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COSTS OF MANAGEMENT PRACTICES AND POLICY OPTIONS FOR THE ANNUAL CROPPING AREA OF THE PACIFIC NORTHWEST

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Historically, soil erosion and sedimentation has been a persistent environmental problem in the annual cropping area of the Pacific Northwest in the annual cropping area of the Palouse. Average annual soil losses have been estimated since the mid-1930's, and they average about 8.8 tons per acre (Kaiser). The variability in the soil loss per acre is great with individual fields losing as much as 20 tons per acre on the crop seeded after summer fallow.

Palouse runoff erosion results from the interaction of climate, soil types, steepness of slope, slope length, arrangement of slopes, soil depth, permeability, and soil stability. Soil treatment factors such as surface cover, moisture content of the soil profile, degree of pulverization, and the adherence of tillage marks to the field contour (Kaiser) also affect the amount of erosion occurring in this area.

The Palouse annual cropping area receives approximately 20 inches of average annual rainfall. An excess of 60 percent of this precipitation falls during the November to March period of the growing season. Most of the runoff from this precipitation is a result of the non-permeability of the frozen soil during February and March.

The approaches to reducing soil erosion and sedimentation have concentrated on soil treatment factors such as reduced tillage operations and the elimination of summer fallow. In both cases above, the intent is to reduce the soil disturbance as much as possible, and also to provide a greater degree of soil cover in order to protect the soil. In the case of summer fallow, the soil losses have been estimated to exceed three times those occurring under annual cropping. Soil cover and less tillage are obviously very important in reducing soil erosion and sedimentation under these conditions.

As early as the beginning of the 20th Century Washington State College was extending information on soil erosion, and warning farmers of the danger of erosion on summer-fallow land (Kaiser). However, summer fallow has been an important factor in controlling weeds. In addition, the use of increasingly larger horsepower tractors which have been adopted over time has resulted in higher speeds, more soil pulverization and increased erosion. Finally, the use of fertilizers and pesticides has tended to offer some hope for improving the soil erosion sedimentation situation in that they provided an alternative to summer fallow. However, these factors have also had the effect of masking or hiding the productivity losses which were resulting from excessive soil losses on clay knobs and ridge tops,

On top of all this physical and technical input one also needs to impose the role of the federal government. On the one hand government programs have been directed at supporting farm prices and reducing farm production, Other government programs have been directed toward increasing production, Still other programs were directed toward controlling soil erosion and sedimentation. The results of these programs have been mixed. Price support and output increasing programs have tended to exacerbate erosion, while the erosion and sediment control programs have tended to reduce it. The final position is that we have traded off erosion control against price supports and technology and make very little progress in improving erosion and sedimentation, In fact, the rates of soil erosion and sedimentation has increased over time if the historical record is correct.

Research Results

I want to report briefly on two recent studies which were conducted evaluating erosion control in the annual cropping region of the Pacific Northwest. The first was an economic analysis of erosion control on the Palouse Thatuna-Naff soil association found in Latah County, Idaho, and Whitman County, Washington. (Harker, 1977) This study utilized on the M.U.S.L.E. (Modified

Universal Soil Loss Evaluation) adapted for the Pacific Northwest by D.K. McCool. It considered an 1,100 acre farm, with slopes of 40 percent. The bottom line conclusions of this analysis were that by shifting to minimum tillage and by changing to a less intensive crop rotation it was possible to reduce annual soil loss to 4 tons per acre at a resource cost of approximately $30 per acre. At this level of soil loss all of the productive land on this farm would be cropped, however the proportion of wheat in the crop rotation would be considerably less than it would be at the optimum levels which corresponded to 9.0 tons of soil loss per acre. In addition, the intensity of tillage would be less as soil loss declined. There are two counter balancing forces which operate, one is the reduced tillage which tends to reduce the variable costs of production and the other the shifting of the crop rotation which reduces the potential income from this farm.

Figure 1 provides a graphical explanation of what happened when soil losses were reduced from the normal level under conventional tillage (9.6 tons/acre) to lower levels. Soil loss is measured against net returns to fixed investment in this graph. As soil loss is reduced back toward the origin on the abscissa, income is reduced. The lowest level considerd in this analysis was 4.0 tons per acre. At this point all of the land normally carried in production was maintained in production. At soil loss levels less than 4.0 tons per acre land would have to be retired from production.

These data and the analysis were based on 1975 price and production relationships and were pre-government program prices. Wheat was priced at $3.06 per bushel, barley at $100 per ton, and dry field peas at $.08 per pound.

The conservation practices used to control soil erosion consisted of two general practices, these were: 1) the use of minimum tillage, and 2) changing the crop rotation. In the case of the application of minimum tillage this procedure was used to reduce soil losses down to the level of 7.5 tons per acre. Below 7.5 tons per acre it became necessary to change to more extensive crop rotations. This can be seen in the lower portion of the graph. In addition, the lower portion of the graph is divided into two parts. The upper part is referred to as "high ground" and the lower part as "low ground". The "high ground" consists of land with more than 12 percent slope, and "low ground" of land with less than 12 percent slope. In the case of "low ground", the rotations remained relative stable until the 4.25 ton per acre soil loss level was reached, at this point barley was added to the rotation. In the case of the "high ground", the rotation began to change below 7.5 tons per acre by adding barley to the rotation, at 5.5 tons soil loss and less per acre a second year of barley was added to the rotation, a third, fourth, and fifth year below 5.25 tons per acre, and below 4.25 tons per acre the rotation went to continuous barley.

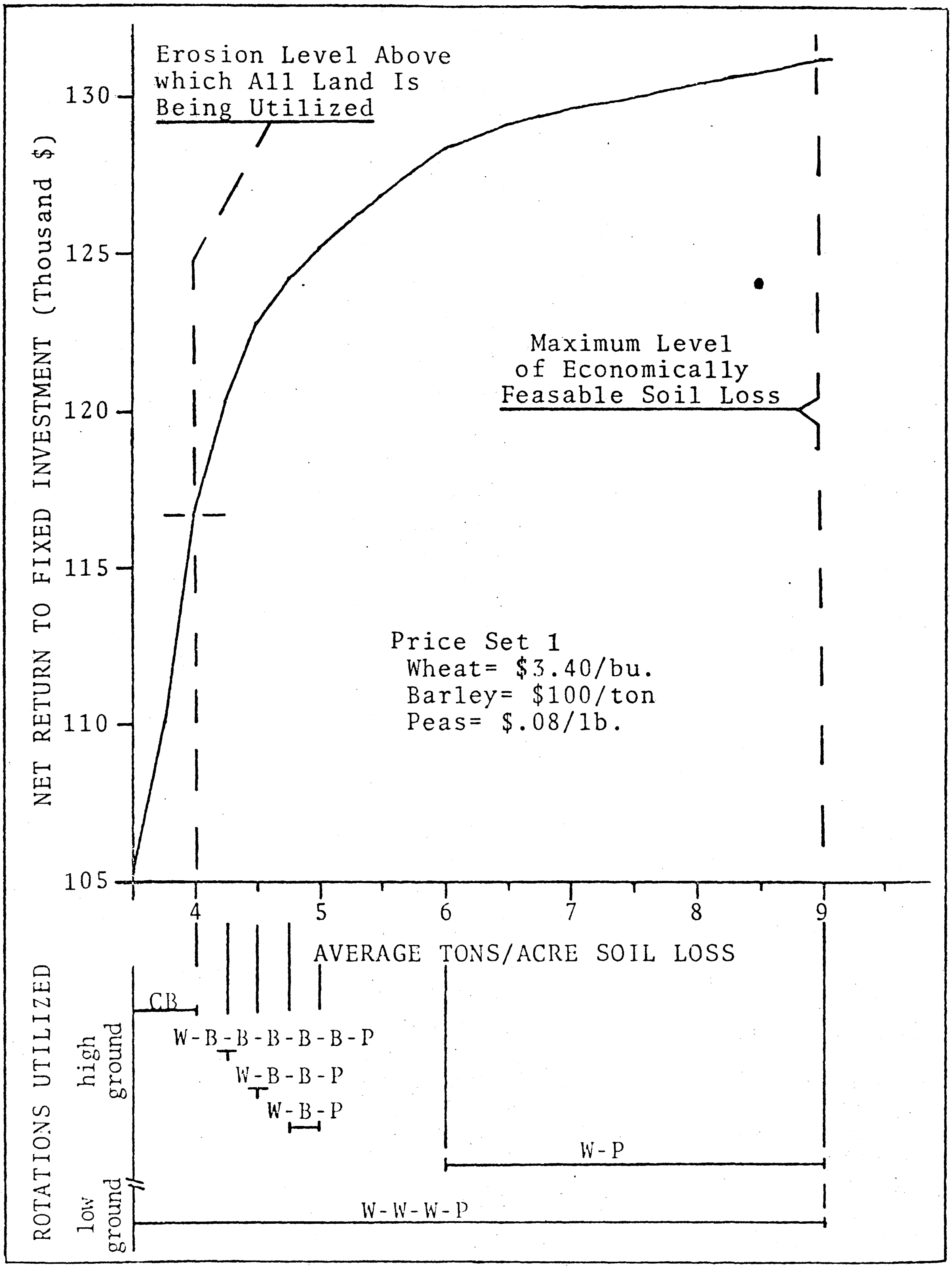

Figure 1. Net income, based on price set one, and crop rotations as both relate to soil loss on the Genesee farm. (Discontinuity of rotation specification signifies a combination of the rotations preceding and following.)

Table 1. Estimated total income reduction (per acre) associated with mandatory soil loss control.*

Soil loss level tons/acre	Cost/Acre
9.0	.20
8.0	.61
7.0	1.26
6.0	14.55
5.0	30.72
4.0	

*Price Set:

Wheat $3.40/bushel

Barley $100/ton

Peas $8/cwt.

The reasons that barley was used in these rotations were two. The first was that barley is a spring crop, and spring crops cause very little erosion because it is possible to provide adequate ground cover to protect the land over the winter. The second reason is that given the price relationships used in the analysis, barley was a more profitable crop than were peas.

The conclusions are that it is possible to control soil erosion in this manner, however, it is expensive. The opportunity cost of controlling erosion ranged from $0.20 per acre to $30.72 per acre. The cost of reducing the first ton of soil loss was only $0.20 per acre as shown in table 1. This reflects only the costs associated with minimum tillage which were added time tilling the land and a minor yield reduction related to minimum tillage. These costs increase slowly up to and including the sixth ton of soil loss is prevented. Reducing soil losses from 6 to 5 tons per acre comes at a considerably increased cost of $14.55 per acre. This increased cost reflects not only the increased costs related to minimum tillage, but also the fact that the crop rotation is changing, see figure 1. As indicated in figure 1, barley comes into the rotation which reduces the amount of winter wheat produced on the farm. This adjustment continuues and the costs per acre for soil controlling soil erosion continue to increase as soil losses were reduced to four tons per acre, at which point costs increased to $30.72 per acre. Soil losses could be reduced below four tons per acre, but below this level cropland would have to be retired to some form of permanent cover crop. In this study this level was selected as a limit beyond which we would not pursue further soil loss reduction.

In a second study done to evaluate a set of BMP's developed by the Latah Soil and Water Conservation District, a similar setting--1,400 acre farm with moderate slopes--to that in the first study was used as the basis for analysis. (Berglund, 1978) The first point program includes the following:

1. restriced summer fallow,
2. minimum tillage,
3. contour seeding,
4. divided slopes, and
5. permanent seeding of critical erosion areas.

In general the economic impacts follow the same general patterns in this study that they did in the first with two notable differences. First, land was retired from production which had some important effects on the analysis. Second, all of the best management practices were applied to the farm cropping system.

The analysis indicated that higher levels of erosion control could be achieved at lower cost when the Five Point Program was adopted. Two situations were developed in the analysis. These are shown in Table 2. The left hand portion of this table shows the economic impact in terms of income foregone per acre when 10 percent of the representative farm's land was retired, under the three rotations evaluated. The right hand side of the table shows this impact when only 2.5 percent of the land is seeded to permanent cover and 7.5 percent is farmed using continuous barley. In the case where 10 percent of the land was seeded to permanent cover the average cost varied between $7.17 and $11.21 per acre. When only 2.5 percent of the land was seeded to permanent cover the cost varied between $5.32 and $9.36 per acre.

What this analysis clearly reflects is that the use of Five Point Program management practices can reduce both loss to acceptable levels more economically by permanently seeding some of the cropland to permanent cover - alfalfa/ grass - this can be done by merely using minimum tillage and shifting to a less intensive rotation, The point is that the "Five Point Program" maintains a higher level of the more profitable crops in the rotation than did the original study, Farmers can afford to retire some of their marginal lands, This analysis used a 1400 acre farm in using the "Five Point

Table 2. Estimated total and per acre costs of Five Point Program on a 1400 acre farm,

Crop Rotation	Total Cost of 5 Pnt. Plan w/10% C.S.A.	Cost per acre	Total Cost of 5 Pnt. Plan w/ 2.5% C.S.A. & 7.5% C.B.	Cost per acre
WW-P	$15,698.20	$11.21	$13,110.00	$9.36
WW-P-B	14,071.68	10.05	11,484.48	8.20
WW-B-SF	10,038.93	7.17	7.451.73	5.32

WW-P = Winter wheat (50%)-Peas (50%).
WW-P-B = Winter wheat (40%)-Peas (40%)-Barley (20%).
WW-B-SF = Winter wheat (33%)-Barley (33%)-Summerfallow (33%).
C.S.A. = Critical Seeded Area.
C.B. = Continuous Barley

Program" compared to shifting to less intensive tillage and crop rotations.

The linear programming analyses used in both of these studies demonstrate that soil erosion can be controlled using various practices. What is critical is the package of practices used to do the control, and this is reflected in the relative cost of control. In the case of the first study the cost of controlling soil loss to 4 tons per acre averaged $30 per acre. In the second study which controlled soil loss to between 2.5 per acre the cost of control varied between (2.5% C.S.A. and 7.5% C.B.) and $11.21 (10% C.S.A.). This represents an increase in the efficiency of soil erosion control of approximately 300 percent. It demonstrates that the cost of soil erosion control is highly variable depending upon the practices used to control erosion.

Conclusions

These studies have demonstrated the effectiveness of BMP's in controlling erosion. These analyses were short-run evaluations which estimated the opportunity cost associated with controlling erosion and sedimentation measured in terms of income foregone. The magnitude of the difference between the two procedures was that the expanded use of BMP's resulted in a reduced annual soil loss level at a lower cost in terms of income foregone. This was achieved by reducing the seeded acreage on the model farm, and maintaining a more intensive crop rotation by using the other BMP's to reduce soil erosion. In other words, in the second study we added to our kit of tools for controlling soil erosion by adding 1) contour seeding, 2) seeding of critical areas, 3) reduced summer fallow, 4) divided slopes, and 5) minimum tillage, compared to using only minimum tillage and changing the cropping system in the first study.

It appears that the soil treatment approach is the way to go in the annual cropping area of the Palouse. We are expanding these studies to look at additional BMP's in order to determine if we can reduce the income foregone costs even more. In the future the next step will be to estimate the on- and off-farm benefits related to erosion and sediment control which may balance off the costs which the individual farmer has to bear without some form of cost sharing for BMP's. With the present studies as is evident we have data which can be used to establish cost sharing rates for the short-run effects of adopting BMP's. However, we do not yet have adequate analysis on which to base cost sharing rates in light of the long-run benefits of maintaining soil productivity.

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