# Economics of On-Farm Methods Of Controlling Sediment Loss From Surface-Irrigated Fields



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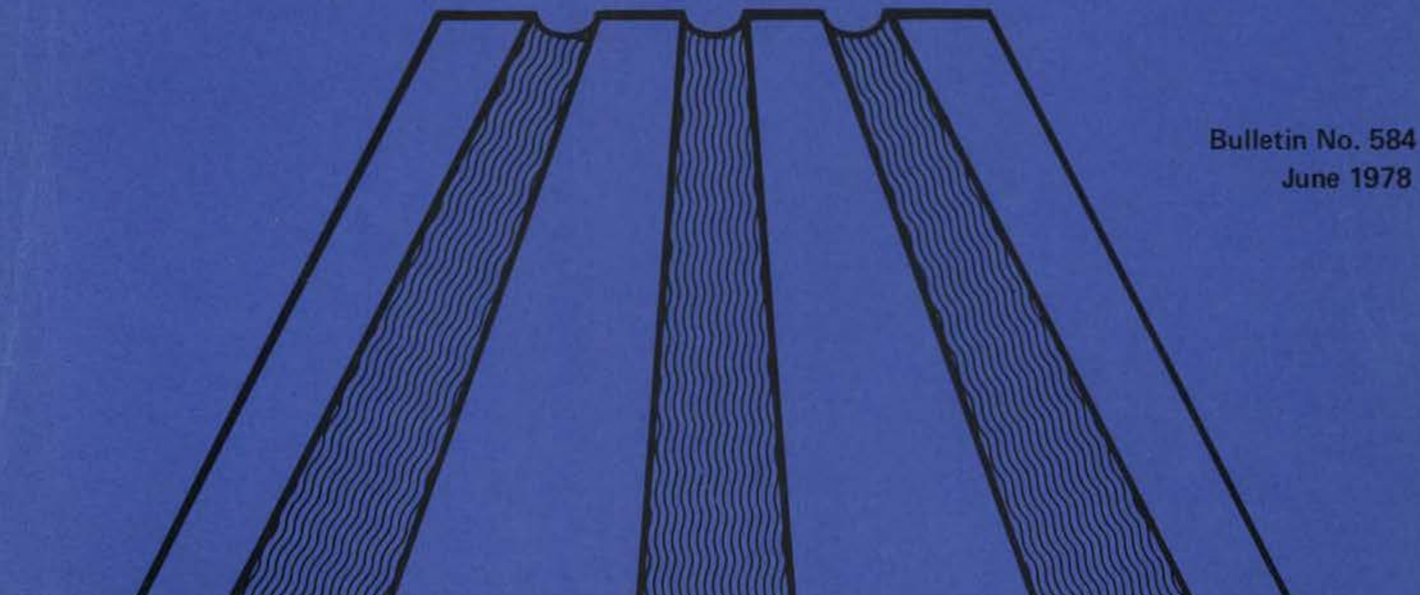

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# Table of Contents



## *About the Authors*


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# Economics of On-Farm Methods of Controlling Sediment Loss from Surface-Irrigated Fields

*L. R. Conklin, K. H. Lindeborg, E. L. Michalson, R. B. Long*

## Introduction

The full impact of erosion on surface irrigated land is becoming more and more widely perceived in society today. Not only is productive topsoil washed away over time, it is filling in downstream waterways and reservoirs and degrading the water quality of downstream flows. Many people are concerned over what can be done to reduce the magnitude of this problem, and what the costs would be.

This report describes cost effectiveness estimates for selected methods of reducing the sediment loss from irrigated farms. It also describes the farm income consequences of having to meet specified restrictions on sediment loss. The calculations are based on data from field monitoring studies and from a survey of farmers in the Magic Valley and Boise Valley of southern Idaho.

The report is organized in four sections. The first describes farming in the two valleys in general terms. The second outlines the farm survey procedure. The third section describes the estimates of costs associated with the selected methods of sediment loss reduction, and the last section discusses the effects of sediment loss restrictions on farm income.

## Description of the Study Areas

### Magic Valley

For this report, the Magic Valley is considered to include the irrigated lands of Jerome and Twin Falls counties. In 1972, farming provided 22% of the personal income generated in these two counties, while food processing provided another 5% (2). Many non-farm jobs in the area depend on sales to farmers and their families.

Figures from the 1974 Census of Agriculture show that the average irrigated farm in the area has about 180 acres of cropland. However, the size of farms varies considerably.

The most widely grown crops in both counties have been alfalfa hay, dry beans, wheat and potatoes. Barley, mixed grain, sugarbeets and seed peas are also major crops, the latter mainly in Twin Falls County.

### Boise Valley

Fieldwork for this part of the study was performed at several sites in Canyon County.

In Canyon County, farming provided 20% of all personal income in 1972, while food processing provided another 9%. The personal income accounts are not detailed enough to show what proportion of local commerce depended on sales to farm families, but with farming and food processing providing 29% of personal income, agricultural production is obviously an important segment of the county's economy.

The average irrigated farm in the country has about 145 acres of cropland, according to figures in the 1974 Census of Agriculture. Again, farm size varies over a wide range.

The most widely grown crops in Canyon County have been alfalfa hay, sugarbeets, wheat and barley. Other major crops, on an acreage basis, include corn silage, alfalfa seed, potatoes, dry beans, seed corn and corn grain. Many other specialty crops, including fruit, vegetables and seed crops contribute significantly to the value of farm sales but are grown on a relatively small portion of the total cropland.

# Farm Survey Procedure

## Data Collection

The economic investigations were directed toward establishing the cost effectiveness of farming practices that would reduce the loss of sediment from irrigated fields.

After the harvest season in 1975, 150 randomly selected farm operators were interviewed and asked to describe their present farming practices, with special emphasis on field operations and irrigation practices. Sampling areas were delineated to assure that the farms within them had soils, topography and water supply conditions similar to those at the monitored field sites. The study area in Twin Falls County consisted of the irrigated land with predominately Portneuf silt loam soil that lies between the Snake River and the irrigation canal east of the city of Twin Falls. Irrigation water is supplied by the Twin Falls Canal Company.

From the 62 sections of land (1 section = 640 acres) in the study area, 12 were selected at random. The goal was to interview everyone who farmed 40 acres or more of irrigated land in the sample sections; 36 interviews were carried out.

The study area in Jerome County consisted of 70 sections of irrigated land, lying east and south of Jerome. Most of the soils in this area are silt loams. Irrigation water is supplied by the Northside Canal Company.

Data collection was made on the same basis: 14 sections were selected at random from the 70 in the study area, and 29 interviews were conducted.

Two study areas were delineated in Canyon County on the basis of soil associations. The Wilder-Parma area included three tracts of the Greenleaf-Nyssaton-Garbutt Association. The Nampa-Melba area included areas of the Power-Purdam Association together with the Minidoka-Marsing-Vickery Association. This is the combination of soils found on the University of Idaho Research and Extension Center south of Caldwell. In the southern part of this area, the Scism-Bahem-Trevino Association predominated.

**Table 1. Size classification of sample farms.**

| Study area | Number of small farms[1] | Median size | Number of large farms[1] | Median size |
|---|---|---|---|---|
| | | (acres) | | (acres) |
| Twin Falls | 21 | 140 | 15 | 320 |
| Jerome | 18 | 140 | 11 | 300 |
| Wilder-Parma | 15 | 140 | 8 | 340 |
| Nampa-Melba | 29 | 160 | 18 | 320 |

[1]Small farms have 250 irrigated acres or less, large farms have more than 250 irrigated acres.

Fifteen percent of the sections in each study area were selected at random. Following the procedure used in the Magic Valley, interviews were conducted with 23 farm operators in the Wilder-Parma area and 47 in the Nampa-Melba area.

## Analysis of Survey Data

The sample farms in each study area were classified into two size categories (Table 1). The small-farm category included farms with 250 irrigated acres or less which typically employs one man full-time. The large-farm category included farms with more than 250 irrigated acres, typically employing two or more men.

Typical cultural practices were identified from survey information for the crops most widely grown on these farms.

**Table 2. Crops grown on model farms.**

| Crop | Small farm | Large farm |
|---|---|---|
| | (acres) | (acres) |
| **Twin Falls** | | |
| Bean seed | 60 | 80 |
| Commercial beans | 20 | 60 |
| Pea seed | 20 | 40 |
| Alfalfa hay | 40 | 80 |
| Spring wheat | 0 | 60 |
| Total | 140 | 320 |
| **Jerome** | | |
| Commercial beans | 40 | 60 |
| Spring wheat | 40 | 80 |
| Alfalfa hay | 60 | 80 |
| Potatoes | 0 | 80 |
| Total | 140 | 300 |
| **Wilder-Parma** | | |
| Sugarbeets | 40 | 100 |
| Potatoes | 40 | 80 |
| Winter wheat | 40 | 80 |
| Alfalfa hay | 20 | 80 |
| Total | 140 | 340 |
| **Nampa-Melba** | | |
| Sugarbeets | 60 | 140 |
| Corn seed | 40 | 60 |
| Dry beans | 40 | 60 |
| Alfalfa hay | 20 | 0 |
| Winter wheat | 0 | 60 |
| Total | 160 | 320 |

This information was combined with input and commodity prices prevailing in 1975; the Oklahoma State University budget generator was then used to produce cost-and-returns budgets for each crop.

A representative farm was described for each size category. The representative farm is equal to the median farm in that category in size, and the crop rotation includes the most commonly grown crops (Table 2).

# Cost Effectiveness of Selected Sediment Control Practices

## Estimation of Physical Parameters

The surface irrigation under consideration in this report uses furrows or corrugates to distribute the water over a field. Even with just one method of water application, however, the sediment loss from a surface irrigated field is a function of many parameters. Included in these parameters are soil characteristics, field topography and the rate and timing of water application.

Irrigation water supply, return flow and sediment loss were estimated for typical crop and field conditions in the study areas (Table 3). These estimates assume silt loam soils with slopes varying from 0.5 to 4% and are based on data from field monitoring projects conducted by the University of Idaho over the past 5 years (1, 3, 4).

The physical effectiveness of the sediment loss reduction practices considered in this report were estimated on the basis of field experiments conducted by the University of Idaho (2). These estimates, presented in Table 4, are expressed in terms of the percentage of sediment loss under present management that would be retained on the farm by using a particular practice. For example, sediment ponds would reduce the present sediment loss under typical management by 67%. On a bean field, this would be a reduction from 3.6 tons per acre loss to 1.2 tons per acre.

## Description of Sediment Loss Control Practices

*Flow cutback* involves running the usual amount of water down the furrow or corrugate until the water is through to the lower end, then cutting back stream size for the remainder of the irrigation set. This reduced flow results in less erosion and less soil transport in the furrows. However, labor required to perform the cutback operation would be doubled because, in essence, the water must be set and then reset.

*Vegetative strips* are strips of close-growing crops such as grass or grain established across the lower end of a field to slow the velocity of tailwater running off the field, causing it to deposit some of its sediment. Crops that are normally planted with a drill can be double or even triple-planted in a strip across the lower end of a field.

A *sediment pond* is a pond dug into a waterway to reduce flow velocity and retain sediment. Effectiveness of a sediment pond depends on its shape and size and on the volume of flow going through it. In several monitored ponds, about two-thirds of the incoming sediment was retained.

*Minibasins* are small, shallow ponds constructed on the lower end of a field by putting in a low berm, or dike, along the bank of the drain ditch. Other berms are constructed perpendicular to the drain ditch, so that each basin retains the tailwater flow of just a few furrows. The berm along the drain ditch also serves as a spillway when necessary, so it should be seeded with grass to minimize erosion into the ditch.

*Sprinklers* are becoming widely used, mainly in areas with no facilities for surface irrigation or with sandy soils that are difficult to surface irrigate. Some land is being converted to sprinkler irrigation using power-move systems, largely for the sake of labor saving and field consolidation. Sprinkler systems can be designed to apply water at a rate equal to or less than the soil intake rate. When this is done, surface runoff and sediment losses are eliminated.

**Table 3. Sediment loss levels for surface irrigated crops, under typical farm conditions.**

| Crops | Sediment loss |
|---|---|
| | (tons/acre) |
| Potatoes | 18.0 |
| Corn, beans, beets | 3.6 |
| Small grain, peas | 1.4 |
| Alfalfa | 0.4 |

## Economic Analysis

The assumptions and calculations involved in figuring the cost effectiveness of the selected sediment loss control practices are described in the following sections.

### *Flow Cutback*

The irrigation labor typically involved in growing a crop was computed from the farm survey data. For each crop the number of irrigations was multiplied by 0.4 hour/acre to

**Table 4. Estimated sediment loss reduction for selected control practices.**

| Control practice | Percent of sediment loss under present management that would be retained on farm |
|---|---|
| Flow cutback | 30 |
| Vegetative strip | 50 |
| Sediment pond | 67 |
| Minibasins | 90 |
| Sprinklers | 100 |

compute the hours of irrigation labor used per acre over the irrigation season. We assumed the cutback procedure would double irrigation labor time, which was valued at $3 per hour. Table 5 presents the cost figures.

## *Vegetative Strips*

Vegetative strips generally require taking some cropland out of production. The cost analyses were based on 20-acre fields, which commonly have dimensions of 1,320 by 660 feet. Since water may run across either the long or short side, depending on field slope, the average length of 990 feet was selected to compute the amount of land that would be out of production. A vegetative strip 990 feet long and 8 feet wide requires 7,920 square feet of land, the equivalent of 0.18 acres removed from production.

For row crops, we assumed that the field ends would be less productive per unit area than the entire field and that the land out of production would have yielded 80% of the field average. For grain and peas, we assumed a normal harvest would be taken from the overplanted strip. No strip was used on alfalfa or on potatoes. A vegetative strip seems redundant on alfalfa, and would probably be obliterated by the first irrigation on potatoes.

Table 6 shows the opportunity costs, or the returns to land and management that would be given up by replacing cropland with a vegetative strip.

Operating costs for a vegetative strip include the costs of seeding the strip and spreading the deposited sediment back over the field after harvest. With row crops, the time involved in getting the drill set up to plant the strip, driving to the field, planting the strip, driving back to the farmstead and putting the drill away is difficult to estimate. For calculation of labor costs and machinery variable costs, the actual field time was multiplied by four in an attempt to include all the steps in the operation. On grass and pea fields, only the time involved in making another pass over the lower end of the field was used in computing costs.

Machine field time and variable costs per hour of operation came from the model farm budgets for grain enterprises. We assumed the farmer already had the machinery and that machinery fixed costs had already been allocated to crop enterprises. Therefore, no fixed costs were charged to the strips.

Spreading sediment back over the field could be accomplished with a land plane. This would probably have to be done every year for row crops, every other year for grain and peas. Based on figures from the cost budgets, this operation would cost $1.50 per acre.

Table 7 shows annual operating costs and Table 8 shows total annual costs associated with vegetative strips.

## *Sediment Ponds*

The costs associated with sediment ponds were studied for a situation in which each 20-acre field would have a pond in its tailwater drain. The size of pond needed for each crop was estimated by converting weight to volume, using 80 pounds per cubic foot of sediment as a conversion factor. Pond surface area was also computed, figuring that each pond would be 4 feet deep (5 feet on potatoes).

Operating costs were calculated at $1.20 per cubic yard — about $0.60 per cubic yard for excavation and another $0.60 for spreading sediment back on the field (Table 9).

To compute the costs of land taken out of production by installation of a sediment pond, the surface area of the pond was first tripled to allow for margins around it. Then the returns to land and management that would be given up on this area of land were computed. Row crop yields on field ends were again assumed to be 20% below field averages. Table 10 shows the opportunity costs of the land out of production and Table 11 presents the total annual costs for the ponds.

## *Mini-Basins*

The land area taken out of production for mini-basins would be the same as that for vegetative strips, so the opportunity costs of land out of production would also be the same.

**Table 6. Opportunity cost of installing a vegetative strip of 0.18 acre on a 20 acre field.**

| Crop | Opportunity cost |
|---|---|
| Dry beans | $24.30 |
| Bean seed | 50.00 |
| Corn seed | 34.70 |
| Sugarbeets | 36.70 |

**Table 5. Costs associated with flow cutback to reduce sediment loss on a typical farm in the Magic Valley or Boise Valley.**

| Crop | No. of irrigations | Irrigation labor | | Added labor cost | Sediment retained | Cost of sediment retained |
|---|---|---|---|---|---|---|
| | | Normal | Cutback | | | |
| | | (hours/acre) | | ($/acre) | (tons/acre) | ($/ton) |
| Dry beans | 7 | 2.8 | 5.6 | $ 8.40 | 1.1 | $ 7.60 |
| Bean seed | 8 | 3.2 | 6.4 | 9.60 | 1.1 | 8.70 |
| Corn | 7 | 2.8 | 5.6 | 8.40 | 1.1 | 7.60 |
| Sugarbeets | 10 | 4.0 | 8.0 | 12.00 | 1.1 | 10.90 |
| Potatoes | 12 | 4.8 | 9.6 | 14.40 | 5.4 | 2.70 |
| Pea seed | 5 | 2.0 | 4.0 | 6.00 | 0.4 | 15.00 |
| Winter wheat | 5 | 2.0 | 4.0 | 6.00 | 0.4 | 15.00 |
| Spring wheat | 4 | 1.6 | 3.2 | 4.80 | 0.4 | 12.00 |
| Alfalfa hay | 6 | 2.4 | 4.8 | 7.20 | 0.1 | 72.00 |

The berm along the drain ditch bank would probably need to be shaped and seeded every 5 years. Costs for this operation are shown in Table 12.

Maintaining the mini-basins would involve spreading sediment and rebuilding the field berms every year on row crops, every other year on grain and peas. For alfalfa, basins put in before establishment would serve for the duration of the stand. Construction costs are shown in Table 13. Since mini-basins retain 1.8 times as much sediment as vegetative strips for a given field and crop, spreading costs were figured to be 1.8 times those for strips. This amounts to $54 per year for beans, beets, corn and potatoes, $27 per year for grain and peas, $9 per year for alfalfa.

**Table 7. Annual operating costs associated with a vegetative strip on a 20-acre field.**

| | | | |
|---|---|---|---|
| **Row crops** | | | |
| Variable costs for drill and tractor: $3.88/hour x 0.35 hour/acre x 0.18 acre x 4 | = | $1.00 | |
| Labor cost of seeding: $3/hour x 0.35 hour/acre x 0.18 acre x 4 | = | 0.80 | |
| Wheat or barley seed: 100 lb./acre x 0.18 acre x $0.10/lb. | = | 1.80 | |
| Spreading sediment: 20 acre x $1.50/acre | = | 30.00 | |
| Total | = | $33.60 | |
| **Corrugated crops** | | **Grain** | **Peas** |
| Variable costs for drill and tractor: $3.88/hour x 0.35 hour/acre x 0.18 acre | = | $0.25 | $0.25 |
| Labor cost of seeding: $3/hour x 0.35 hour/acre x 0.18 acre | = | 0.20 | 0.20 |
| Wheat seed | = | 1.80 | |
| Pea seed | = | | 6.40 |
| Spreading sediment: 20 acre x $1.50/acre x 0.5 | = | 15.00 | 15.00 |
| Total | = | $17.25 | 21.85 |

**Table 8. Total annual costs (opportunity costs plus operating costs) associated with a vegetative strip on a 20-acre field.**

| Crop | Whole field costs | Cost per acre | Sediment retained | Cost of sediment retained |
|---|---|---|---|---|
| | | | (tons/acre) | ($/ton) |
| Dry beans | $57.90 | $2.90 | 1.8 | $1.60 |
| Bean seed | 83.60 | 4.18 | 1.8 | 2.30 |
| Corn seed | 68.30 | 3.42 | 1.8 | 1.90 |
| Sugarbeets | 70.30 | 3.52 | 1.8 | 2.00 |
| Pea seed | 21.85 | 1.09 | 0.7 | 1.60 |
| Grain | 17.25 | 0.86 | 0.7 | 1.20 |

**Table 9. Annual operating costs for sediment ponds on 20-acre fields.**

| Crop | Pond size | Operating cost, pond full | Percent of pond filled in one year | Annual operating costs |
|---|---|---|---|---|
| | (cubic yard) | | | |
| Beans, beets, corn seed | 96 | $115.20 | 50 | $ 57.60 |
| Potatoes | 250 | 300.00 | 100 | 300.00 |
| Grain, peas | 52 | 62.50 | 33 | 20.80 |
| Alfalfa hay | 24 | 28.80 | 25 | 7.20 |

**Table 10. Opportunity cost of land out of production for sediment ponds on 20-acre fields.**

| Crop | Net return given up | Land area | Opportunity cost of land out of production |
|---|---|---|---|
| | ($/acre) | (acre) | |
| Dry beans | $135 | 0.045 | $ 6.10 |
| Bean seed | 278 | 0.045 | 12.50 |
| Corn seed | 193 | 0.045 | 8.70 |
| Sugarbeets | 204 | 0.045 | 9.20 |
| Potatoes | 289 | 0.093 | 26.90 |
| Pea seed | 240 | 0.024 | 5.80 |
| Winter wheat | 154 | 0.024 | 3.70 |
| Spring wheat | 134 | 0.024 | 3.20 |
| Alfalfa hay | 104 | 0.011 | 1.10 |

**Table 11. Total annual costs (opportunity cost plus operating costs) associated with a sediment pond on a 20-acre field.**

| Crop | Whole field cost | Cost per acre | Sediment retained | Cost of sediment retained |
|---|---|---|---|---|
| | | | (tons) | ($/ton) |
| Dry beans | $ 63.70 | $ 3.18 | 2.40 | $1.30 |
| Bean seed | 70.10 | 3.50 | 2.40 | 1.50 |
| Corn seed | 66.30 | 3.32 | 2.40 | 1.40 |
| Sugarbeets | 66.80 | 3.34 | 2.40 | 1.40 |
| Potatoes | 326.90 | 16.34 | 12.00 | 1.40 |
| Pea seed | 26.60 | 1.33 | 0.93 | 1.40 |
| Winter wheat | 24.50 | 1.22 | 0.93 | 1.30 |
| Spring wheat | 24.00 | 1.20 | 0.93 | 1.30 |
| Alfalfa hay | 8.30 | 0.42 | 0.27 | 1.60 |

**Table 12. Annual cost of shaping and seeding the ditch berm for mini-basins on 20-acre fields.**

| | | |
|---|---|---|
| Labor: 5 hour x $3/hour ÷ 5 years = | | $3.00 |
| Machine variabel costs: 2.5 hours x 2.50/hours ÷ 5 years | = | 1.25 |
| Grass seed: 8.25 lb. x $1/lb. ÷ 5 years | = | 1.65 |
| Total | | $5.90 |

Table 14 shows the total annual costs for the mini-basins. Operating costs are $5.90 (from Table 12) plus basin construction costs on an annual basis (from Table 13) plus sediment spreading costs.

## *Sprinkler Irrigation*

Any large scale conversion of surface irrigated lands to sprinklers would have impacts that are beyond the scope of this study. The availability of power for pumping would probably be a major constraint. Even so, the costs of installing and operating a sprinkler system can be compared with costs of other methods of reducing sediment loss. We assumed in this analysis that a sprinkler system would be operated to eliminate water runoff and sediment loss from the fields.

Costs estimates computed for a side roll sprinkler system are shown in Table 15. The system consists of a pump taking water out of a pond, a mainline and 6 laterals for 140 acres of irrigated crops on a quarter section of land. Depreciation was calculated on a straight-line basis, with a useful life of 15 years for all components and a salvage value of 10% of new price. Annual interest was computed at 8% per year on average investment, which is defined by the formula:

Average investment = ½ (new price + salvage value)

Table 16 shows labor costs savings that result from the conversion to sprinkler irrigation. Maintenance time on the water distribution system is cut by two-thirds. Irrigation labor is reduced by 0.1 hour per acre per irrigation. Machine labor savings result from the elimination of certain operations, such as land planing and corrugating.

Total annual costs associated with the sprinkler system are shown in Table 17. Power costs $1.50 per acre per irrigation, and repairs cost $1 per acre per irrigation. Net annual cost is the sum of power costs, repair costs, depreciation and interest less labor cost savings.

**Table 13. Construction costs for mini-basins on 20-acre fields.**

| Crop | Furrow spacing | Furrows per basin | Basins in 990 ft. | Labor time[1] @ 0.3 hr./basin |
|---|---|---|---|---|
| | (inches) | | | (hour) |
| Beans, beets | 44 | 4 | 67 | 20 |
| Corn | 30 | 5 | 79 | 24 |
| Potatoes | 36 | 4 | 82 | 25 |
| Grain, peas, alfalfa | 30 | 6 | 66 | 20 |

| Crop | Labor cost @ $3/hr. | Machine variable cost @ $2.50/hr. | Total construction costs Per time | Annual |
|---|---|---|---|---|
| Beans, beets | $60.00 | $16.75 | $76.75 | $76.75 |
| Corn | 72.00 | 19.75 | 91.75 | 91.75 |
| Potatoes | 75.00 | 20.50 | 95.50 | 75.50 |
| Grain, peas | 60.00 | 16.50 | 76.50 | 38.25 |
| Alfalfa | 60.00 | 16.50 | 76.50 | 25.50[2] |

[1]Machine labor 0.1 hour/basin, shovel work 0.2 hour/basin

[2]Three year stand

## Summary

The sediment loss reduction practices considered in this study showed a wide variation in costs. Table 18 presents the costs per acre for each practice, and Table 19 shows the costs per ton of sediment retained.

Sediment ponds and vegetative strips were the two practices with the lowest costs, both per acre and per ton of sediment retained. The greater physical effectiveness of the ponds made them slightly less costly per ton of sediment retained for all crops except grain.

Mini-basins and flow cut-back had similar costs per acre. Flow cut-back was the most expensive method since it reduced sediment loss by only 30%. Mini-basins were more effective in reducing sediment loss and showed better cost effectiveness than flow cut-back.

Conversion from surface irrigation to sprinklers would eliminate sediment loss from fields but would involve a large increase in costs over those associated with other control practices. Costs per ton of sediment retained would be fairly low for potatoes because of the large volume of sediment loss with surface irrigation. However, the cost per acre of converting surface irrigation to sprinklers is high for all crops.

**Table 14. Total annual costs associated with a mini-basin on a 20-acre field[1].**

| Crop | Opportunity cost of land out of production | Operating costs | Total costs Whole field | Total costs Per acre | Sediment retained | Cost of sediment retained |
|---|---|---|---|---|---|---|
| | | | | | (tons/acre) | ($/ton) |
| Dry beans | $24.30 | $136.65 | $160.95 | $ 8.05 | 3.24 | $2.50 |
| Bean seed | 50.00 | 136.65 | 186.65 | 9.33 | 3.24 | 2.90 |
| Corn seed | 34.70 | 151.65 | 186.35 | 9.32 | 3.24 | 2.90 |
| Sugarbeets | 36.70 | 136.65 | 173.35 | 8.67 | 3.24 | 2.70 |
| Potatoes | 52.00 | 154.40 | 206.40 | 10.32 | 4.50 | 2.30 |
| Pea seed | 43.20 | 71.15 | 114.35 | 5.72 | 1.26 | 4.50 |
| Winter wheat | 27.70 | 71.15 | 98.85 | 4.94 | 1.26 | 3.90 |
| Spring wheat | 24.10 | 71.15 | 95.25 | 4.76 | 1.26 | 3.80 |
| Alfalfa hay | 18.70 | 40.40 | 59.10 | 2.96 | 0.36 | 8.20 |

[1]Because of the large volume of sediment, the mini-basins on a potato field would probably fill up before the season ended. For purposes of comparison, we assumed that 25% of incoming sediment for the season will be retained.

Table 15. Annual fixed costs of owning and operating a side-roll sprinkler system on 140 acres of irrigated crops.

| Item | Investment cost | Annual depreciation | Annual interest |
|---|---|---|---|
| | | ($/year) | ($/year) |
| Laterals | $27,000 | $1,620 | $1,188 |
| Mainline | 6,600 | 396 | 290 |
| 50 HP pump | 3,500 | 210 | 154 |
| Pond | 500 | 33 | 20 |
| | 34,600 | 2,259 | 1,652 |

Table 16. Labor cost savings resulting from the conversion of a surface irrigation system to a side-roll sprinkler system.

| Crop | Labor cost savings Ditch maint. | Irrigation | Machine labor | Total |
|---|---|---|---|---|
| | ($/acre) | ($/acre) | ($/acre) | ($/acre) |
| Dry beans | $3.00 | $2.10 | $3.10 | $8.20 |
| Bean seed | 3.00 | 2.40 | 3.10 | 8.50 |
| Corn seed | 3.00 | 2.10 | 2.30 | 7.40 |
| Sugarbeets | 3.00 | 3.00 | 3.40 | 9.40 |
| Potatoes | 3.00 | 3.60 | 0 | 6.60 |
| Peas | 3.00 | 1.50 | 1.50 | 6.00 |
| Winter wheat | 3.00 | 1.50 | 1.50 | 6.00 |
| Spring wheat | 3.00 | 1.20 | 1.50 | 5.70 |
| Alfalfa hay | 3.00 | 1.80 | 1.50 | 6.30 |

Table 17. Costs of owning and operating a side-roll sprinkler system, relative to sediment retention.

| Crop | No. of irrigations | Power and repair | Depreciation and interest | Labor cost savings | Net annual cost | Sediment retained | Cost of sediment retained |
|---|---|---|---|---|---|---|---|
| | ($/acre) | ($/acre) | ($/acre) | ($/acre) | ($/acre) | (tons/acre) | ($/ton) |
| Dry beans | 7 | $17.50 | $28.00 | $8.20 | $37.30 | 3.6 | $10.40 |
| Bean seed | 8 | 20.00 | 28.00 | 8.50 | 39.50 | 3.6 | 11.00 |
| Corn seed | 7 | 17.50 | 28.00 | 7.40 | 38.10 | 3.6 | 10.60 |
| Sugarbeets | 10 | 25.00 | 28.00 | 9.40 | 43.60 | 3.6 | 12.10 |
| Potatoes | 12 | 30.00 | 28.00 | 6.60 | 51.40 | 18.0 | 2.90 |
| Peas | 5 | 12.50 | 28.00 | 6.00 | 34.50 | 1.4 | 24.60 |
| Winter wheat | 5 | 12.50 | 28.00 | 6.00 | 34.50 | 1.4 | 24.60 |
| Spring wheat | 4 | 10.00 | 28.00 | 5.70 | 32.30 | 1.4 | 23.10 |
| Alfalfa hay | 6 | 15.00 | 28.00 | 6.30 | 36.70 | 0.4 | 91.80 |

Table 18. Cost per acre summary for selected sediment loss control practices.

| Crop | Sediment pond | Vegetative strip | Mini-basins | Flow cut-back | Side-roll sprinkler |
|---|---|---|---|---|---|
| | | ($ per acre) | | | |
| Dry beans | $ 3.18 | $2.90 | $ 8.05 | $ 8.40 | $37.30 |
| Bean seed | 3.50 | 4.18 | 9.33 | 9.60 | 39.50 |
| Corn seed | 3.32 | 3.42 | 9.32 | 8.40 | 38.10 |
| Sugarbeets | 3.34 | 3.52 | 8.67 | 12.00 | 43.60 |
| Potatoes | 16.34 | – | 10.32 | 14.40 | 51.40 |
| Pea seed | 1.33 | 1.09 | 5.72 | 6.00 | 54.50 |
| Winter wheat | 1.22 | 0.86 | 4.94 | 6.00 | 54.50 |
| Spring wheat | 1.20 | 0.86 | 4.76 | 4.80 | 32.30 |
| Alfalfa | 0.42 | – | 2.96 | 7.20 | 36.70 |

Table 19. Cost effectiveness summary for selected sediment loss control practices.

| Crop | Sediment pond | Vegetative strip | Mini-basins | Flow cut-back | Side-roll sprinklers |
|---|---|---|---|---|---|
| | | ($ per ton of sediment retained) | | | |
| Dry beans | $1.30 | $1.60 | $2.50 | $ 7.60 | $10.40 |
| Bean seed | 1.50 | 2.30 | 2.90 | 8.70 | 11.00 |
| Corn seed | 1.40 | 1.90 | 2.90 | 7.60 | 10.60 |
| Sugarbeets | 1.40 | 2.00 | 2.70 | 10.90 | 12.10 |
| Potatoes | 1.40 | – | 2.30 | 2.70 | 2.90 |
| Pea seed | 1.40 | 1.60 | 4.50 | 15.00 | 24.60 |
| Winter wheat | 1.30 | 1.20 | 3.90 | 15.00 | 24.60 |
| Spring wheat | 1.30 | 1.20 | 3.80 | 12.00 | 23.10 |
| Alfalfa | 1.60 | – | 8.20 | 72.00 | 91.80 |

# Farm Income Implications of Sediment Loss Reduction

The costs of employing practices such as those considered in this study to reduce sediment losses from irrigated fields can also be discussed in terms of their effects on farm income. In this section, the farm models are used to describe how sediment loss control would affect the net returns to land and management (used as a measure of net farm income) on representative farms in each study area.

## Small Farm Models

Relationships between level of sediment loss and net returns to land and management for the small models are presented in Figs. 1, 2, 3 and 4. Points A and E in each of these figures correspond to the sediment loss control practices on that particular farm model. The points represent data given in Tables 20, 21, 22 and 23 for the basic crop rotation (first row of data for each practice). The sediment loss and net returns to land and management with typical current management practices and crop mixes are shown as point A in each figure. Adjustments to a sediment loss constraint at some level lower than point A are different for each farm model and are described in the following paragraphs.

The cost curves presented in Figs. 1, 2, 3 and 4 (right ordinate) show the annual cost of sediment loss control for each farm model. In this case, points A through E represent the reductions in net returns to land and management resulting from the use of the corresponding sediment loss control practices.

The data in each table indicate what happens to the net returns to land and management as the crop mix is adjusted to meet a sediment loss constraint. Each case assumes that no land is retired from irrigated crop production. Two of the small farm models include a grain crop on which a vegetative strip could be used instead of a sediment pond to control losses. On grain, vegetative strips are more cost effective than sediment ponds even though they do not remove as much sediment. Since we assumed there would be no runoff or sediment loss from sprinkler-irrigated fields, the crop mix need not be changed for sprinklers.

### *Twin Falls Area*

The total sediment loss from the small farm model for the Twin Falls area with present management practices is 330 tons (Table 20). This corresponds to point A in Fig. 1. If a sediment loss limit were set at a level between points A and C, the farm operator's most efficient response (from a sediment loss control standpoint) would be to put in enough sediment ponds to meet the constraint. All fields would have sediment ponds at point C.

If sediment loss were to be limited to a level between points C and D, the farmer would have to use sediment ponds on some fields and mini-basins on others. At point D, all fields would have mini-basins.

A sediment loss constraint set below 30 tons (point D) would cause some crop mix adjustment. For example, changing the crop mix to include only alfalfa hay would reduce sediment loss to 6 tons for the mini-basin control practice (see Table 20). To reduce sediment loss below about 20 tons, the least-cost method would be to convert the farm to sprinkler irrigation and go back to the original crop mix.

**Table 20. Crop mix, sediment loss and returns to land and management data for alternative control practices, Twin Falls small farm model.**

| Control practice | Crop mix (acres) Dry beans | Bean seed | Pea seed | Alfalfa hay | Sediment loss | Returns to land and management |
|---|---|---|---|---|---|---|
| | | | | | (tons) | |
| No sediment control | 20 | 60 | 20 | 40 | 330 | $38,400 |
| | | 60 | 20 | 60 | 270 | 38,000 |
| | | | 20 | 120 | 75 | 18,700 |
| | | | | 140 | 55 | 16,200 |
| Vegetative strips | 20 | 60 | 20 | 40 | 175 | 38,100 |
| | | 60 | 20 | 60 | 145 | 36,800 |
| | | | 20 | 120 | 60 | 18,600 |
| | | | | 140 | 55 | 16,200 |
| Sediment ponds | 20 | 60 | 20 | 40 | 110 | 38,100 |
| | | 60 | 20 | 60 | 90 | 36,800 |
| | | | 20 | 120 | 25 | 18,600 |
| | | | | 140 | 18 | 16,200 |
| Mini-basins | 20 | 60 | 20 | 40 | 30 | 37,500 |
| | | 60 | 20 | 60 | 25 | 36,200 |
| | | | 20 | 120 | 8 | 18,200 |
| | | | | 140 | 6 | 15,800 |
| Sprinklers | 20 | 60 | 20 | 40 | 0 | 33,100 |

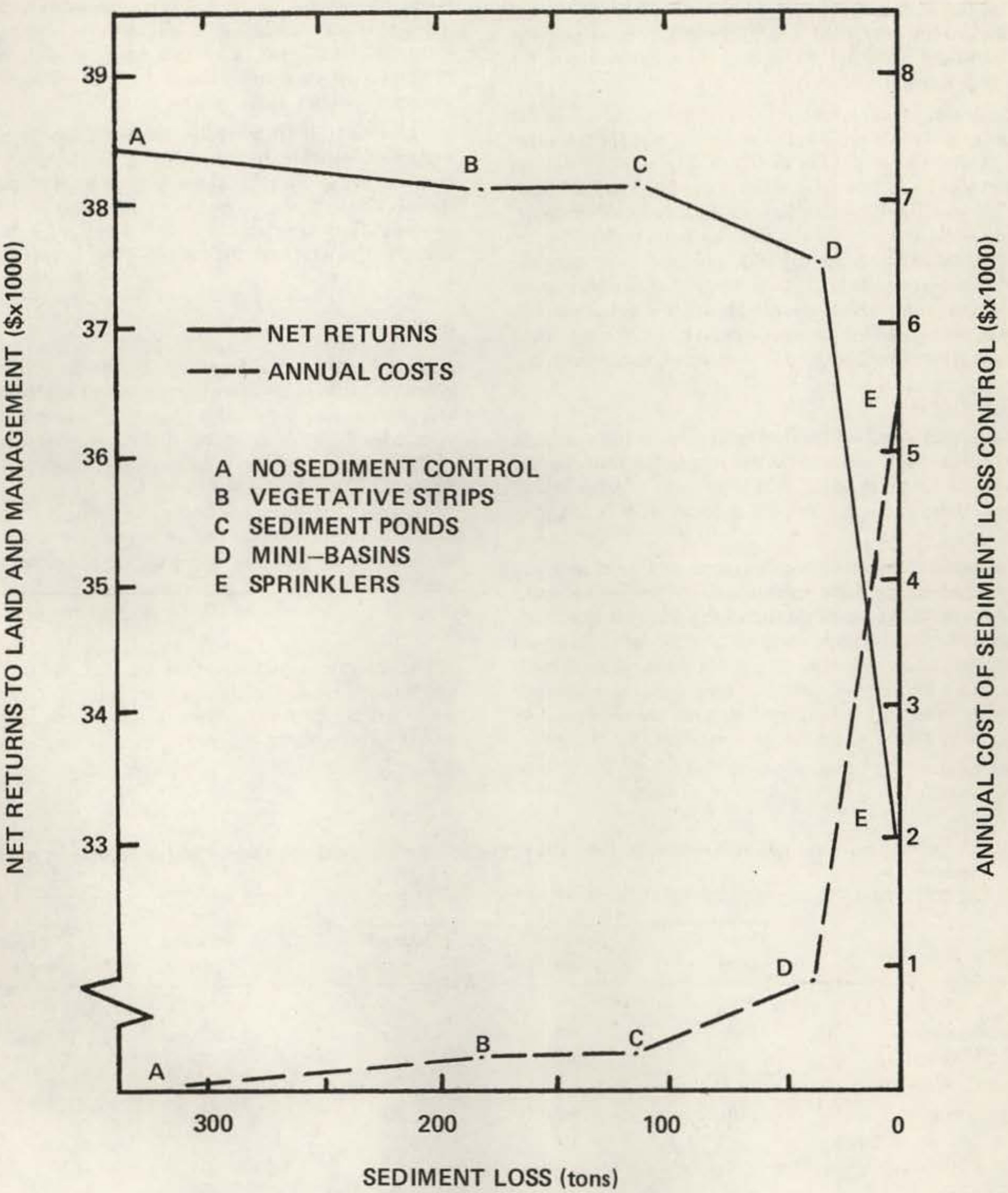


**Fig. 1. Returns to land and management and costs associated with different levels of sediment loss, Twin Falls small farm model.**

Each of the farm models assumed that conversion to sprinklers would not be gradual; that is, that either none of the fields would be sprinkler irrigated or all of them would be.

Assumptions regarding the crop mix affect the results obtained for each farm model. In this case, the maximum area allowed for bean seed was 60 acres. The maximum for pea seed would be 20 acres and that the minimum area for alfalfa hay would be 40 acres.

The annual cost of sediment loss control (reduction in net farm income) versus the level of sediment loss for this farm model is shown as a cost curve in Fig. 1. The annual sediment loss from this farm model could be reduced from about 330 to 110 tons at a rather modest cost ($300 per year) by using sediment ponds. It could be reduced by 90% by using mini-basins at a cost of $900 per year. Reducing the annual loss below about 20 tons would require the use of sprinkler irrigation which would be quite costly. In this case, the use of side-roll systems would reduce the return to land and management by $5,300 per year or about 14%.

## Jerome Area

The data in Table 21 show that farm income and sediment loss values for the Jerome farm model are less than for the Twin Falls farm model. With present management practices, sediment loss from the Jerome farm is 225 tons (point A, in Fig. 2).

If a sediment loss constraint were set at a level between points A and C, the farm operator could put in sediment ponds (or vegetative strips on the spring wheat) to meet the constraint. Sediment ponds would have to be used on all fields to meet a limit of 75 tons (point C). To meet a sediment loss limit set between C and D, some fields would have sediment ponds and others would have mini-basins. At point D, all fields would have mini-basins.

A sediment loss limit set below 22 tons (point D) would cause some crop mix adjustment, or force a conversion to sprinklers. Sediment loss could be reduced to 6 tons if the only crop is alfalfa grown with mini-basins. Further reductions in sediment loss might be attained by retiring land from production, but the farm operator would be more likely to install sprinklers or sell his farm (depending on his financial situation). For this farm model, beans were constrained to a maximum area of 40 acres and the minimum alfalfa areas was 60 acres.

The reduction in farm income associated with sediment loss control for the Jerome farm model is shown by the cost curve in Fig. 2. Starting at the present level of sediment loss (point A), the first increments of reduction have a relatively low cost. Reducing the loss to less that 6 tons would imply a reduction in net farm income of $5,000, a decrease of about 27%.

## Wilder-Parma Area

Data for the small farm for the Wilder-Parma area are given in Table 22. Potatoes are included in the crop mix for this model. Since the large volume of sediment loss from potato fields would probably fill mini-basins before the end of the irrigation season, a relatively low sediment retention efficiency (25%) was assumed for mini-basins with potatoes. As a result, sediment loss for the mini-basin practice is greater than the loss for sediment ponds when potatoes are included in the rotation. The loss when sediment ponds are used for potatoes and mini-basins are used for the other crops (beets, wheat and alfalfa) is shown as point D' in Fig. 3.

The unconstrained sediment loss for this farm model is 930 tons (point A, Fig. 3). If a sediment loss constraint were set at a level between points A and C, the farm operator would have to put in sediment ponds (or vegetative strips on

**Table 21. Crop mix, sediment loss and returns to land and management data for alternative control practices, Jerome small farm model.**

| Control practice | Crop mix (acres) Dry beans | Spring wheat | Alfalfa hay | Sediment loss | Returns to land land management |
|---|---|---|---|---|---|
| | | | | (tons) | |
| No sediment control | 40 | 40 | 60 | 225 | $18,400 |
| | | 80 | 60 | 135 | 17,300 |
| | | | 140 | 55 | 14,700 |
| Vegetative strips | 40 | 40 | 60 | 125 | 18,200 |
| | | 80 | 60 | 80 | 17,200 |
| | | | 140 | 55 | 14,700 |
| Sediment ponds | 40 | 40 | 60 | 75 | 18,200 |
| | | 80 | 60 | 45 | 17,200 |
| | | | 140 | 19 | 14,700 |
| Mini-basins | 40 | 40 | 60 | 22 | 17,700 |
| | | 80 | 60 | 14 | 16,700 |
| | | | 140 | 6 | 14,300 |
| Sprinklers | 40 | 40 | 60 | 0 | 13,400 |

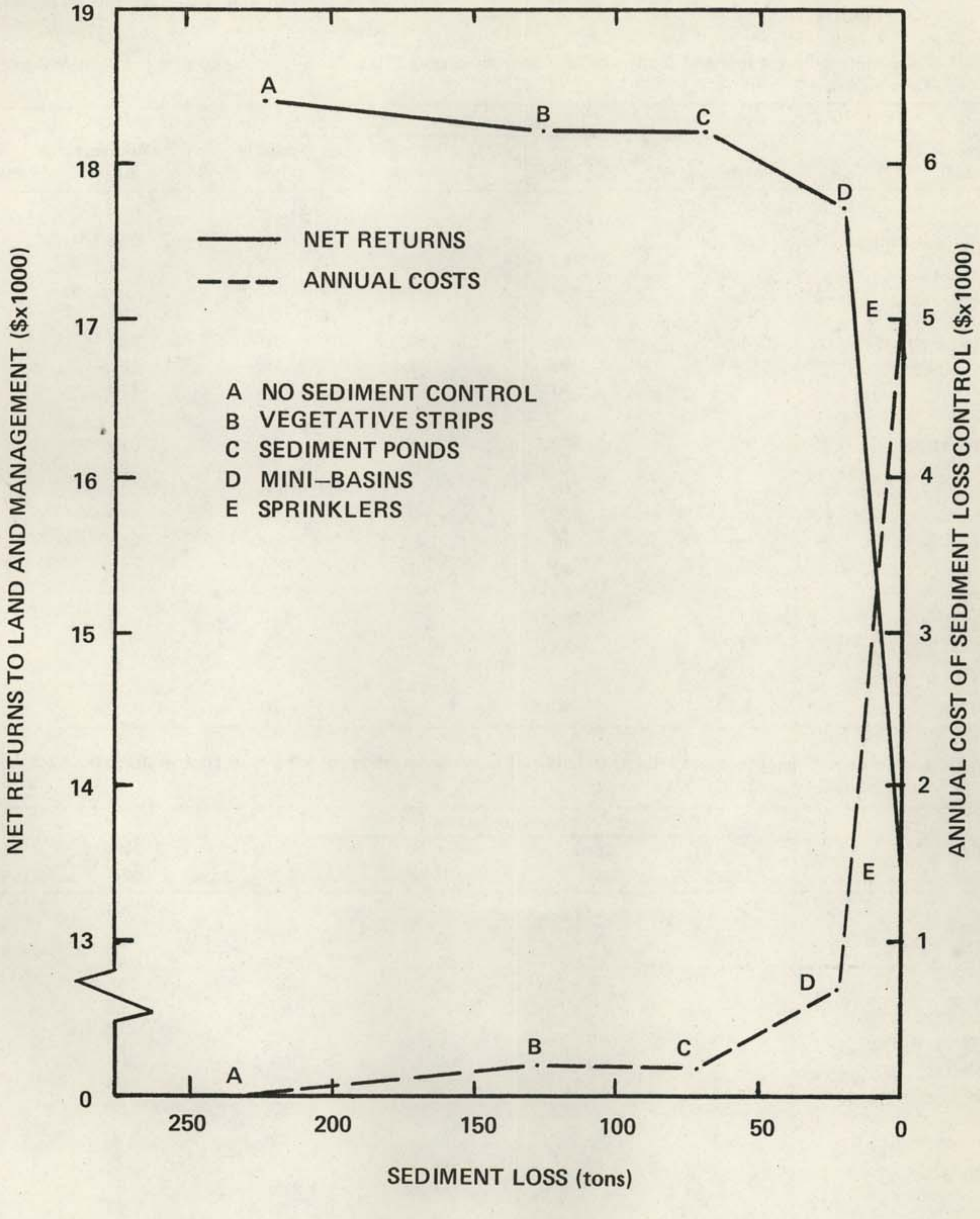


Fig. 2. Returns to land and management and costs associated with different levels of sediment loss, Jerome small farm model.

wheat) to comply. Sediment ponds would have to be installed on all fields to meet a limit of 310 tons (point D). To meet a sediment loss limit between D and D′, some fields would have mini-basins and some (including all of the potato fields) would have sediment ponds. At point D′, all fields except the potato fields would have mini-basins.

A sediment loss limit below 260 tons (point D′) would cause the farmer to change the crop mix. If the farmer had to

**Table 22. Crop mix, sediment loss and returns to land and management data for alternative control practices, Wilder-Parma small farm model.**

| Control practice | Crop mix (acres) Potatoes | Sugarbeets | Winter wheat | Alfalfa hay | Sediment loss | Returns to land and management |
|---|---|---|---|---|---|---|
| | | | | | (tons) | |
| No sediment control | 40 | 40 | 40 | 20 | 930 | $41,900 |
| | | 40 | 80 | 20 | 265 | 27,800 |
| | | 40 | | 100 | 185 | 24,500 |
| | | | | 140 | 55 | 14,600 |
| Vegetative strips | 40 | 40 | 40 | 20 | 830 | 41,700 |
| | | 40 | 80 | 20 | 135 | 27,600 |
| | | 40 | | 100 | 110 | 24,300 |
| | | | | 140 | 55 | 14,600 |
| Sediment ponds | 40 | 40 | 40 | 20 | 310 | 40,900 |
| | | 40 | 80 | 20 | 90 | 27,500 |
| | | 40 | | 100 | 60 | 24,300 |
| | | | | 140 | 19 | 14,600 |
| Mini-basins | 40 | 40 | 40 | 20 | 560 | 40,900 |
| | | 40 | 80 | 20 | 25 | 27,000 |
| | | 40 | | 100 | 18 | 23,800 |
| | | | | 140 | 6 | 14,200 |
| Ponds for potatoes, basins for others | 40 | 40 | 40 | 20 | 260 | 40,800 |
| Sprinklers | 40 | 40 | 40 | 20 | 0 | 35,900 |

**Table 23. Crop mix, sediment loss and returns to land and management data for alternative control practices, Nampa-Melba small farm model.**

| Control practice | Crop mix (acres) Dry beans | Corn seed | Sugarbeets | Alfalfa hay | Sediment loss | Returns to land and management |
|---|---|---|---|---|---|---|
| | | | | | (tons) | |
| No sediment control | 40 | 40 | 60 | 20 | 510 | $41,300 |
| | | 40 | 60 | 60 | 385 | 39,300 |
| | | | 60 | 100 | 255 | 30,900 |
| | | | | 160 | 65 | 16,700 |
| Vegetative strips | 40 | 40 | 60 | 20 | 260 | 40,900 |
| | | 40 | 60 | 60 | 205 | 38,900 |
| | | | 60 | 100 | 150 | 30,700 |
| | | | | 160 | 65 | 16,700 |
| Sediment ponds | 40 | 40 | 60 | 20 | 170 | 40,900 |
| | | 40 | 60 | 60 | 128 | 39,000 |
| | | | 60 | 100 | 85 | 30,700 |
| | | | | 160 | 21 | 16,700 |
| Mini-basins | 40 | 40 | 60 | 20 | 50 | 40,000 |
| | | 40 | 60 | 60 | 40 | 38,200 |
| | | | 60 | 100 | 25 | 30,100 |
| | | | | 160 | 6 | 16,300 |
| Sprinklers | 16.2 | 16.2 | 24.3 | 8.1 | 0 | 35,000 |

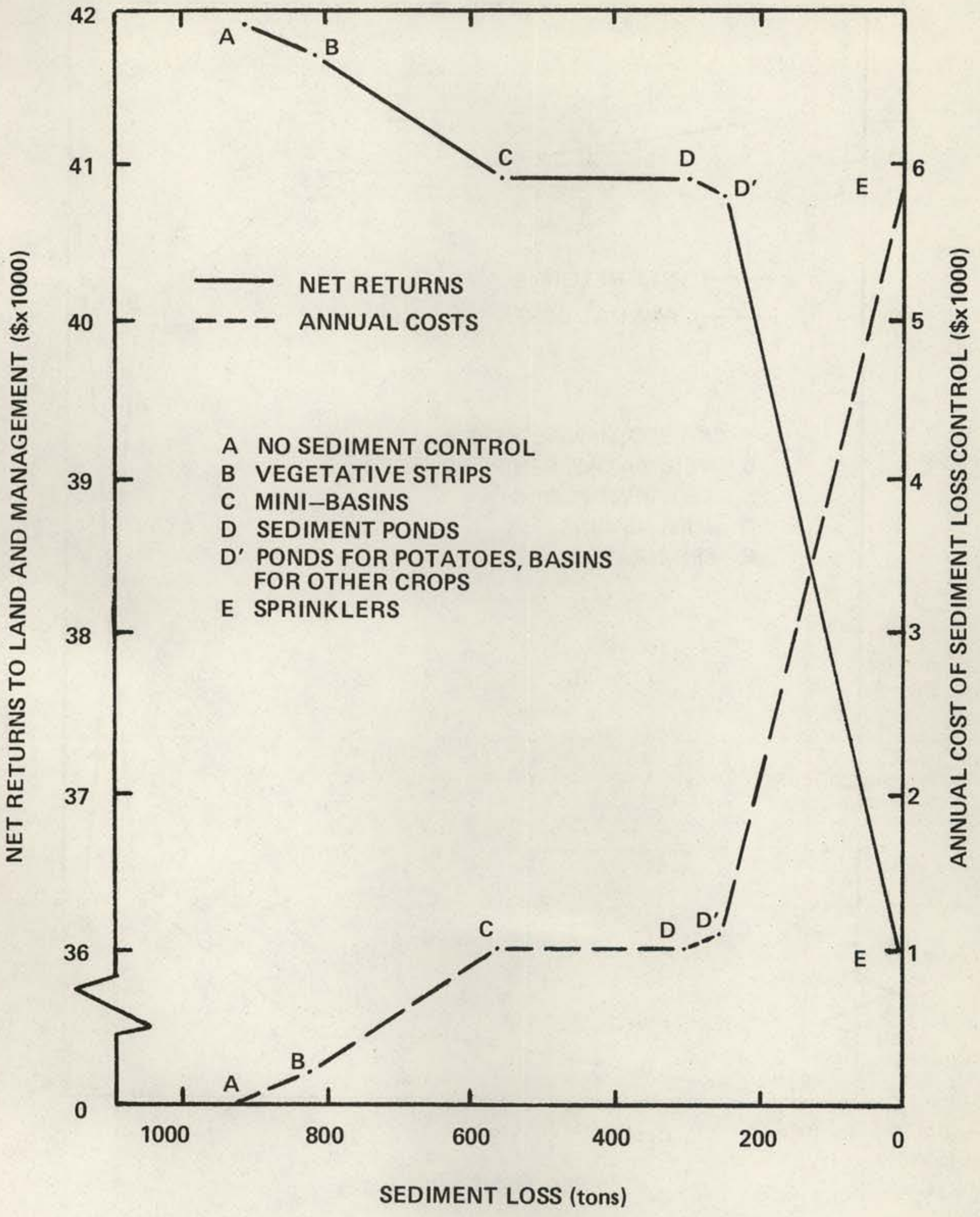


Fig. 3. Returns to land and management and costs associated with different levels of sediment loss, Wilder-Parma small farm model.

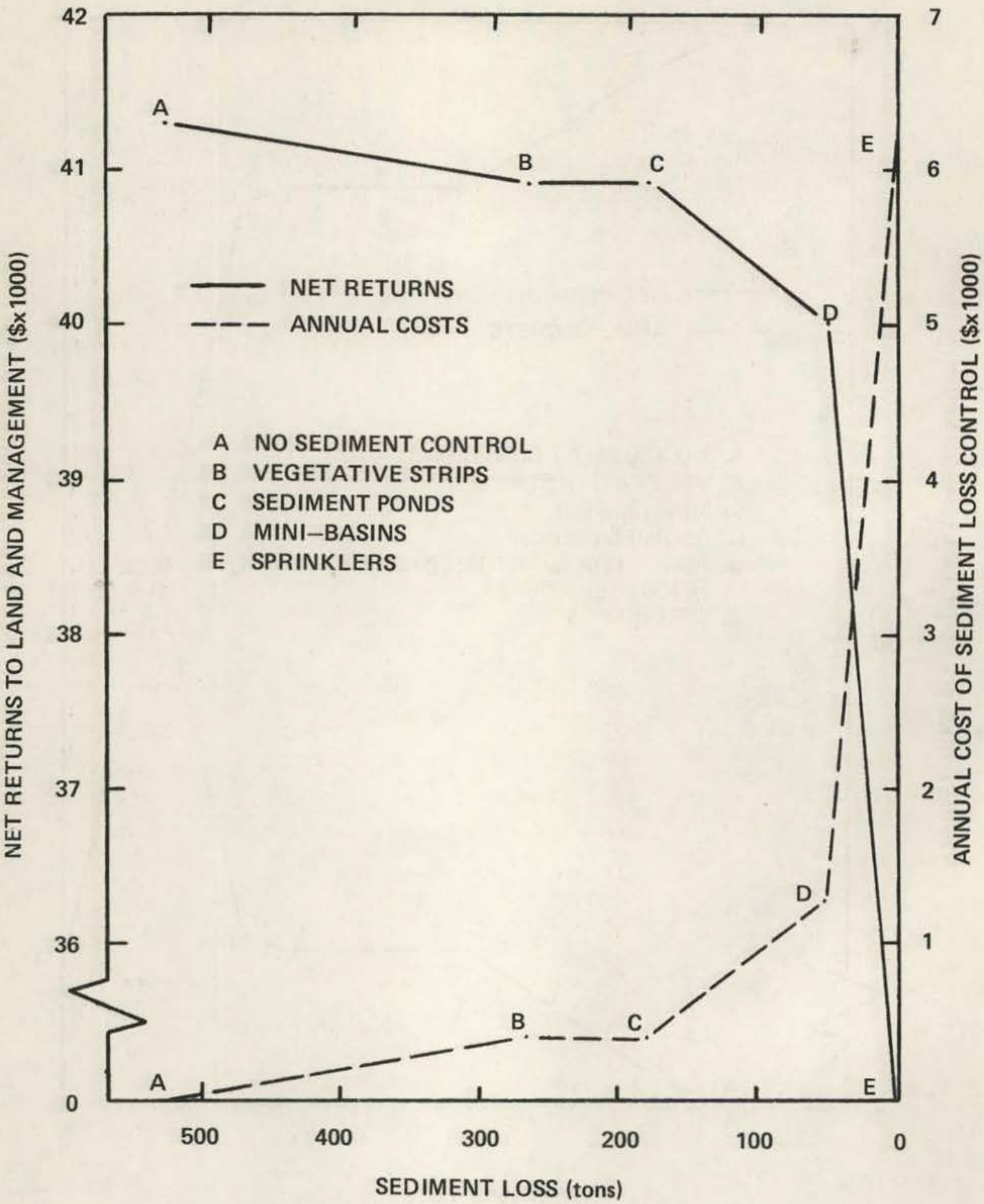


Fig. 4. Returns to land and management and costs associated with different levels of sediment loss, Nampa-Melba small farm model.

reduce sediment loss below about 175 tons, the least-cost alternative would be to install sprinklers and go back to the original crop mix. For this farm model, beets and potatoes were constrained to a maximum area of 40 acres each and the minimum alfalfa area was 20 acres.

The cost of sediment loss control for this farm model is also shown in Fig. 3. The cost of reducing the loss to about 28% of its present level would be $1,100, about 2.5% of the present return to land and management. It would cost the farm operator $6,000 per year to reduce the loss to less than 175 tons through the use of sprinklers. This would result in a 15% reduction in the net farm income.

### *Nampa-Melba Area*

The crop mix and other data for the small farm model for the Nampa-Melba area are given in Table 23. Although different crops are involved, the graphs of farm income and sediment control costs for this farm model (Fig. 4) are similar to those for the Twin Falls model. The unconstrained sediment loss for this model is 510 tons (point A in Fig. 4). The farm operator would have to use sediment ponds to meet a sediment loss constraint of 170 tons (point C) and would have to use mini-basins if the constraint were set between 170 and 50 tons (point D).

To meet a sediment loss constraint set between points D and E, the farm operator could adjust his crop mix. Substituting alfalfa with mini-basins for the other crops would reduce the sediment loss to less than 50 tons for this farm model. If the sediment loss limit were set below about 33 tons, the farm operator's least-cost alternative would be to convert to sprinkler irrigation and go back to his original crop mix. For this model, sugarbeets and seed corn were constrained to maximum areas of 60 and 40 acres respectively. The minimum alfalfa area was set at 20 acres.

Reducing the sediment loss from this farm model to less than 30 tons would require the use of sprinkler irrigation. This would result in a 15% or $6,300 reduction in net farm income.

## Large Farm Models

Data for the four large farm models considered in this study are presented in Tables 24, 25, 26 and 27. The points in Figs. 5, 6, 7 and 8 correspond to the same sediment control practices or devices used on small farm models. Each of the large farm models includes a grain crop on which a vegetative strip could be used to effectively control some of the sediment loss.

### *Twin Falls Area*

Crop mix, sediment loss and returns to land and management data for the large farm model for the Twin Falls area are presented in Table 24. The total sediment loss from the farm with present management practices is 675 tons. This loss corresponds to point A in Fig. 5. If a sediment loss limit were set at a level between points A and C, the farm operator's most efficient response would be to use sediment ponds to meet the constraint. Mini-basins would have to be used if the limit were set between points C and D.

**Table 24. Crop mix, sediment loss and returns to land and management data for alternative control practices, Twin Falls large farm model.**

| Control practice | Crop mix (acres) Spring wheat | Dry beans | Bean seed | Pea seed | Alfalfa hay | Sediment loss | Returns to land and management |
|---|---|---|---|---|---|---|---|
| | | | | | | (tons) | |
| No sediment control | 60 | 60 | 80 | 40 | 80 | 675 | $70,500 |
| | | 60 | 80 | 40 | 140 | 615 | 69,500 |
| | | | 80 | 40 | 200 | 425 | 65,500 |
| | | | | 40 | 280 | 170 | 40,900 |
| | | | | | 320 | 130 | 36,100 |
| Vegetative strips | 60 | 60 | 80 | 40 | 80 | 355 | 69,900 |
| | | 60 | 80 | 40 | 140 | 335 | 68,900 |
| | | | 80 | 40 | 200 | 252 | 65,100 |
| | | | | 40 | 280 | 140 | 40,900 |
| | | | | | 320 | 130 | 36,100 |
| Sediment ponds | 60 | 60 | 80 | 40 | 80 | 225 | 69,900 |
| | | 60 | 80 | 40 | 140 | 205 | 68,900 |
| | | | 80 | 40 | 200 | 140 | 65,100 |
| | | | | 40 | 280 | 55 | 40,700 |
| | | | | | 320 | 45 | 36,000 |
| Mini-basins | 60 | 60 | 80 | 40 | 80 | 70 | 68,600 |
| | | 60 | 80 | 40 | 140 | 60 | 67,600 |
| | | | 80 | 40 | 200 | 40 | 63,900 |
| | | | | 40 | 280 | 17 | 39,900 |
| | | | | | 320 | 13 | 35,200 |
| Sprinklers | 60 | 60 | 80 | 40 | 80 | 0 | 58,800 |

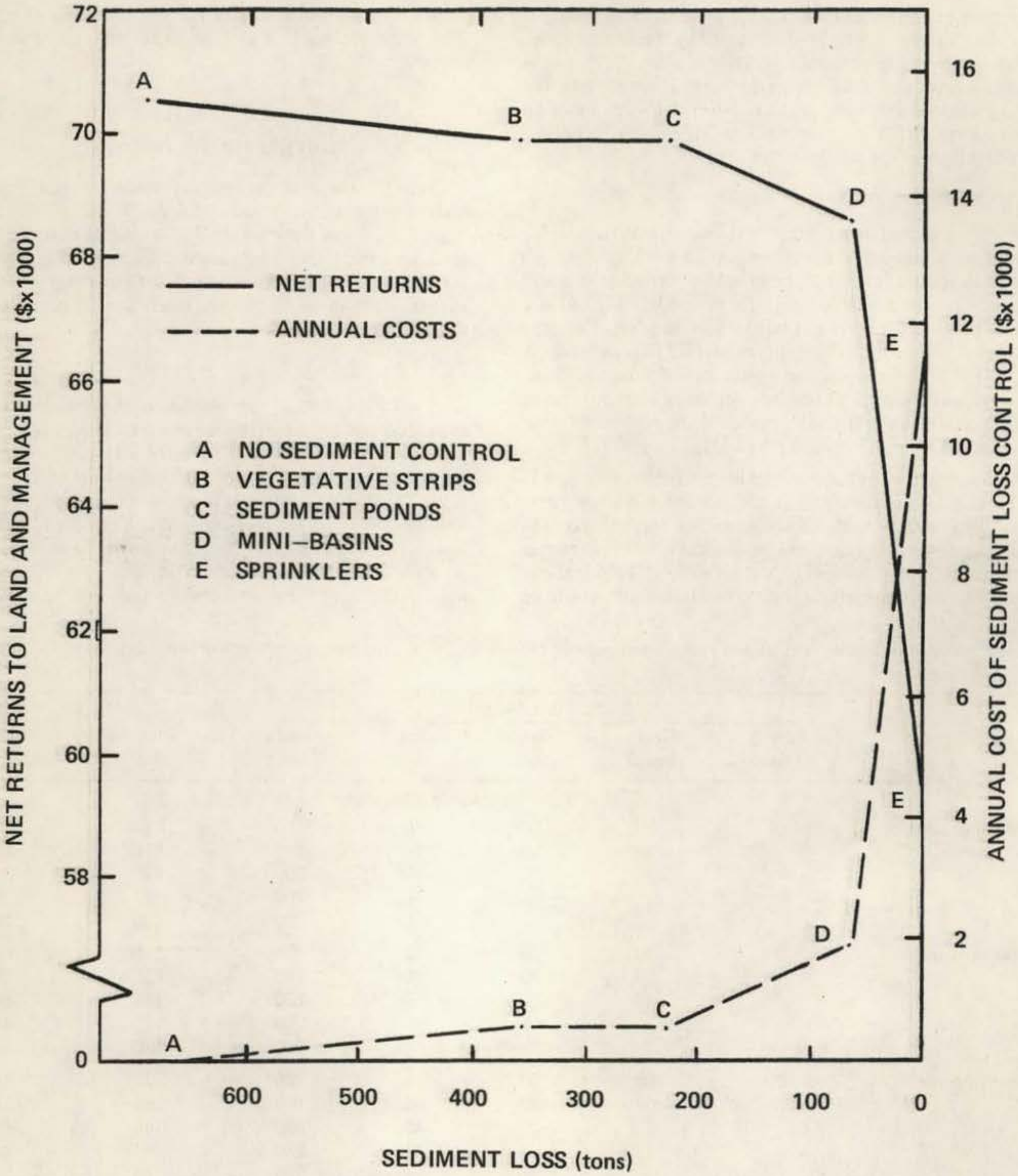


Fig. 5. Returns to land and management and costs associated with different levels of sediment loss, Twin Falls large farm model.

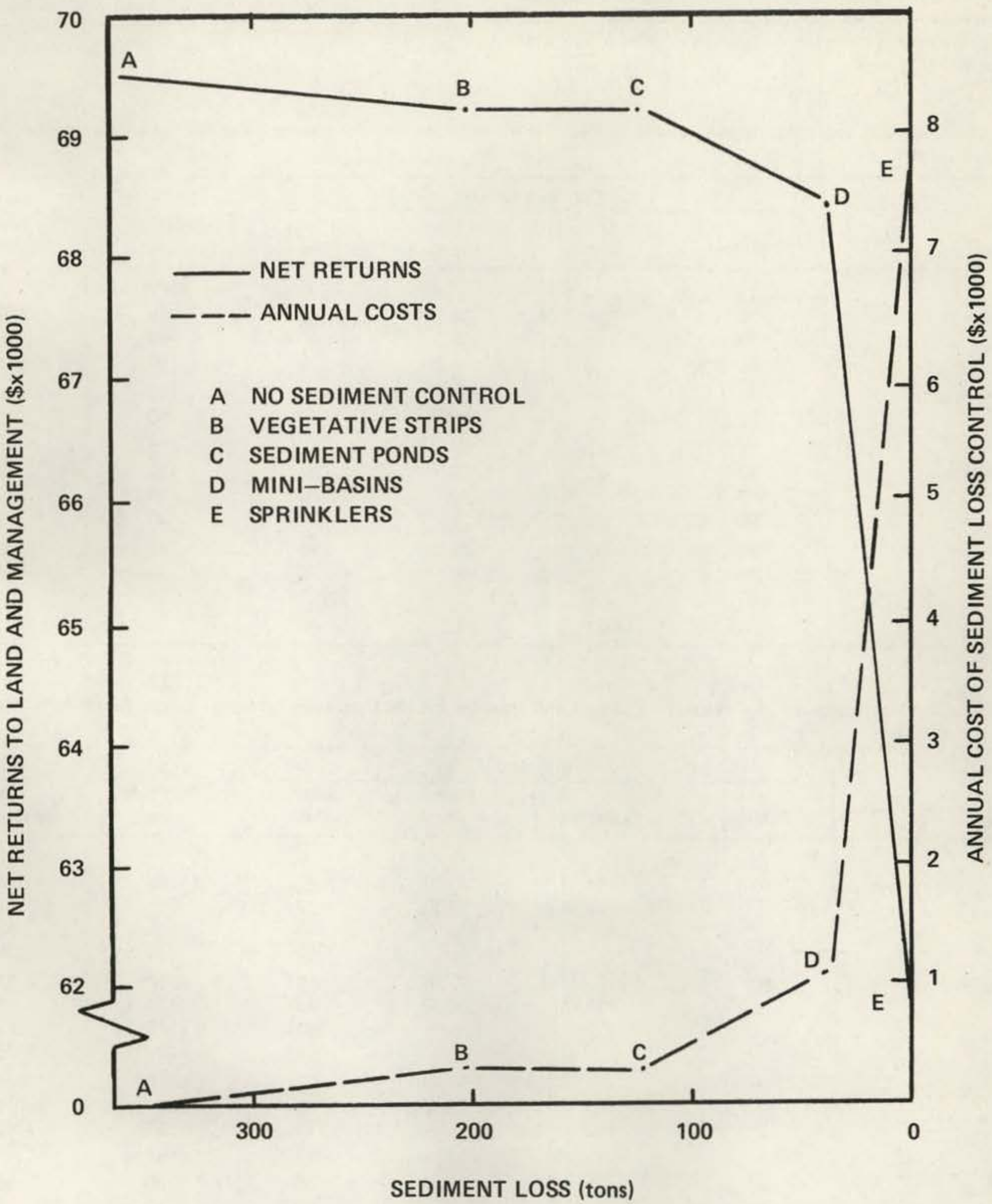


**Fig. 6. Returns to land and management and costs associated with different levels of sediment loss, Jerome large farm model.**

A sediment loss constraint set below 70 tons (point D) would cause some crop mix adjustments. Alfalfa would have to be substituted for wheat to reduce the loss to 60 tons, for dry beans to reduce the loss to 40 tons and for bean seed to reduce it to 17 tons. To reduce the loss below about 35 tons, sprinkler irrigation would have to be used along with the original crop mix.

For this farm model, pea seed was constrained to a maximum area of 40 acres, bean seed to 80 acres and dry beans to 60 acres. Minimum alfalfa area was 80 acres.

The reduction in returns to land and management associated with sediment loss control for this farm model is shown by the cost curve in Fig. 5. The first increments of

**Table 25. Crop mix, sediment loss and returns to land and management data for alternative control practices, Jerome large farm model.**

| Control practice | Crop mix (acres) Potatoes | Dry beans | Spring wheat | Alfalfa hay | Sediment loss | Returns to land and management |
|---|---|---|---|---|---|---|
| | | | | | (tons) | |
| No sediment control | 80 | 60 | 80 | 80 | 360 | $69,500 |
| | 80 | | 140 | 80 | 230 | 67,600 |
| | 80 | | | 220 | 90 | 61,700 |
| Vegetative strips | 80 | 60 | 80 | 80 | 195 | 69,200 |
| | 80 | | 140 | 80 | 130 | 67,500 |
| | 80 | | | 220 | 90 | 61,700 |
| Sediment ponds | 80 | 60 | 80 | 80 | 120 | 69,200 |
| | 80 | | 140 | 80 | 75 | 67,400 |
| | 80 | | | 220 | 30 | 61,600 |
| Mini-basins | 80 | 60 | 80 | 80 | 35 | 68,400 |
| | 80 | | 140 | 80 | 23 | 66,700 |
| | 80 | | | 220 | 9 | 61,000 |
| Sprinklers | 80 | 60 | 80 | 80 | 0 | 61,700 |

**Table 26. Crop mix, sediment loss and returns to land and management for alternative control practices, Wilder-Parma large farm model.**

| Control practice | Crop mix (acres) Potatoes | Sugarbeets | Winter wheat | Alfalfa hay | Sediment loss | Returns to land and management |
|---|---|---|---|---|---|---|
| | | | | | (tons) | |
| No sediment control | 80 | 100 | 80 | 80 | 1950 | $98,300 |
| | | 100 | 160 | 80 | 615 | 71,300 |
| | | 100 | | 240 | 455 | 62,700 |
| | | | | 340 | 135 | 36,900 |
| Vegetative strips | 80 | 100 | 80 | 80 | 1710 | 97,900 |
| | | 100 | 160 | 80 | 324 | 70,800 |
| | | | | 240 | 275 | 62,400 |
| | | | | 340 | 135 | 36,900 |
| Sediment ponds | 80 | 100 | 80 | 80 | 650 | 96,200 |
| | | 100 | 160 | 80 | 205 | 70,800 |
| | | 100 | | 240 | 150 | 62,400 |
| | | | | 340 | 45 | 36,800 |
| Mini-basins | 80 | 100 | 80 | 80 | 1130 | 95,900 |
| | | 100 | 160 | 80 | 60 | 69,400 |
| | | 100 | | 240 | 45 | 61,200 |
| | | | | 340 | 14 | 35,900 |
| Ponds for potatoes, basins for others | 80 | 100 | 80 | 80 | 530 | 95,200 |
| Sprinklers | 80 | 100 | 80 | 80 | 0 | 84,100 |

sediment loss reduction are rather inexpensive. For example, the loss can be reduced to about one-third its present level at a cost of $600 per year. However, reducing the sediment loss to less than about 38 tons would involve a reduction in net farm income of $11,700 or 17%.

## Jerome Area

Data for the large farm model for the Jerome area are presented in Table 25. Under present management practices, 80 acres of sprinkler-irrigated potatoes are included in the crop mix. The other crops are surface irrigated.

The sediment loss from this farm under present conditions is 360 tons (point A, Fig. 6). Adoption of sediment ponds would reduce the loss to 120 tons (point C). The use of mini-basins would reduce it to 35 tons (point D). The crop mix would have to be changed to reduce the loss below 35 tons. Sprinkler irrigation would have to be used along with the original crop mix to reduce the loss to less than about 10 tons.

For this model, potatoes were limited to a maximum area of 80 acres and beans to 60 acres. A minimum alfalfa area of 80 acres was also used.

The costs of sediment loss control for this model are shown in Fig. 6. These costs are low relative to the costs shown for the other farm models because part of the farm is already sprinkler irrigated. Elimination of sediment loss would cost $7,800 per year or 11% of the present net returns to land and management.

## Wilder-Parma Area

Crop mix and other data for the Wilder-Parma area are given in Table 26. The crop mix for this model is almost the same as the mix for the small farm model for this area. Relationships between farm income and sediment loss control shown in Fig. 7 are also very similar to those for the small farm model. Again, point D′ represents the case where sediment ponds are used for potatoes and mini-basins are used for the other crops.

The sediment loss from this farm under current management practices is 1,950 tons (point A, Fig. 7). The use of sediment ponds would reduce this loss to 650 tons (point D). To meet a sediment loss constraint between points D and D′, some fields would have mini-basins and some (including all of the potato fields) would have sediment ponds. At point D′, all fields except the potato fields would have mini-basins. A sediment loss limit below 520 tons (point D′) could be met by substituting wheat for potatoes. A limit set below about 330 tons would require the installation of sprinklers and a return to the original crop mix (point E).

In this case, potatoes were constrained to a maximum area of 80 acres and sugarbeets were limited to 100 acres. The minimum area for alfalfa was 80 acres.

The costs of sediment loss control for this model are shown by the cost curve in Fig. 7. Sediment loss could be reduced to about 28% of its present level at a cost of $3,100 or about 3% of the present net returns to land and management by using ponds for potatoes and mini-basins for other crops. Reducing the loss below about 330 tons through the installation of sprinklers would reduce the returns by about 14%.

## Nampa-Melba Area

Data for the large farm model for the Nampa-Melba area are given in Table 27. This model differs from the others in that it includes no alfalfa. The lowest sediment yield, among the crops in the model, comes from wheat.

**Table 27. Crop mix, sediment loss and returns to land and management data for alternative control practices, Nampa-Melba large farm model.**

| Control practice | Crop mix (acres): Dry beans | Corn seed | Sugarbeets | Winter wheat | Sediment loss | Returns to land and management |
|---|---|---|---|---|---|---|
| | | | | | (tons) | |
| No sediment control | 60 | 60 | 140 | 60 | 1020 | $90,700 |
| | | 60 | 140 | 120 | 890 | 90,400 |
| | | | 140 | 180 | 755 | 79,700 |
| | | | | 320 | 450 | 51,800 |
| Vegetative strips | 60 | 60 | 140 | 60 | 510 | 89,800 |
| | | 60 | 140 | 120 | 445 | 89,600 |
| | | | 140 | 180 | 378 | 79,000 |
| | | | | 320 | 225 | 51,700 |
| Sediment ponds | 60 | 60 | 140 | 60 | 340 | 89,900 |
| | | 60 | 140 | 120 | 295 | 89,700 |
| | | | 140 | 180 | 250 | 79,000 |
| | | | | 320 | 150 | 51,500 |
| Mini-basins | 60 | 60 | 140 | 60 | 100 | 88,100 |
| | | 60 | 140 | 120 | 90 | 88,000 |
| | | | 140 | 180 | 75 | 77,600 |
| | | | | 320 | 45 | 50,300 |
| Sprinklers | 60 | 60 | 140 | 60 | 0 | 78,000 |

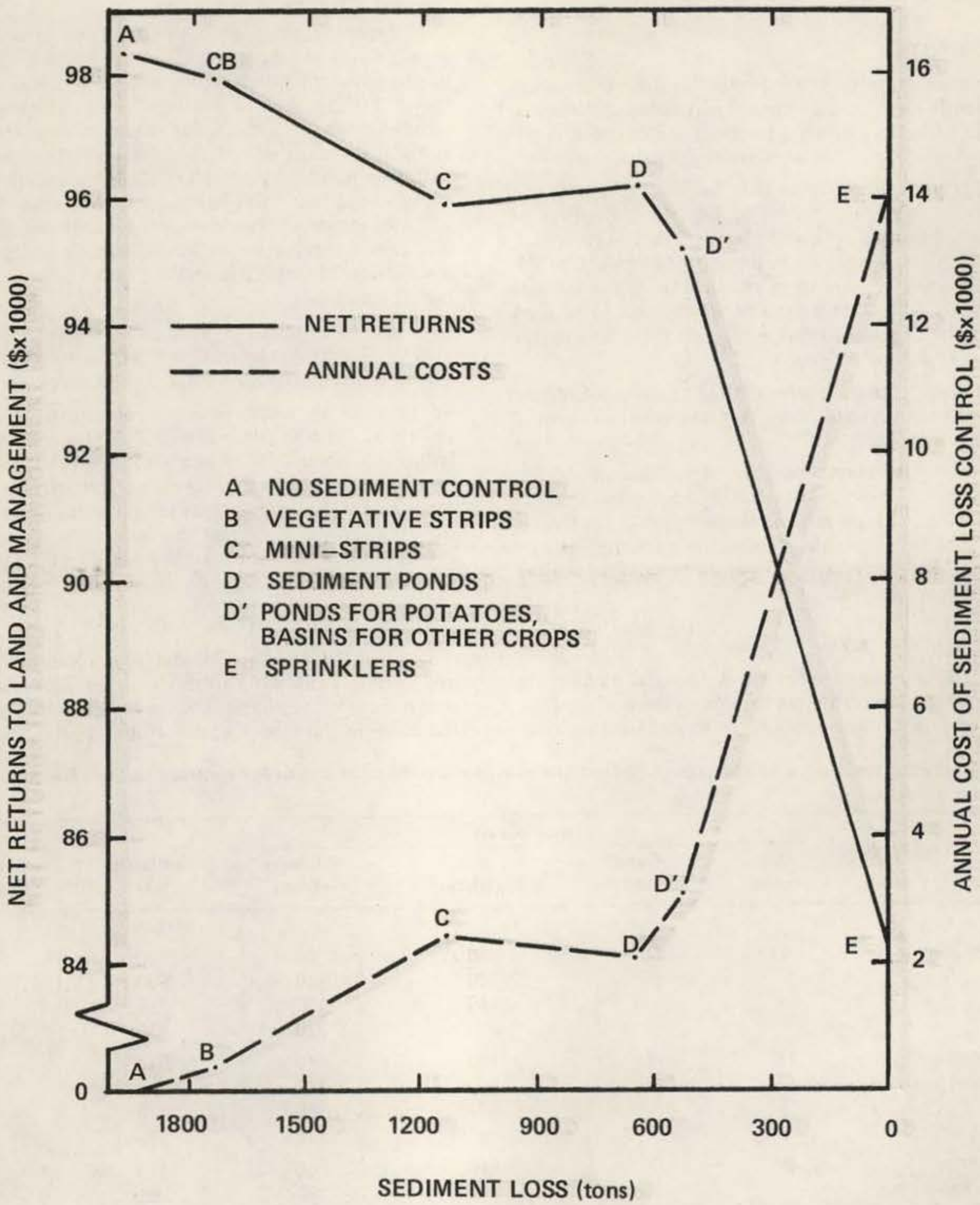


Fig. 7. Returns to land and management and costs associated with different levels of sediment loss, Wilder-Parma large farm model.

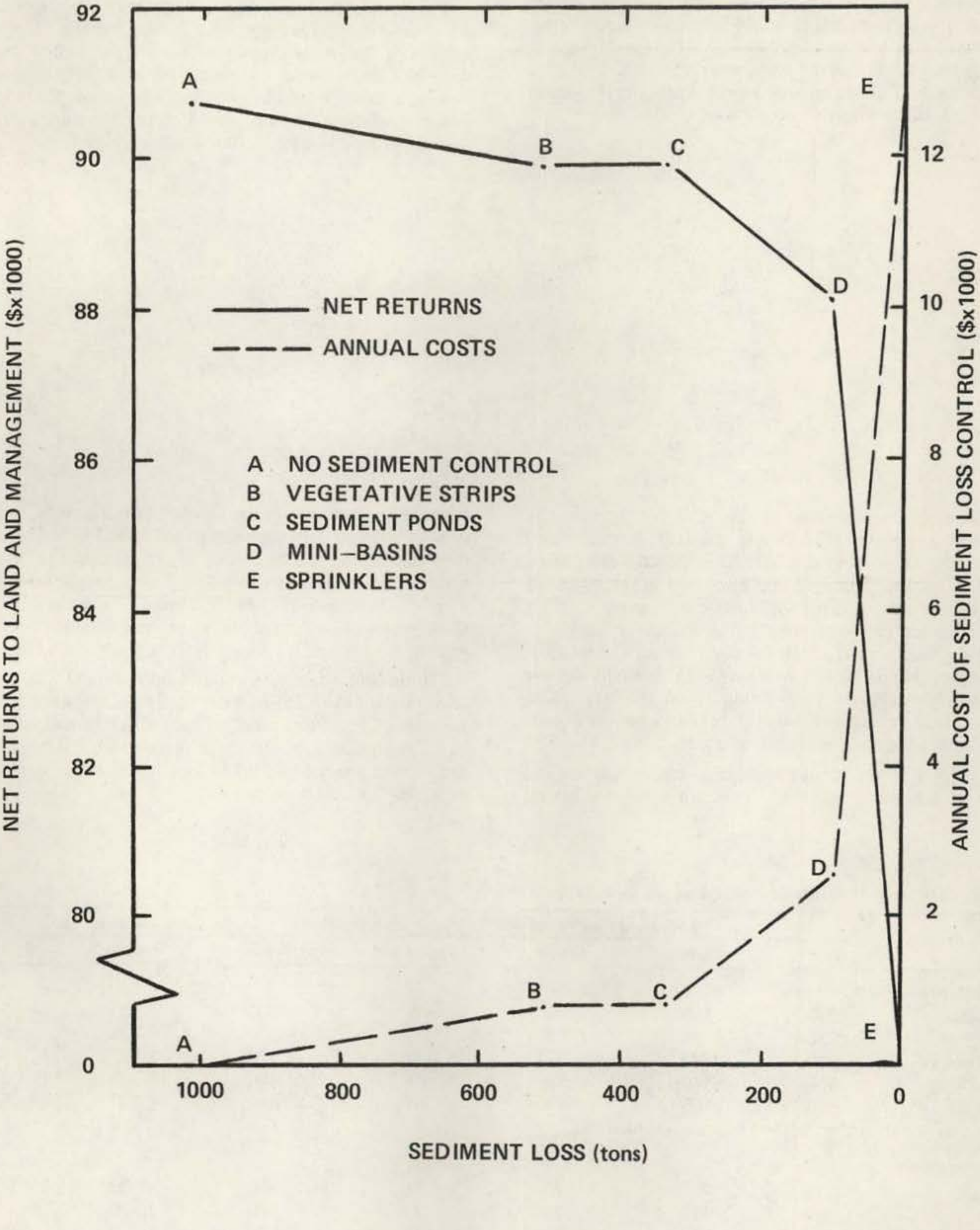


Fig. 8. Returns to land and management and costs associated with different levels of sediment loss, Nampa-Melba large farm model.

The total sediment loss from this farm under present management practices is 1,020 tons (point A, Fig. 8). This loss could be reduced to 340 tons by the use of sediment ponds (point C) and to 100 tons by the use of mini-basins (point D). The farm operator would have to change the crop mix to reduce the loss below 100 tons. If the farm operator were required to reduce the loss below about 75 tons, the least-cost method would be to convert to sprinkler irrigation and go back to the original crop mix.

For this model, sugarbeets were constrained to a maximum area of 140 acres and seed corn to an area of 60 acres. The minimum area of wheat was 60 acres.

The costs of sediment loss control are shown by the cost curve in Fig. 8. Like the cost curves for the other farm models, it shows that modest costs are associated with the first 70% decrease in sediment loss and that the costs to eliminate losses would be quite high. To reduce the sediment loss below about 75 tons would reduce the returns to land and management by $12,700, a decrease of 14%.

# Summary

Based on the assumptions of this study concerning the physical effectiveness of different control practices and devices, sediment losses from surface-irrigated fields can be reduced to between one-half and one-third of their present levels at a modest cost. This could be done by using on-farm sediment ponds (or vegetative buffer strips on grain) to remove the sediment from the surface runoff from fields. The costs of ponds would average $475 annually on the small farm models and $950 annually on the large farm models. The reduction in net returns to land and management for ponds is slightly more than 1% (Table 28).

Compared with sediment ponds, mini-basins increase the amount of sediment retained on the model farms for all crops except potatoes. They also increase the costs. For both sizes of farm models, the average sediment loss reduction for the mini-basins is 82% (from 500 to 90 tons for the small farm models and from 1,000 to 185 tons for the large ones). The annual costs average $1,000 and $2,175 respectively, for the two sets of farm models. These costs would lower the net returns to land and management by slightly more than 2.5%.

Elimination of surface runoff and sediment losses would require the use of sprinkler irrigation. This would cost an average of $5,650 annually on the small farm models and $11,600 annually on the large farm models. The resulting decrease in the net returns to land and management would be about 15% in both cases.

**Table 28. Summary of sediment loss and annual cost data.**

| | Sediment loss (tons) | | | | Annual costs ($) | | |
|---|---|---|---|---|---|---|---|
| | Base | Ponds | Basins | Sprinklers | Ponds | Basins | Sprinklers |
| **Small farm models** | | | | | | | |
| Twin Falls | 330 | 110 | 30 | 0 | 300 | 900 | 5,300 |
| Jerome | 225 | 75 | 22 | 0 | 200 | 700 | 5,000 |
| Wilder-Parma | 930 | 310 | 260[1] | 0 | 1,000 | 1,100 | 6,000 |
| Nampa-Melba | 510 | 170 | 50 | 0 | 400 | 1,300 | 6,300 |
| Average | 500 | 165 | 90 | 0 | 475 | 1,000 | 5,650 |
| Average decrease in returns to land and management (%) | | | | | 1.4 | 2.8 | 16.1 |
| **Large farm models** | | | | | | | |
| Twin Falls | 675 | 225 | 70 | 0 | 600 | 1,900 | 11,700 |
| Jerome | 360 | 120 | 35 | 0 | 300 | 1,100 | 7,800 |
| Wilder-Parma | 1,950 | 650 | 530[1] | 0 | 2,100 | 3,100 | 14,200 |
| Nampa-Melba | 1,020 | 340 | 100 | 0 | 800 | 2,600 | 12,700 |
| Average | 1,000 | 335 | 185 | 0 | 950 | 2,175 | 11,600 |
| Average decrease in returns to land and management (%) | | | | | 1.2 | 2.6 | 14.1 |

[1] Sediment ponds on potatoes, mini-basins on other crops.

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*Dean, College of Agriculture*
*University of Idaho*

TEACHING RESEARCH SERVICE

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