388.	52359.	42118.	791.	15820.	2025.	3000.	26276.	5364.	1582.	180.	1303.	3602.
7	142388.	52359.	41031.	791.	15820.	1755.	3000.	27632.	5816.	1582.	180.	1303.	4054.
8	142388.	52359.	39836.	791.	15820.	1521.	3000.	29061.	6330.	1582.	180.	1303.	4568.
9	142388.	52359.	39137.	791.	15820.	1318.	3000.	29963.	6655.	1582.	180.	1303.	4893.
10	142388.	52359.	38375.	791.	15820.	1143.	3000.	30901.	6992.	1582.	180.	1303.	5230.
11	142388.	52359.	37544.	791.	15820.	990.	3000.	31884.	7367.	1582.	180.	1303.	5605.
12	142388.	52359.	36638.	791.	15820.	858.	3000.	32922.	7772.	1582.	180.	1303.	6010.
13	142388.	52359.	35651.	791.	15820.	744.	3000.	34023.	8201.	1582.	180.	1303.	6439.
14	142388.	52359.	34575.	791.	15820.	645.	3000.	35199.	8660.	1582.	180.	1303.	6898.
15	142388.	52359.	33403.	791.	15820.	559.	3000.	36457.	9188.	1582.	180.	1303.	7426.

E.

DISCOUNTED AFTER TAX NET INCOMES FOR ALTERNATIVE INTEREST RATES

YEAR	FOR I = 0%	FOR I = 5%	FOR I = 10%	FOR I = 15%	FOR I = 20%	FOR I = 25%	FOR I = 30%
1	8407.	7590.	6846.	6167.	5545.	4972.	4444.
2	16853.	15287.	13928.	12744.	11704.	10786.	9972.
3	16511.	14263.	12405.	10856.	9555.	8454.	7515.
4	16145.	13282.	11027.	9231.	7786.	6613.	5653.
5	15742.	12334.	9774.	7826.	6326.	5158.	4240.
6	15326.	11436.	8651.	6626.	5133.	4018.	3175.
7	14874.	10571.	7633.	5592.	4151.	3119.	2370.
8	19941.	13497.	9303.	6519.	4638.	3346.	2445.
9	19617.	12645.	8319.	5576.	3802.	2633.	1850.
10	19279.	11836.	7433.	4765.	3114.	2070.	1398.
11	18904.	11053.	6626.	4063.	2544.	1624.	1055.
12	18500.	10301.	5895.	3458.	2075.	1271.	794.
13	18070.	9583.	5234.	2937.	1689.	993.	597.
14	17612.	8895.	4638.	2489.	1372.	775.	447.
15	17083.	8218.	4090.	2099.	1109.	601.	334.
SUM OF DISCOUNTED NET INCOMES	252863.	170790.	121802.	90949.	70541.	56433.	46289.
EQUIVALENT CONSTANT ANNUAL NET INCOME	16858.[a]	16454.	16014.	15554.	15087.	14623.	14163.

F.

ECONOMISTS BEFORE TAX NET RETURNS TO LABOR AND MANAGEMENT

GROSS RETURNS	VARIABLE COSTS	HIRED LABOR COST	INTEREST ON AVERAGE INVESTMENT IN: MACHNRY	INTEREST ON AVERAGE INVESTMENT IN: IRRIG.	INTEREST ON AVERAGE INVESTMENT IN: LAND	STRAIGHT-LINE DEPREC. ON: MACHNRY	STRAIGHT-LINE DEPREC. ON: IRRIG.	OVERHEAD	NET INCOME
142388.	48237.	4122.	9136.	2025.	43200.	16611.	2455.	7040.	9563.[b]

[a] After-tax cash flow net income of owner-operator
[b] Economic net return to owner-operator's labor and management