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Number 626

# The Conservation Reserve Program

## An Economic Assessment

C. Edwin Young
C. Tim Osborn

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## Abstract

The Conservation Reserve Program (CRP) will boost net farm income and improve environmental quality over the life of the program (1986-99). These gains will come at the cost of somewhat higher food prices and Government administrative expenses, and potential downturns in farm input industries and other local economic activity tied to farming where enrollment is heavy. The authors estimated the net economic benefits of the program to range between $3.4 billion and $11.0 billion in present value, based on the effects covered in this report. Any estimate of the net Government expense of the CRP is highly dependent upon projected commodity market conditions and assumed levels of the acreage reduction program in the absence of the CRP. Prior to the 1988 drought, the authors estimated a small net Government expense. A more recent estimate made after the 1988 drought and with higher assumed acreage reduction levels in the absence of the CRP resulted in a significantly higher net Government expense.

**Keywords:** Conservation, soil erosion, water quality, Food Security Act of 1985, Conservation Reserve Program

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# Summary

The Conservation Reserve Program (CRP) will boost net farm income and improve environmental quality substantially over the life of the program (1986-99). These gains will come at the cost of somewhat higher food prices and Government administrative expenses, and potential downturns in farm input industries and other local economic activity tied to farming where enrollment is heavy. Net economic benefits of the program range between $3.4 billion and $11.0 billion in present value, according to estimates derived in this report.

The report also looks behind the bottom-line estimate to determine how well the CRP does in reaching each of its multiple goals, which are to reduce soil erosion, protect the Nation's long-term capability to produce food and fiber, reduce sedimentation, improve water quality, create better habitat for fish and wildlife, curb production of surplus commodities, and provide income support to farmers.

The CRP's progress toward its explicit goals must be measured against other effects that the program has on the overall economy. Taking 45 million acres of cropland out of production for 10 years increases commodity prices and reduces environmental problems linked with soil erosion. The price hikes and production cuts cause ripple effects in the farm sector, agricultural industries, and other segments of the economy tied to agriculture.

Farm income (present value) will rise by $9.2-$20.3 billion between 1986 and 1999 from higher commodity prices and lower production costs. Landowners who plant trees as the cover crop on approximately 3.5 million CRP acres will gain $4.1-$5.4 billion in wealth. Landowners also gain as CRP rental payments are transferred to them from the Government.

Environmental benefits, quantified at about $6.0-$13.6 billion, will be felt mostly in off-farm areas now being affected by agricultural soil erosion. The value of improvements in surface water quality from the CRP ranges from $1.9 to $5.3 billion. Wildlife habitat benefits range from $3.0 to $4.7 billion. Wind erosion abatement benefits range from $0.4 to $1.1 billion. Even though protecting soil productivity for the future is a primary factor in determining whether a field is eligible for enrollment in the CRP, soil productivity benefits account for only $0.8-$2.4 billion of the CRP's environmental gains.

A 45-million-acre CRP will cost the Federal Government $21.5-$22.8 billion in rents, bonuses, cost sharing, and technical assistance. Most of these costs are offset by savings in price and income support payments to farmers. Government payments to farmers fall by $16.2-$19.5 billion because some commodity base is retired and market prices rise, resulting in indirect cost savings.

Less agricultural production will mean fewer purchases of inputs and less money spent on storing and processing agricultural commodities. Fertilizer use will decline by as much as 12 percent. Exports also will decline as production falls.

Consumer food costs will climb by $12.7-$25.2 billion over the life of the CRP, peaking around 1995. Food cost increases will be less than 1 percent in any given year.

The range of estimated economic effects would change if projected crop price levels would have been attained through other land retirement programs in the absence of the CRP. The range also would change by including other effects not measured in this analysis such as decreased social losses from production of excess crop supplies and diminished quantity of agricultural products exported. CRP environmental quality benefits are sensitive to regional enrollment patterns and would vary if enrollment criteria and procedures were changed from the conditions assumed in this report. Finally, if this analysis had been conducted after the effects of the 1988 drought were known, some estimated economic effects would change significantly. In particular, estimated CCC cost savings would be reduced due to higher post-drought commodity prices. Thus, our estimates of the net economic benefit and net Government expense of the CRP should be interpreted as approximations of the true effects of the program.

# The Conservation Reserve Program

## An Economic Assessment

C. Edwin Young
C. Tim Osborn*

### Introduction

The Conservation Reserve Program (CRP) is the current centerpiece of USDA's natural resource conservation efforts. Among its multiple goals are to reduce soil erosion and protect the Nation's long-term capability to produce food and fiber. The program also creates other, unintended economic effects. Some research has been done in USDA and elsewhere to assess specific aspects of the program. This report sorts out the major economic consequences of the program so that policymakers and producers can gain a broader and longer range view of the program.[1]

The CRP will boost net farm income and improve environmental quality substantially over the life of the program (1986-99). Food prices and Government administrative expenses will rise and local economic activity tied to farming will slow. These conclusions are based on simulations conducted using the Food and Agricultural Policy Simulator (FAPSIM), an annual econometric simulation model. The FAPSIM simulations were augmented with a variety of natural resource databases, CRP enrollment data through the first six signups, and several natural resource models. The original FAPSIM simulation projected large commodity price increases after 1992. For comparison, we also performed an additional simulation under the constraint that prices do not rise after 1992 to obtain the range of figures given in this report.

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[1]The analysis was conducted prior to the 1988 drought. Therefore, the estimated economic effects do not reflect the price and stocks changes that resulted from the drought.

#### Background on the CRP

The CRP is a voluntary cropland retirement program that was established in the Conservation Title (XII) of the Food Security Act of 1985 (FSA, PL 99-1980). In exchange for placing cropland fields with highly erodible soil into the CRP for 10 years, USDA pays participating farm owners or operators an annual per-acre rent and one-half of the cost of establishing conservation practices and a permanent land cover. The law states that the Secretary of Agriculture shall place 40-45 million acres of highly erodible land into the CRP by the end of the 1990 crop year, and that to the extent practicable at least one-eighth of the total be planted to trees.[2]

### CRP Participation

Enrollment in the CRP was assumed to expand from the halfway point that had been attained in mid-1988 to the full 45 million acres by the end of 1990. Participation trends in mid-1988 and data on the location of highly erodible cropland formed the basis for our projections about the location and magnitude of the CRP's effects. Regional patterns of enrollment by 1990 are expected to diverge from the mid-1988 pattern, as enrollment in high participation areas reaches eligibility limits and enrollment shifts to the Corn Belt and other areas where participation has been low. After 1996, some land returns to crop production after completing 10 years in the reserve.

The FSA also established three complementary natural resource conservation programs: "swampbuster," "sodbuster," and conservation

[2]Additional background information is provided in the appendix.

compliance. These programs require farmers to protect soil and water resources as a precondition to participation in USDA price and income support programs. Acreage now in the CRP will be subject to conservation compliance rules if it returns to production after having been in the reserve for the 10-year term.

### Potential Enrollment

Approximately 101 million acres of highly erodible cropland are eligible for CRP enrollment. However, because enrollment is generally limited to no more than 25 percent of the cropland in a county, approximately 70 million acres are actually available for CRP enrollment (table 1). The majority of this cropland is located in the Corn Belt, Northern Plains, Southern Plains, and Mountain regions (fig. 1). Erodible land is further concentrated within these regions.

### Actual Enrollment

Total enrollment in the CRP for the first six signups (through February 1988) included over 239,000 contracts covering approximately 25.5 million acres of cropland. About 24 million acres were retired from production as of the 1988 crop year, while the remainder was scheduled for 1989 retirement (table 2). Erosion on these acres fell by an average of 21 tons per acre per year (USDA, ERS, 1988). The direct Federal cost for retiring an acre of CRP land averaged $48 a year for rent and $37 to establish cover crops (one-time payment). Almost 90 percent of the cropland enrolled in the first six signups was planted in grass cover (table 3). Tree planting (6 percent) and wildlife habitat (4 percent) were the other primary conservation covers. Over 16,000 acres of cropland were enrolled for placement in filter strips in the sixth signup.

Retired wheat base totaled 7.6 million acres while retired corn base totaled 2.9 million acres for the first six signups (table 4). The largest proportional cuts in commodity base acreage were for barley, sorghum, and oats. These cropland retirements reduce the acreage eligible for USDA annual commodity programs. Base acreage reductions remain in effect for the full 10 years of a CRP contract.

Average CRP rental rates increased from $42 per acre per year for the first signup of March 1986 to about $48 per acre per year for the fifth and sixth signups (table 2). Two factors explain this increase. First, the geographic distribution of acres enrolled in later signups shifted to areas where agricultural land was more productive. The cost of retiring land in such areas is greater since it has higher cash rental rates and a more valuable commodity base.[3] Second, many farmers have become aware of the maximum rental rates paid by USDA for their areas. With this knowledge, farmers tend to submit bids near the cap even if they might be willing to accept lower rental payments. State programs which supplement USDA rental payments and/or cover establishment cost shares are not included in the data on CRP rents.

#### *Regional Enrollment Patterns*

CRP enrollment for the first six signups was greatest in the Northern Plains region. Over 6 million acres were enrolled, representing 45 percent of the region's eligible land (table 5). Enrollment was also high in the Southern Plains and Mountain regions. The lowest enrollment was in the Northeast. Although about 78 percent of all U.S. counties contain some CRP enrollment, over 80 percent of all enrolled acreage is contained in only 18 percent of U.S. counties. Most of these counties are located in the Mountain, Northern Plains, and Southern Plains regions (fig. 2).

Most of the geographic pattern of CRP enrollment is explained by differences in the amount of eligible land in a given area. How CRP payments compare with prevailing market rents for cropland (bid/rent ratio) also helps determine regional enrollment trends (Dicks, 1987a). The highest level of participation for the first six signups (52 percent of available acreage) was in the Mountain region, where the ratio of CRP rental payments to average market rent was also highest (2.1). The Corn Belt had the lowest bid/rent ratio (0.8), and low participation (22 percent).

### Enrollment Projections

Total enrollment reaching 45 million acres by the end of 1990 was projected assuming that enrollment criteria and other rules remain the same as they were before 1988 (table 6). Acreage projected for enrollment in the near future was allocated among regions based on actual regional enrollment shares through 1987.

But enrollment cannot reach 45 million acres unless regional shares change, because some counties will approach the 25-percent cap on land retirement. For

[3]This was especially true for the fourth signup where, due to a one-time bonus for corn base retirement, a proportionally higher amount of valuable Corn Belt acreage was enrolled, resulting in a higher average rental rate of $51 per acre.

**Table 1—Regional distribution of highly erodible cropland eligible for the CRP**

| Region | Total cropland | Harvested cropland | CRP eligible[1] | CRP available[2] | Share of total | | Share of harvested | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Eligible | Available | Eligible | Available |
| | *Million acres* | | | | *Percent* | | | |
| Northeast | 17.3 | 12.9 | 4.2 | 3.0 | 24 | 17 | 33 | 23 |
| Appalachian | 22.7 | 17.3 | 6.8 | 4.7 | 30 | 21 | 39 | 27 |
| Southeast | 18.2 | 13.4 | 3.1 | 2.7 | 17 | 15 | 23 | 20 |
| Delta States | 21.9 | 17.9 | 2.5 | 2.1 | 11 | 10 | 14 | 12 |
| Corn Belt | 92.4 | 82.4 | 21.8 | 16.4 | 24 | 18 | 26 | 20 |
| Lake States | 43.9 | 17.9 | 6.2 | 5.7 | 14 | 13 | 35 | 32 |
| Northern Plains | 93.4 | 71.7 | 16.9 | 13.3 | 18 | 14 | 24 | 19 |
| Southern Plains | 44.9 | 29.7 | 16.9 | 8.7 | 38 | 19 | 57 | 29 |
| Mountain | 43.3 | 25.7 | 18.5 | 10.0 | 43 | 23 | 72 | 39 |
| Pacific | 22.7 | 15.8 | 4.4 | 3.1 | 19 | 14 | 28 | 20 |
| United States | 420.7 | 323.7 | 101.2 | 69.7 | 24 | 17 | 31 | 22 |

[1]Two-thirds of the field must meet one of the following conditions (see appendix for definition):
1) In land capability class VI-VIII.
2) In land capability class II-V and eroding at 3T (2T or above if planted to trees).
3) Erodibility index exceeds 8 and eroding above 1T.
[2]Assumes that no more than 25 percent of the eligible land in any county may be enrolled in the CRP.

Source: USDA, Soil Conservation Service, National Resources Inventory, 1982.

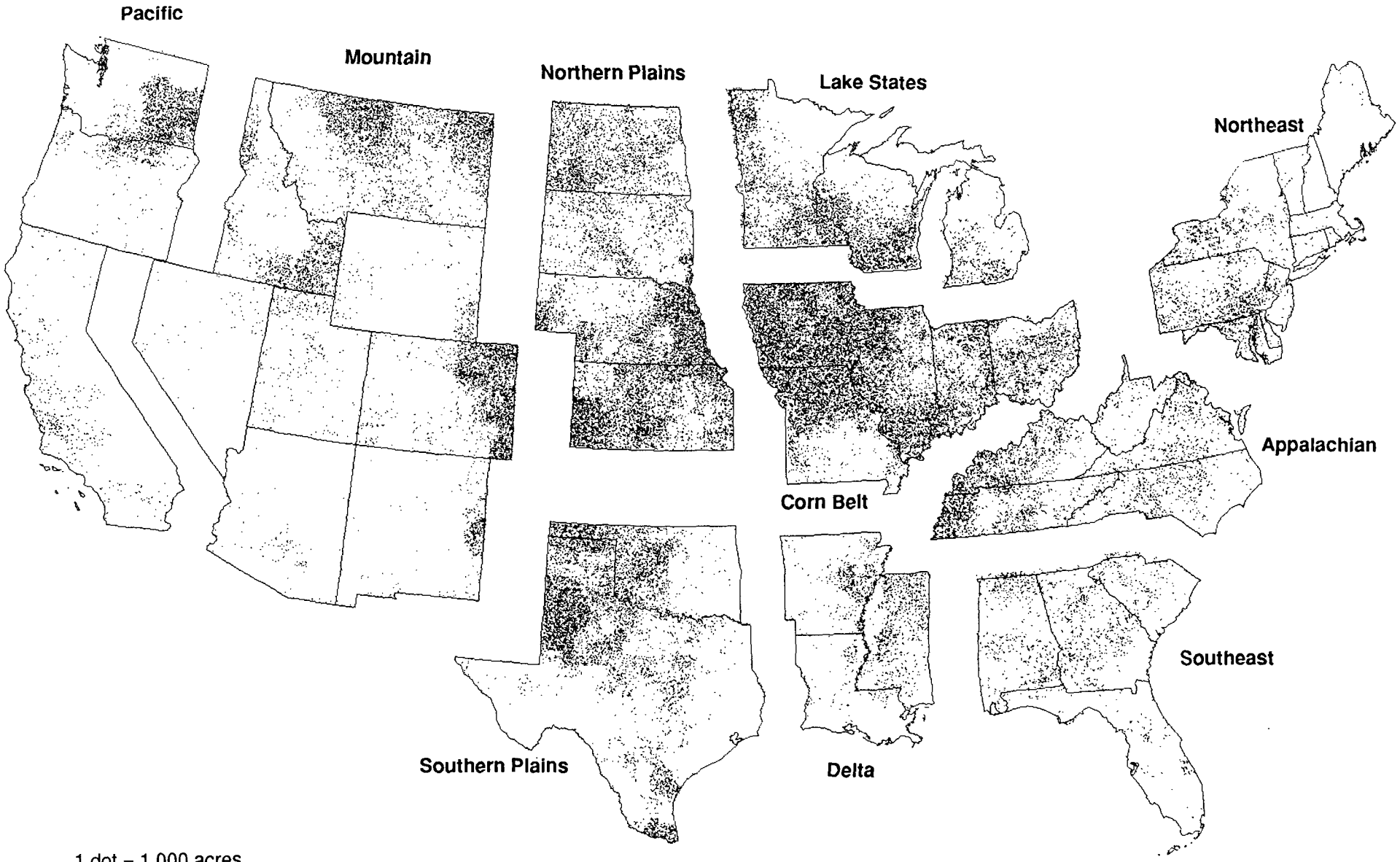
**Table 2—CRP enrollment, signups 1-6**

| Item | Contracts | Acres | Average rental rate | Average erosion reduction |
|---|---|---|---|---|
| | *1,000* | *Million* | *$/acre/year* | *Tons/acre/year* |
| Signup period: | | | | |
| #1--March 1986[1] | 9.4 | 0.75 | 42.06 | 26 |
| #2--May 1986[1] | 21.5 | 2.77 | 44.05 | 27 |
| #3--August 1986[2] | 34.0 | 4.70 | 46.96 | 25 |
| #4--February 1987[3] | 88.0 | 9.48 | 51.19 | 19 |
| #5--July 1987[3] | 43.7 | 4.44 | 48.03 | 17 |
| #6--February 1988[4] | 42.7 | 3.38 | 47.90 | 18 |
| Total[5] | 239.3 | 25.53 | 48.40 | 21 |
| Cumulative enrollment by crop year: | | | | |
| 1986 | 21.0 | 2.04 | 43.11 | 28 |
| 1987 | 145.9 | 15.71 | 49.15 | 23 |
| 1988 tentative[6] | 228.6 | 24.24 | 48.52 | 21 |
| 1989 tentative[6] | 239.3 | 25.53 | 48.40 | 21 |

[1]Eligible acres included cropland in land capability classes II through V eroding at least three times greater than the tolerance rate (see definitions in appendix), or any cropland in land capability classes VI through VIII.
[2]Eligible acres expanded to include cropland in land capability classes II through V eroding at least two times the tolerance rate and having gully erosion.
[3]Eligible acres expanded to include cropland eroding above the tolerance rate with an erodibility index of eight or greater.
[4]Eligible acres expanded to include cropland in land capability classes II through V eroding at least two times the tolerance rate if planted in trees. Eligibility also extended to cropland areas 66 to 99 feet wide adjacent to permanent water bodies for placement in filter strips.
[5]Totals may not add due to rounding.
[6]Actual number of contracts, acres enrolled, rental rates, and erosion reduction are not final pending future signups.

Source: USDA, ERS, 1988.

Figure 1—Cropland eligible for the Conservation Reserve Program by farm production region




1 dot = 1,000 acres
69.7 million acres total

**Table 3—Conservation practices used on CRP acreage, signups 1-6**

| Practice | FY 1986 | FY 1987 | FY 1988 | FY 1989 | Total[1] | |
|---|---|---|---|---|---|---|
| | ..... | ..... | *1,000 acres* | ..... | ..... | *Percent* |
| Grass cover | 1,699 | 12,416 | 7,672 | 1,077 | 22,864 | 89.6 |
| Trees | 213 | 759 | 474 | 135 | 1,581 | 6.2 |
| Wildlife habitat | 126 | 488 | 373 | 61 | 1,048 | 4.1 |
| Field windbreaks | 1 | 3 | 1 | 0 | 5 | 0 |
| Diversions | 10 | 26 | 33 | 0 | 69 | .3 |
| Erosion, sediment, and water control structures | 9 | 22 | 8 | 0 | 39 | .2 |
| Grass and sod waterway | 2 | 5 | 2 | 0 | 9 | 0 |
| Shallow water areas | 0 | 1 | 1 | 0 | 2 | 0 |
| Filter strips[2] | 0 | 0 | 13 | 3 | 16 | .1 |
| Total[3] | 2,043 | 13,670 | 8,536 | 1,276 | 25,525 | 100.0 |

[1]Totals may not add due to rounding.
[2]Filter strips were approved as a CRP conservation practice beginning with the sixth signup held during February 1988.
[3]More than one conservation practice may be applied to a given acre, so total acres may be less than the sum of acreage in all conservation practices.

**Table 4—Commodity base acreage enrolled in the CRP, signups 1-6[1]**

| Crop | Base acreage in 1985 | Enrolled in CRP | |
|---|---|---|---|
| | ..... *Million acres* | ..... | *Percent* |
| Barley | 12.4 | 2.0 | 15.8 |
| Sorghum | 18.9 | 1.9 | 10.2 |
| Oats | 9.2 | .9 | 9.8 |
| Wheat | 91.7 | 7.6 | 8.3 |
| Cotton | 15.4 | 1.1 | 6.9 |
| Corn | 82.2 | 2.9 | 3.5 |
| Rice | 4.1 | -- | -- |
| Peanuts | 1.5[2] | -- | -- |
| Tobacco | .7[2] | -- | -- |
| Total | 236.1 | 16.3 | 6.9 |

--=Negligible.
[1]Totals may not add due to rounding.
[2]Acres harvested.

1990, the projections assume that more acreage in the Corn Belt and other regions with low participation rates will be enrolled.[4] Between 1991 and 1995, we assume that enrollment will remain constant.

[4]In projecting 1990 enrollment, trend estimates through the sixth signup were dampened by including a proportionate weighting factor for the distribution of available acres. Expected rental rates increased to reflect higher rents required to attract this land.

Starting in 1996, some enrolled acreage becomes available for return to crop production. Most of this land will be subject to the conservation compliance program. If farmers return the land to crop production, they must use soil conservation practices or forgo participation in USDA commodity programs. In this analysis, we could not predict which CRP land would meet USDA requirements for soil conservation and qualify for reentry into production, or whether it would be profitable for farmers to take the land out of retirement under the conservation practices required. Therefore, we assumed that CRP land planted to trees would stay in retirement after contract expiration while land planted to grass would return to crop production. This relatively conservative assumption has little effect on the estimates made in the report.

## Gross Economic Effects of the CRP

Taking 45 million acres out of crop production will have an economic impact on localized rural economies and on the entire U.S. agricultural sector. The size of changes in market prices, USDA expenditures, and natural resource use will depend on how much agricultural production falls.

The major economic effects of the CRP include less total crop production, higher commodity prices, decreased environmental and soil productivity damages caused by soil erosion, reduced Government costs for commodity programs, and diminished

economic activity in rural areas where enrollment is heavy.

### Baseline Assumptions

Because interest should be focused on changes resulting exclusively from implementation of the program, the CRP's effects were uniformly compared with a baseline situation characterized by the absence of the CRP. Clearly, estimates of the economic effects of the CRP depend critically upon the assumptions of the baseline. Since agricultural programs and policies that would have occurred without the CRP are unknown, there is no single correct baseline scenario.

We used the following baseline: if the CRP had not been implemented, other agricultural programs

**Table 5—Regional patterns of CRP enrollment, signups 1-6**

| Region | Enrollment | Share of CRP-eligible acres | Average rental rate | Ratio of CRP rent to average cash rent[1] | Average cover crop cost-share | Average erosion reduction |
|---|---|---|---|---|---|---|
| | *1,000 acres* | *Percent* | *$/acre/year* | *Ratio* | *$/acre* | *Tons/acre/year* |
| Northeast | 134 | 4 | 57 | 1.5 | 60 | 48 |
| Appalachian | 863 | 18 | 54 | 1.3 | 42 | 28 |
| Southeast | 1,246 | 46 | 42 | 1.4 | 35 | 15 |
| Delta States | 778 | 37 | 43 | 1.1 | 31 | 22 |
| Corn Belt | 3,558 | 22 | 70 | .8 | 39 | 19 |
| Lake States | 2,073 | 36 | 58 | 1.1 | 31 | 17 |
| Northern Plains | 6,040 | 45 | 47 | 1.5 | 34 | 17 |
| Southern Plains | 4,101 | 47 | 40 | 1.7 | 20 | 34 |
| Mountain | 5,219 | 52 | 40 | 2.1 | 37 | 20 |
| Pacific | 1,514 | 49 | 49 | 1.2 | 37 | 13 |
| Total[1] | 25,526 | 37 | 48 | 1.1 | 37 | 21 |

[1]Average county rents from ERS land value survey.
[2]Totals may not add due to rounding.

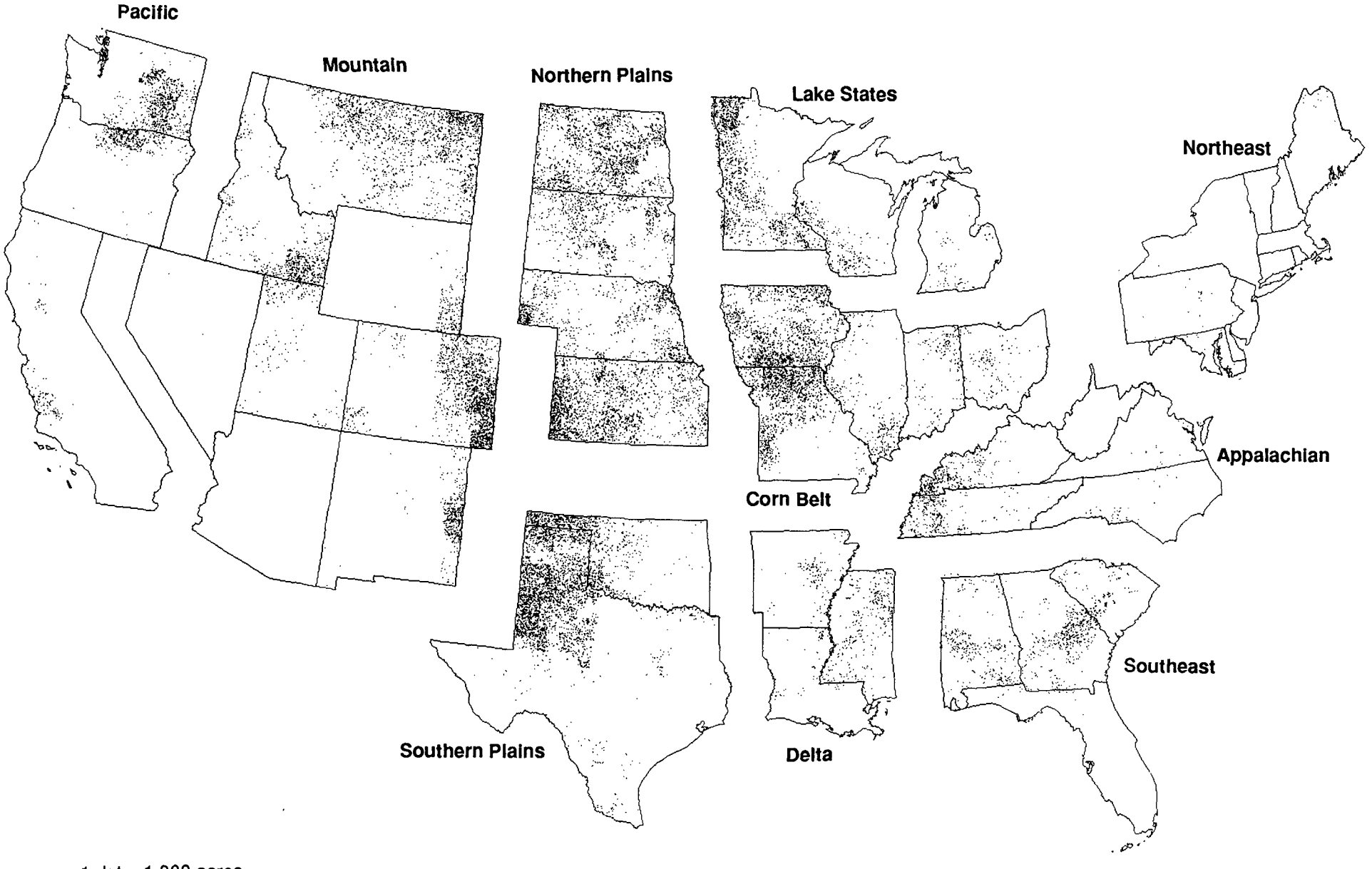
**Table 6—Projections of cumulative CRP enrollment**

| Region | 1988[1] | | | 1989[2] | | | 1990[3] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Enrollment | Rental costs | Cover crop cost-share | Enrollment | Rental costs | Cover crop cost-share | Enrollment | Rental costs | Cover crop cost-share |
| | *1,000 acres* | *---$/acre---* | | *1,000 acres* | *---$/acre---* | | *1,000 acres* | *---$/acre---* | |
| Northeast | 128 | 57 | 71 | 429 | 64 | 72 | 730 | 64 | 72 |
| Appalachian | 891 | 54 | 48 | 1,430 | 60 | 48 | 1,969 | 60 | 48 |
| Southeast | 1,161 | 42 | 35 | 1,533 | 49 | 35 | 1,905 | 48 | 35 |
| Delta States | 797 | 43 | 32 | 1,114 | 50 | 32 | 1,432 | 50 | 32 |
| Corn Belt | 3,838 | 69 | 38 | 5,742 | 79 | 38 | 7,648 | 79 | 38 |
| Lake States | 2,329 | 58 | 33 | 3,058 | 67 | 33 | 3,788 | 66 | 33 |
| Northern Plains | 6,135 | 47 | 38 | 7,882 | 54 | 38 | 9,630 | 53 | 38 |
| Southern Plains | 4,289 | 40 | 45 | 5,534 | 45 | 45 | 6,779 | 45 | 45 |
| Mountain | 5,709 | 40 | 31 | 7,089 | 45 | 31 | 8,469 | 45 | 31 |
| Pacific | 1,724 | 49 | 39 | 2,187 | 56 | 39 | 2,649 | 56 | 39 |
| Total[4] | 27,001 | 48 | 37 | 35,998 | 56 | 39 | 44,999 | 56 | 39 |

[1]Assumes enrollment through first six signups (table 3) plus 1.5 million acres distributed according to the distribution of the original 25.5 million acres enrolled.
[2]A linear interpolation between 1988 and 1990 enrollment projections.
[3]Assumes that the final 18 million acres to enter the program will be distributed according to the distribution of remaining CRP-eligible cropland.
[4]Totals may not add due to rounding.

Source: Dicks, unpublished (1987).

Figure 2—Conservation Reserve Program enrollment by farm production region, through July 1988




1 dot = 1,000 acres
28.13 million acres enrollment through seventh signup, July 1988

would have been the same as under current law. Acreage reduction programs and paid land diversions are the main agricultural programs that are relevant to this assumption, because they create effects similar to the CRP's effects. We assumed that farm programs would have been the same since there is no consensus on the level of supply control that would have occurred in the absence of the CRP, or on the mix of other programs (loan rates, target prices, and annual land diversion payment rates) that would have been required to achieve a similar level of supply control.

An equally valid but different baseline assumption is that supply control programs would have been expanded in the absence of the CRP. However, identification and estimation of the economic effects of this expanded supply control scenario would be difficult and would require many arbitrary assumptions. Had we assumed that other supply control programs would grow if the CRP had not been put into effect, estimates of some economic effects would have been quite different from those presented in this report.

### Agricultural Gains

Farm prices, producer income, and land values will rise under the CRP. Higher commodity prices generated by the CRP boost farm income by an estimated $9.2-$20.3 billion in present value between 1986 and 1999. Landowners gain as CRP rental payments are transferred to them from the Government. Planting trees as the cover crop on CRP acreage adds to the future income of the farm sector. The value of eligible cropland will be supported by the future value of CRP payments.

### *Crop Production and Prices*

Prices for all the crops covered in the analysis rise slowly at first, with barley, cotton, and wheat prices rising the most in the early phase of the program. Prices climb rapidly after 1990 according to the original simulation, so we compared the original results with a second analysis that holds commodity prices stable after 1992. This second analysis assumes that USDA policymakers would institute policies to moderate price increases.

The extent of production and price adjustments caused by the CRP depends on: 1) the productivity of the land retired; 2) interactions with other Government programs; and 3) the responsiveness of production and consumption to prices.

A farmer electing to retire land via the CRP will tend to enroll the least productive acreage. The percentage reduction in the total production of commodities thus will be less than the percentage reduction in acres.

Some of the land enrolled in the CRP would have been idled anyway under acreage reduction programs or voluntary paid diversion programs. Thus, part of the production decline is not due solely to the CRP, but would have occurred without the CRP.

As total production falls due to the CRP, prices of agricultural commodities rise, causing farmers to plant additional acreage. This partially offsets the drop in production due to the CRP and moderates the increases in commodity prices. Stocks also moderate the price increases. We assumed that for every acre retired by the CRP approximately 0.2 acres would enter production from other sources, such as land formerly under another acreage reduction program, pastureland, or fallow. This land was assumed to have average productivity and erodibility.

Cropland retirement reduces soil erosion, thus creating a benefit for future crop production. Studies have shown that a portion of the increase in soil productivity accrues to the landowner (Ervin and Mill; Miranowski and Hammes). The aggregate value of soil productivity benefits is discussed later in the report.

The effects of the CRP on crop production and prices were simulated using the Food and Agricultural Policy Simulator (FAPSIM) (Salathe and others). FAPSIM, an annual econometric simulation model, contains livestock and crop submodels that balance commodity prices and quantities under various policy assumptions. It calculates how changes in farm programs affect farm income, consumer price indexes, and Government expenditures. The projections of CRP enrollment in table 6 were incorporated into the model to simulate the effects of the CRP on production, prices, and farm income. The acreage reduction program set-aside requirements for wheat were assumed as follows: 22.5 percent for 1986, 27.5 percent for 1987-89, and 20 percent thereafter. For corn, set-aside requirements were held constant at 20 percent. A 15-percent paid land diversion was also assumed for corn.

Corn prices increase by slightly more than 2 percent in the projection for 1990 while small grain prices increase by 12 percent (table 7). By 1994 corn prices were projected to increase by over 18 percent. Prices for the program commodities continue to increase through 1994 because planted acreage falls and total supply declines.

By 1990, when 45 million acres of cropland were assumed to have entered the CRP, the net reduction in cropland is 37 million acres. Estimated changes in planted acreage for the major crops are summarized in table 7. By 1990 the cuts in planted acreage ranged from about 8 percent for oats to 25 percent for barley.

The estimated changes in commodity prices depend on the underlying assumptions concerning demand and supply elasticities, the rate of decrease in surplus stocks, and the response of USDA program managers. Prices would increase faster if demand were more inelastic, if stocks were drawn down at a faster rate, or if greater supply reduction resulted from retiring an acre of CRP cropland (less slippage or higher assumed crop yields). Price differentials between the with- and without-CRP scenarios would be lower if foreign competitors reacted to the higher price by expanding production, if farmer participation in other USDA price and income support programs changed to take advantage of the price effects, or if USDA program managers altered supply control programs to moderate the price shifts. These factors could operate in such a manner as to completely negate the price changes.

**Table 7—Commodity market changes under the CRP**

| Item | 1988 | 1990 | 1992 | 1994 |
|---|---|---|---|---|
| | | *Percent change* | | |
| Wheat: | | | | |
| Acres | -8.3 | -13.3 | -12.7 | -10.8 |
| Production | -7.0 | -13.5 | -12.6 | -10.6 |
| Stocks | -3.0 | -14.8 | -29.7 | -26.8 |
| Prices | 5.8 | 11.8 | 15.7 | 22.6 |
| Corn: | | | | |
| Acres | -4.7 | -8.6 | -7.2 | -5.7 |
| Production | -4.0 | -7.7 | -6.4 | -4.9 |
| Stocks | -5.7 | -23.4 | -35.0 | -36.3 |
| Prices | .1 | 2.3 | 11.8 | 18.4 |
| Sorghum: | | | | |
| Acres | -12.3 | -21.6 | -19.5 | -18.4 |
| Production | -9.3 | -19.0 | -16.3 | -14.2 |
| Stocks | -10.3 | -82.2 | -176.4 | -188.6 |
| Prices | 2.2 | 7.1 | 18.7 | 24.3 |
| Barley: | | | | |
| Acres | -13.2 | -24.7 | -22.3 | -23.8 |
| Production | -11.1 | -22.4 | -19.8 | -20.6 |
| Stocks | -13.3 | -72.5 | -140.3 | -226.3 |
| Prices | 7.6 | 12.0 | 20.7 | 32.9 |
| Oats: | | | | |
| Acres | -4.7 | -8.1 | -8.2 | -8.2 |
| Production | -7.8 | -12.3 | -11.2 | -10.5 |
| Stocks | -15.2 | -41.5 | -45.7 | -45.1 |
| Prices | 4.4 | 12.0 | 19.8 | 23.3 |
| Cotton: | | | | |
| Acres | -9.3 | -14.4 | -14.2 | -17.2 |
| Production | -4.9 | -8.6 | -7.9 | -12.1 |
| Stocks | -9.2 | -18.6 | -22.1 | -30.3 |
| Prices | 6.0 | 11.0 | 15.0 | 17.6 |
| Rice: | | | | |
| Acres | .1 | -.6 | -.9 | -1.1 |
| Production | .1 | -.6 | -.9 | -1.0 |
| Stocks | .1 | -1.0 | -1.5 | -1.9 |
| Prices | -.2 | 4.3 | 6.5 | 9.1 |
| Soybeans: | | | | |
| Acres | -5.6 | -8.4 | -8.2 | -8.2 |
| Production | -4.8 | -7.2 | -6.8 | -6.6 |
| Stocks | -.9 | -1.2 | -1.9 | -2.5 |
| Prices | 4.5 | 7.2 | 10.8 | 13.0 |

A more realistic alternative assumption is that the overall price effects shown by FAPSIM are overestimated. A simple way to accommodate this assumption is to assume that no additional price increases attributable to the CRP occur after 1992. The price differentials remain constant from 1992 through 1995 and then begin to decline as CRP cropland returns to production. This somewhat arbitrary assumption yields an intermediate time path of price adjustments. The lower end of the range of price and income changes is based on this assumption.

### *Farm Income*

Based on the assumptions made for this report, farm income is estimated to increase substantially under the CRP. Most of the benefits will come later, as commodity prices climb after 1992. Because our estimates of farm income are sensitive to assumptions made about prices, we examined two scenarios—one assuming that prices rise as estimated using the FAPSIM model, and another holding prices constant after 1992.

The present value of net farm income at a 4 percent rate of discount, excluding direct CRP rental payments and establishment costs paid to farmers, was estimated to increase by $20.3 billion over the life of the CRP (fig. 3). Approximately 85 percent of the increase in net farm income occurs after 1992 when commodity prices rise rapidly according to the first set of assumptions in the FAPSIM model. As some of the land initially enrolled in the CRP comes back into production after 1995, net income begins to decline because supply increases and prices fall.

Under the second assumption, which uses the results from FAPSIM but holds market prices constant after 1992, the present value of net farm income increases by only $9.2 billion.

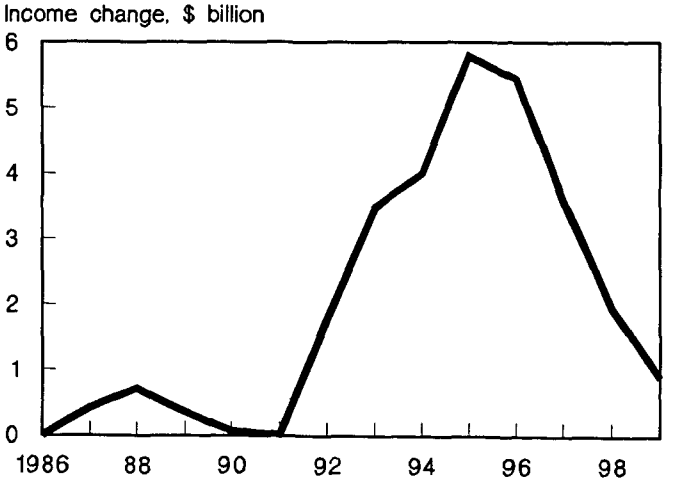
Reduced agricultural production caused by the CRP will boost total agricultural revenue, assuming that the demand for agricultural commodities is inelastic. Higher crop prices raise total revenue from the sale of farm products. Aggregate production costs will likely fall since less total land is used for agricultural production. Thus, the CRP should lead to an increase in total net farm returns. In addition to these market changes, CRP rental payments add to the income of farmers.[5] When land enrolled in the CRP is planted to trees, the discounted future value of the trees increases the net wealth of the landowner. The increase in income will be partially offset by the farmer's share of the costs of establishing vegetative cover and the loss of Government payments associated with the retirement of crop base.

If market prices exceed loan rates, farmers will lose income from deficiency payments. This decline does not completely offset the price increase since deficiency payments are paid only on base production and the revenue gain from higher market prices affects all acreage.

Farmers must pay for at least 50 percent of costs to establish ground cover and must maintain the cover for the duration of the CRP contract. Average production costs increase as fixed costs for items such as machinery and land must be spread over a smaller cropland base. Average production costs may also rise if farmers use more fertilizers and pesticides on their non-CRP cropland to boost yields in response to higher crop prices.

[5]CRP rental payments are not included in the estimated $9.2-$20.3 billion increase in net farm income. Rental payments are transfers from the Government to farmers and do not add to national income.

Figure 3
**Farm income rises under the CRP**




**Timber Production.** An acre of trees yields nearly $2,000 per acre (discounted at 4 percent) over 45 years. Total income to landowners who plant trees on their CRP acreage grows by $4.1-$5.4 billion, based on an estimate of up to 3.5 million acres of trees in the reserve. Cropland planted to trees under the CRP provides a future source of income to landowners when the trees are harvested. Over 1.5 million acres were planted to trees during the first six signups. Most of this land is in the Southeast and Delta regions. If this trend were to continue, approximately 2.7 million acres would be converted to trees with a 45-million-acre CRP. Changes in the program designed to encourage tree planting could result in over 3.5 million acres planted to trees.

Trees planted under the CRP must be retained until they grow to a marketable size to contribute to future net income. Managed stands of Southern pine typically are thinned for pulpwood after 15-17 years of growth. Commercial thinnings are then repeated at 10-year intervals until final harvest at age 40-45 years. Outside the South, production periods may be almost twice as long because of shorter growing seasons and differences in tree species.

Based on evidence from tree planting under other programs, it is likely that about 85 percent of trees will be retained beyond the 10-year CRP contract period. Alig and others found that 86 percent of the acres planted to trees in the South under the Soil Bank Program were still in trees after 15-20 years, while Kurtz and others found an 85 percent retention rate for 10-year-old Agricultural Conservation Program tree plantings. Genetically improved tree seedlings, advances in reforestation science, and a favorable market outlook for forest products are other factors that suggest that most trees planted under the CRP will be retained to harvest.

An average CRP acre planted to trees could produce 7,400 cubic feet of commercial wood over 45 years.[6] Thus, 2.7-3.5 million acres of CRP trees would produce 20.0-25.9 billion cubic feet of wood over the same time span.

The present value of an acre of trees would be over $2,040 at a 4 percent rate of discount. The present value of maintenance and harvesting costs would be approximately $210 per acre. The farmer's share of costs to establish trees averaged about $37 per acre based on information from the first six CRP signups. Under the assumption that 85 percent of the tree acres were retained until final harvest, the present

[6]These estimates were provided by Robert Moulton, Forest Service, USDA.

value of 2.3-3.0 million acres of CRP trees ranges from $4.1 to $5.4 billion.

This estimate should be interpreted as a maximum value. Variations can be expected because trees grow faster than average on some sites and slower than average on other sites. Landowners respond to changes in timber prices, harvesting more when prices are high and less when prices are low (Binkley; Boyd). Some land planted in trees may not be harvested so that the landowner might enjoy the aesthetic value associated with standing timber, but no attempt was made to estimate this value.

*Land Values*

Landowners gain around $60-$100 per acre in the value of their land if it is eligible for the CRP. This effect depends on regional markets. Currently available evidence indicates that the CRP's effects on land values are concentrated in the Mountain States and Northern Plains where farmland markets are depressed.

Farm programs that are tied to production affect land values (Herdt and Cochrane; Floyd). Farm programs such as the CRP increase net farm income by raising prices through direct payments or production controls. The increases in income tend to become capitalized into the value of cropland. As the CRP boosts land values, landowners gain wealth from the program. In a perfectly competitive land market, increases in the value of land caused by the CRP would be identical to the present value of CRP increases in farm returns.[7] How much land values rise due to the CRP depends on the size and duration of the changes in farm income and returns to land.

The CRP raises agricultural land values in several ways:

- The CRP provides an alternative market for eligible cropland. The minimum value of a CRP-eligible acre equals the present value of the 10 annual CRP rental payments less maintenance costs and the farmer's share of costs to establish cover crops.
- Enrollment reduces the effective supply of cropland in localized areas and pushes up cash rental rates and land values.
- The future value of any timber production on CRP land increases its value.
- Farmers may be able to lease CRP land to hunters in areas where hunting demand is high and leasing of land for hunting is a common practice.[8]
- Expected net returns rise because the CRP increases commodity prices. The value of cropland rises to reflect the increase in expected net returns. Net returns increase as commodity prices rise, reflecting lower acreage reduction requirements and reduced commodity program participation. If landowners correctly anticipate the increased net returns from market level changes in prices, they will demand higher CRP rental payments as a condition for program participation. However, the general value of all cropland will increase when commodity market prices rise.
- Future productivity of the land is preserved because the CRP cuts soil erosion. Studies have shown that a portion of the increase in soil productivity accrues to the landowner (Ervin and Mill; Miranowski and Hammes).

Research designed to quantify the CRP's impact on land values shows a range of $60-$100 per acre. Shoemaker estimated that the program added up to $60-$70 per acre to CRP-eligible cropland values in the United States (table 8). The greatest estimated increases in land values occurred in the Northeast and Southeast regions. Shoemaker used data from the first five CRP signups, and assumed that rental bids by farmers for the first signup were based on marginal returns to the land. However, bids from signups two through five were not assumed to be based on marginal returns since farmers were aware of the maximum acceptable rental rate in their region and tended to bid near the maximum. Shoemaker's results represent maximum (not actual) estimated effects, since average bid caps rose in response to several factors.

Land values may rise as much as $100 per acre, depending on regional markets. An alternative way

[7]Since this report estimates the increase in net farm income separately, it would be inappropriate to include the increase in land values due to increased profitability of agricultural production when evaluating the overall performance of the CRP. To do so would represent double-counting the effects of the CRP on farm income.

[8]Hunting lease value increases were not estimated for this report. Later in this section, the total value of increased hunting activity resulting from the CRP is estimated.

to view the effect of CRP rental rates on land values is that the CRP establishes a floor on the value of land eligible for the reserve. Where the discounted value of the 10-year CRP contract less cover establishment and maintenance costs is greater than the average value of the cropland, a new minimum price is established for CRP-eligible cropland (fig. 4). The minimum value of eligible land exceeds average cropland values in the Mountain and Northern Plains regions. The average land value in the Mountain region is about $220 per acre, while the present value of the 10-year CRP contract for similar cropland is $320 per acre. Thus, producers in a competitive land market must bid closer to $320 per acre for CRP-eligible land. Even though the land is poor quality for agricultural production, its value could increase by approximately $100 per acre due to the floor set by the CRP.

**Table 8—Gains in the value of land eligible for the CRP (present value), signups 1-5**

| Region | Discount rate (percent) 4 | 6 | 8 |
|---|---|---|---|
| | | *$/acre* | |
| Northeast | 99 | 90 | 83 |
| Appalachian | 58 | 53 | 48 |
| Southeast | 132 | 120 | 110 |
| Delta States | 74 | 68 | 62 |
| Corn Belt | 74 | 68 | 62 |
| Lake States | 58 | 53 | 48 |
| Northern Plains | 58 | 53 | 48 |
| Southern Plains | 49 | 45 | 41 |
| Mountain | 74 | 68 | 62 |
| Pacific | 33 | 30 | 28 |
| United States | 71 | 65 | 59 |

Source: Shoemaker, 1989.

## Export Losses

The FAPSIM model projects that U.S. exports of agricultural commodities decline under the CRP. Crop production falls, which lowers stocks and increases commodity prices. Higher commodity prices curb the quantity of agricultural products exported. The largest percentage export reductions were projected for wheat and corn after 1991 (table 9). Soybeans, sorghum, and cotton exports fall by about 4-8 percent. If U.S. export cutbacks are substantial in markets where it is a major supplier (such as in the corn, wheat, soybean, cotton, and rice markets), world prices may rise, causing other countries to expand production.

The effects of the CRP on U.S. trade competitiveness vary over time. The CRP has little effect on competitiveness in the short run, because economically marginal cropland was retired initially. How-

Figure 4
**CRP maintains a floor on value of eligible land, 1987**

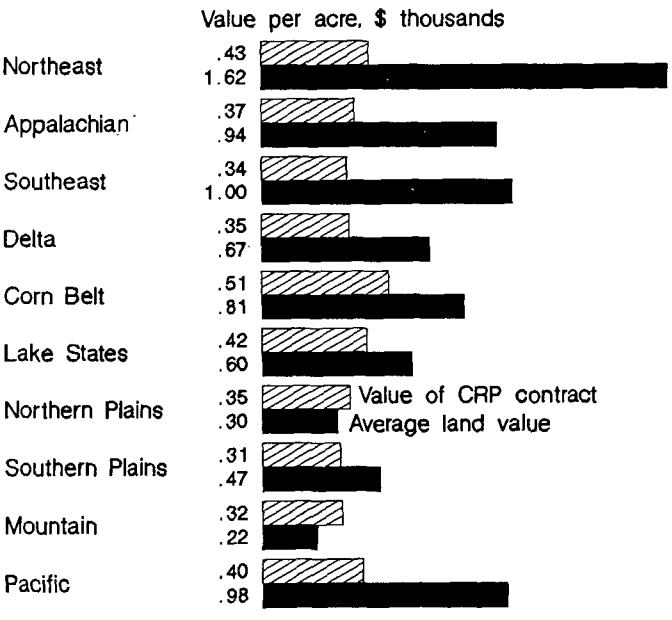



**Table 9—Decline in U.S. exports under the CRP[1]**

| Crop | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|
| | | | | *Percent reductions* | | | | |
| Wheat | 5.2 | 7.8 | 9.6 | 8.7 | 12.7 | 18.1 | 17.4 | 16.6 |
| Corn | .1 | .2 | 1.4 | 4.1 | 6.6 | 10.5 | 10.1 | 10.7 |
| Soybeans | 2.1 | 2.8 | 3.1 | 3.7 | 4.4 | 5.1 | 5.2 | 6.9 |
| Cotton | 1.9 | 3.1 | 1.6 | 5.1 | 1.4 | 4.6 | .1 | 5.7 |
| Sorghum | 4.1 | 3.5 | 7.8 | 5.6 | 8.8 | .8 | 2.8 | 3.5 |

[1]Assumes annual imports for each crop are constant.
Source: FAPSIM simulation, August 19, 1987.

ever, as the program retires more productive land, export competitiveness declines. In the long run, the comparative advantage of resource quality among countries becomes an important determinant of agricultural trade flows. If the CRP helps maintain the productivity of the U.S. resource base while other countries do not enact conservation policies, U.S. comparative advantage in agriculture and longrun competitiveness may be strengthened.

### Consumer Food Costs

The simulation projected that consumer food costs will increase by less than 1 percent in any year as a result of the CRP, peaking around 1995. The present value of the increase in consumer cost was estimated to be $25.2 billion over the program's life. A 1-cent increase in crop prices does not result in a 1-cent increase in consumer food cost since farm prices account for less than 30 percent of the average retail price of food. If we assume that price increases stop at 1992, the rise in consumer food costs would be less ($12.7 billion present value).

The rise in consumer cost hurts lower income households more since they generally spend a larger portion of their disposable income on food. Measures such as the food stamp program offset a portion of this burden, but the price rises would likely require some additional spending on food assistance programs.

## Natural Resource Benefits

Soil, water, and wildlife resources will improve under the CRP. The improvements will be felt mostly in off-farm areas that are currently affected by agricultural soil erosion. The value of improvements in natural resources is estimated at $6.0-$13.6 billion (present value). Soil productivity benefits account for only $0.8-$2.4 billion, even though protecting soil productivity for the future is a primary factor in determining whether a field is eligible for enrollment in the reserve. Estimates of benefits to natural resources depend on how much cropland is retired in a particular region and on how much soil erosion is reduced. Delivery of eroded soils to waterbodies is an important source of water pollution.

### Erosion Control Benefits

Soil loss from water and wind erosion will be reduced under the CRP. Soil erosion, caused by the actions of water and wind, is the primary problem on U.S. cropland targeted by the CRP. Sheet and rill erosion (water erosion) is the primary problem in the Eastern States. Wind erosion generally affects the arid Western States. Preserving soil yields long-range benefits to soil productivity.

#### *Sheet and Rill Erosion*

A 45-million-acre CRP will cut roughly 25 percent of total soil erosion estimated to occur annually on U.S. cropland. Ribaudo and others (1990) estimate that the 45-million-acre CRP will reduce erosion by approximately 17 tons per acre per year on average, for a total annual erosion reduction of about 750 million tons by the final signup (table 10). Erosion control benefits diminish over the life of the program, since cropland with the most serious erosion problems was enrolled first. The average annual erosion reduction for acreage enrolled in the first six signups is about 21 tons per acre (table 2). Land retired in the first two signups averaged 26-27 tons of annual erosion reduction per acre. This fell to an annual average reduction of 17-18 tons per acre in the fifth and sixth signups.

Rising commodity prices caused by the CRP will induce farmers to bring other land into production, so some additional erosion will occur. However, legislation denies commodity program benefits to farmers who bring erodible land into production without conservation measures ("sodbuster"), so new erosion will be minor. The total increase in erosion on new lands brought into production will average 30 million tons per year by 1990, not nearly enough to outweigh the erosion control gains of the CRP. This represents only 4 percent of the total reduction in erosion on CRP-enrolled lands in the United States. The increase in erosion due to the new cultivated land varies from 9 percent of the

**Table 10—Erosion reduced on cropland enrolled in CRP**

| Region | 1988 | 1990 |
|---|---|---|
| | *Million tons/year* | |
| Northeast | 1.5 | 8.4 |
| Appalachian | 22.7 | 46.6 |
| Southeast | 16.4 | 25.4 |
| Delta States | 15.7 | 25.8 |
| Corn Belt | 64.8 | 115.9 |
| Lake States | 34.7 | 48.3 |
| Northern Plains | 93.8 | 128.7 |
| Southern Plains | 126.1 | 179.5 |
| Mountain | 105.6 | 140.3 |
| Pacific | 20.0 | 28.1 |
| Total | 501.3 | 747.0 |

Source: Ribaudo and others, 1990.

erosion reduction on CRP-enrolled lands in the Lake States to less than 2 percent in the Southern Plains and Appalachian region (Ribaudo and others, 1990).

### *Wind Erosion*

The 45-million-acre CRP could yield about $0.5 billion in savings from reduced wind erosion in arid regions. Using a preliminary method developed by Piper, the present value of wind erosion benefits for a 45-million-acre CRP was estimated at $0.4-$1.1 billion, with a most likely estimate of $0.5 billion (table 11). These benefits are concentrated primarily in the Southern Great Plains. About 50 percent of the benefits occur in Texas alone, while 90 percent occur in Texas, Colorado, Kansas, New Mexico, and Oklahoma combined. Reductions in wind erosion

**Table 11—Environmental benefits of the CRP, net present value, 1986-99**

| Region | Soil productivity | Water quality | Wind erosion | Wildlife |
|---|---|---|---|---|
| | | *$million* | | |
| Best estimate: | | | | |
| Northeast | 36 | 127 | na | 368 |
| Appalachian | 107 | 407 | na | 326 |
| Southeast | 43 | 280 | na | 376 |
| Delta States | 46 | 376 | na | 243 |
| Corn Belt | 473 | 584 | na | 846 |
| Lake States | 239 | 406 | na | 1,470 |
| Northern Plains | 216 | 306 | 148 | 100 |
| Southern Plains | 271 | 338 | 155 | 67 |
| Mountain | 150 | 458 | 217 | 18 |
| Pacific | 45 | 275 | 28 | 34 |
| Total | 1,626 | 3,557[2] | 548 | 3,848 |
| Low estimate: | | | | |
| Northeast | 18 | 76 | na | 282 |
| Appalachian | 54 | 160 | na | 250 |
| Southeast | 22 | 167 | na | 288 |
| Delta States | 23 | 231 | na | 187 |
| Corn Belt | 237 | 273 | na | 649 |
| Lake States | 120 | 232 | na | 1,127 |
| Northern Plains | 108 | 162 | 109 | 77 |
| Southern Plains | 136 | 181 | 99 | 52 |
| Mountain | 75 | 248 | 153 | 14 |
| Pacific | 23 | 152 | 25 | 26 |
| Total | 813 | 1,883[3] | 386 | 2,952 |
| High estimate: | | | | |
| Northeast | 54 | 179 | na | 454 |
| Appalachian | 161 | 657 | na | 402 |
| Southeast | 64 | 400 | na | 463 |
| Delta States | 69 | 531 | na | 300 |
| Corn Belt | 709 | 895 | na | 1,043 |
| Lake States | 359 | 576 | na | 1,812 |
| Northern Plains | 324 | 459 | 312 | 123 |
| Southern Plains | 407 | 500 | 282 | 83 |
| Mountain | 224 | 671 | 440 | 23 |
| Pacific | 68 | 406 | 72 | 42 |
| Total | 2,439 | 5,274[4] | 1,106 | 4,745 |

na=Not applicable.
[1]Totals may not add due to rounding.
[2]Excludes filter strip benefits of $170 million.
[3]Excludes filter strip benefits of $0.
[4]Excludes filter strip benefits of $250 million.

due to the CRP are high in other regions of the Western United States, but the economic benefits are low because population in these areas is relatively small.

Estimating the economic damages attributable to wind erosion is difficult and uncertain due to the limited amount of information on this topic. Estimates of erosion reductions from wind erosion control practices are less precise than similar estimates for sheet and rill erosion (USDA, Soil Conservation Service, 1987). And only a few studies have quantified damages from wind erosion. As indicated by the wide range spanned by our estimate and the preliminary nature of the estimation method, considerable uncertainty is associated with this estimate.

Wind erosion damages are caused by high winds carrying fine soil particles, primarily in the Western States. Because drought is common and plant cover is sparse, the wind picks up soil particles, adding to particulate air pollution. Environmental Protection Agency studies have shown that agriculture contributes significantly to air pollution in the San Joaquin area of California, the Phoenix-Tucson area of Arizona, the Las Cruces area of New Mexico, and around Lubbock, Texas (Jutze and Axetell; Record and Baci). Wind erosion episodes can produce short-term particulate loads in the air in rural areas higher than particulate pollution in urban areas. Households and businesses pay more for maintenance and cleaning and for damage to nonfarm machinery. Some people's health suffers from heavy particulate pollution.

#### *Soil Productivity*

Reductions in soil erosion can lead to benefits by maintaining the soil's ability to produce in the future. The present value of the soil productivity benefits for the 45-million-acre CRP was estimated at $1.6 billion, but could range from $0.8 to $2.4 billion (table 11). The Corn Belt and Lake States gain most per acre by preserving their fertile soils.

Excessive erosion reduces crop yields over time by diminishing water-holding capacity and water infiltration rates, and increasing nutrient losses. Applying more fertilizer may mitigate nutrient losses, but fertilizer will not restore yield loss linked with lost water-holding capacity. Soil productivity can be conserved and the costs of adding fertilizer can be avoided by stopping excessive erosion.

By multiplying estimates of the average damages per ton of soil loss times the estimates of erosion reduction due to the program, we projected which regions benefit most from soil productivity gains (Ribaudo and others, 1990). Soil productivity benefits per ton were estimated using the Erosion Productivity Impact Calculator (EPIC). The yield loss and fertilizer cost increases per ton of erosion were simulated over a 50-year time period. The Corn Belt and the Lake States gain more productivity benefits than the Mountain and Northern Plains regions, because higher soil productivity in the Corn Belt and Lake States outweighs the lower enrollment in these regions.

### Water-Quality Benefits

The value of improved surface water quality attributable to the CRP is between $1.9 and $5.3 billion. The CRP affects mainly surface water but could also reduce damages to ground water from agricultural pollution.

Nutrients from chemical fertilizers, animal manure, pesticides, and sediment flow from farmland into waterways as a result of soil erosion. These diminish water quality and impose costs on water users. Excess nutrients, primarily nitrogen and phosphorus, in surface water speed growth of aquatic vegetation. Too much vegetation decreases fish populations and degrades recreational resources. Nutrients and pesticides that leach into ground water can contaminate drinking water supplies. Sediment washing off cropland into waterways can fill reservoirs, block navigation channels, interfere with water conveyance systems, damage aquatic plant life, and impair recreational resources.

#### *Surface Water*

The present value of offsite surface water-quality benefits from the CRP ranges from $1.9 billion to $5.3 billion (table 11) (Ribaudo and others, 1990). Per-acre benefits varied widely among the regions. Midpoints ranged from less than $30 per acre for the Northern Plains to nearly $250 per acre for the Delta region. These benefits depend on the amount of erosion per acre reduced by retiring the land, and the demand for water services (indicated by the damages per ton of erosion). The Appalachian and Delta regions have the highest per-acre reductions in sheet and rill erosion for land enrolled in the CRP, and the highest per-acre benefits for surface water quality.

Erosion reductions are relatively high in the Corn Belt, but water-quality damages per ton of erosion are very low. A region such as the Northeast, with modest per-acre reductions in erosion but high

damages per ton of erosion, has much greater per-acre benefits.

Surface water-quality benefits of the CRP were estimated for nine damage categories for each geographic region following procedures described in Ribaudo, 1989. Depending on available information concerning the relationship between erosion and offsite damages, three different methods were used to link reductions in erosion and changes in pollutant delivery with the economic benefits to water users.

The analysis used a damages-avoided approach to assess effects of the CRP on flooding, navigation, roadside ditches, and irrigation canals. This approach measures changes in expenditures made to counteract or prevent damages from pollutants as a means of estimating the benefits to improved water quality.

Changes in costs of treating water or producing items with water were the basis for the second method used here. This method applies to activities such as water treatment, municipal and industrial use, and water storage. The change-in-treatment-or-production-cost approach is used when water quality is assumed to be a perfect substitute for some input(s) in the production of a good or service.

The change-in-consumer-surplus approach was the third way water-quality benefits were analyzed. This method is used when water quality influences the demand for a good, such as recreation. A change in water quality causes the demand for recreation to shift. The area between the two recreation demand curves measures consumers' willingness to pay for improved water quality.

Recreational fishing increases when water quality improves in the Appalachian and Corn Belt regions. The method used to estimate recreational fishing benefits assumed that recreational activity was harmed by erosion if fish habitat standards were violated.

**Filter Strips.** Converting 93,000 cropland acres to filter strips would add up to $300 million to the surface water-quality benefits of the CRP. The most likely estimate is $170 million.

Eligibility for the CRP was expanded beginning with the February 1988 signup to include filter strips within about 100 feet of water bodies. Installation of filter strips curbs sediment and nutrient pollution of surface waters by slowing runoff. Vegetation near the water can trap and use the soil particles and nutrients. Over 16,000 acres were devoted to filter strips of the 3.4 million acres enrolled during the sixth signup. Assuming that the proportion of land in filter strips remains constant for the remaining signups, approximately 93,000 acres of filter strips would be established under a 45-million-acre CRP.

*Ground Water*

Retiring highly erodible cropland through the CRP is not likely to generate much improvement in ground water quality. Data and methods to make a monetary estimate are not available, but relatively little land is suited for protecting ground water via the CRP. Most erodible cropland is on slopes and loses water through surface runoff. When water runs off the surface, fewer pollutants leach to ground water since less water moves to the ground water (Crowder and Young). Almost 76 million acres of cropland overlay aquifers that are potentially vulnerable to ground water contamination from farming. But only 16 percent of this cropland is highly erodible, so very little is available for CRP enrollment (Algozin and others).

If the CRP were targeted to land that is both vulnerable to ground water contamination and highly erodible, future ground water contamination could be controlled somewhat (fig. 5). Since retired cropland is no longer used for crop production, agrichemical use is reduced or eliminated, and excess agrichemicals do not leach into ground water.

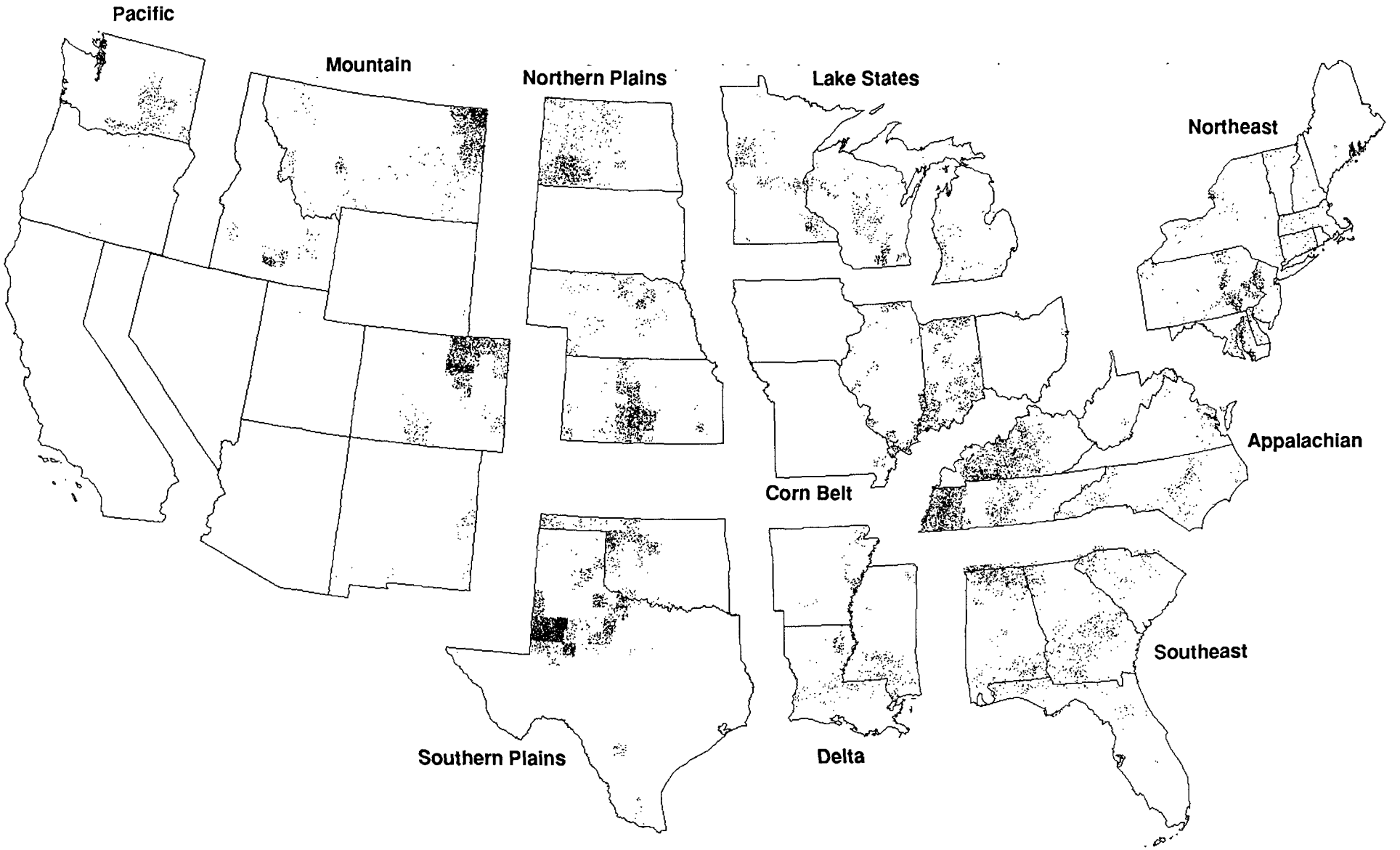
To best control ground water contamination, the CRP should focus on regions like the Southern Plains, where erodible land is found in areas susceptible to ground water pollution. Over 65 percent of the cropland at risk of causing ground water contamination in the Southern Plains is highly erodible. Over 40 percent of the erodible land in the Southeast, Delta, and Appalachian regions is vulnerable to ground water contamination, so these regions would also be appropriate targets.

We could not develop estimates of the economic benefits of ground water improvement attributable to the CRP because we lack methods for valuing changes in ground water quality. Data were not available to determine the susceptibility of CRP-enrolled acreage to ground water contamination.

**Wildlife Habitat Improvements**

Better habitat for wildlife on acreage retired from farming provides economic benefits for hunting amounting to $3.0-$4.7 billion (present value).

Figure 5—Cropland eligible for the Conservation Reserve Program and potentially vulnerable to ground water pollution




1 dot = 1,000 acres
17.2 million acres of eligible and potentially vulnerable cropland

People who enjoy viewing wildlife also benefit, but we are not able to make a monetary estimate. The largest percentage gain in grassland habitat will be in the Lake States and Corn Belt.

Animals use grassy areas near cropland for nesting cover, food, winter cover, and corridors for movement. New grassland habitat created by the CRP is expected to increase farmland wildlife populations. The major beneficiaries will be people who engage in wildlife-related recreational activities, like hunting, fishing, birdwatching, and photography.

We estimated how changes in wildlife populations affect participation in hunting of small game species including pheasant, quail, grouse, prairie chicken, rabbits, hares, and squirrels. The effect of the CRP on waterfowl populations was not estimated.

Wildlife benefits resulting from the CRP were estimated from changes in participation rates for small game hunters due to expanding grassland habitat (Ribaudo and others, 1990) (table 11). The new participation rates were then used to estimate the number of new hunters as a result of the CRP. Standard day values of $28 and $45 were selected from the literature for the value of an average day of hunting. For a point estimate we used $36.50.

The primary factor affecting wildlife benefits was the change in the percentage of grassland in a region. The Lake States and Corn Belt have the largest percentage increases in grassland from the CRP. Although grassland enrollment was high in some of the Western States, these States already have large amounts of rangeland, so that percentage changes in grassland area were small.

The procedures used to estimate wildlife benefits assumed hunter participation rates will continue to increase as more habitat becomes available. But since all CRP land is on private property, hunters may not have access. Our projections were based on adjusted 1980 participation rates and did not reflect recent declines in the popularity of hunting. These caveats imply that the estimates for small game hunting may be high. However, the user-day values employed were conservative and benefits for waterfowl hunters and people who view or photograph wildlife were not included. The final estimates therefore probably undervalue the total benefits to people who take part in recreation involving wildlife.

### Ground Water Savings

Over the 15-year life of the CRP, enough ground water to irrigate up to a million acres a foot deep (acre-foot) could be saved due to retirement of irrigated land in regions suffering from ground water depletion. The ground water savings help to preserve the level of water tables that had been declining due to heavy use of water for irrigation and other needs. Other irrigators in the vicinity gain because costs to pump irrigation water from the ground are lower, or at least do not continue to climb as the water table falls.

From 600,000 to 775,000 irrigated acres may enroll in the CRP (Schaible). Annual ground water savings ranging from 0.8 to 1.0 million acre-feet of water would result if this acreage were retired. Ground water savings of this magnitude would save remaining irrigators between $14 and $28 million (net present value) in pumping costs.

Enrollment in the CRP has partially contradicted the common expectation that producers would retire their least productive, dryland acres. CRP enrollment in the Southern Plains is correlated strongly with ground water decline areas (Schaible). Both the physical characteristics of aquifers and the economics of irrigating cropland explain why producers may choose to retire irrigated land.

For those areas in which the water level has dropped so much that pumping costs are high and returns for irrigated crop production are low, irrigators prefer the CRP as an alternative to reverting to higher risk dryland production. The CRP is especially attractive for those irrigators faced with high pumping lifts and major capital expenditures to revitalize old irrigation systems. For irrigators whose well output is falling, the CRP offers the option of enrolling some of their land and using the water saved to fully irrigate other land. For those irrigators who, expecting the high prices of the 1970's to continue, expanded their irrigated base on acreage with low productive potential, the CRP now offers a way out of a financial crisis. And in areas where CRP rental payments approach average cash rental rates for irrigated cropland, producers may choose to enroll irrigated acres.

## USDA Costs

The CRP will cost the Government about $21.5-$22.8 billion over the life of the program. Peak outlays are expected in 1990-95. Most of the costs are offset by savings in USDA commodity programs amounting to $16.2-$19.5 billion. Payments to compensate farmers for land retirements are the largest cost component.

Program costs include: 1) CRP rental payments to participating farmers for 10 years, 2) cost shares to establish cover crops, 3) technical assistance costs for verifying field eligibility and designing conservation plans, and 4) miscellaneous program administration costs. Some of these costs represent transfers of resources from earlier programs. Cost savings from implementing the CRP go to the Commodity Credit Corporation (CCC). When cropland formerly in CCC programs is removed from production, the CCC saves on price support payments. When market prices increase as a result of the CRP, the CCC saves on deficiency payments. Curbing production of surplus commodities saves the CCC storage costs. Besides the CCC, other Government erosion control programs save resources which otherwise would have been applied to the CRP land.

The analysis did not examine potential effects of the CRP on costs for the Export Enhancement Program (EEP). The EEP was designed primarily to maintain the U.S. share of world trade in agricultural products and is a relatively small component of USDA program costs. Total EEP expenditures are determined by the U.S. Congress, not by USDA, and represent less than 10 percent of USDA expenditures designed to reduce commodity stocks.[9]

## CRP Program Costs

Total Government costs for the 45-million-acre CRP will reach $21.5-$22.8 billion (present value). Rental costs will peak at about $2.5 billion annually during 1990-95, when the program reaches 45 million acres. The total cost figure allows for increases in rental payments above the rates estimated in our analysis of potential enrollment. The payment increases may be needed to offer enough incentive to enroll 45 million acres. In addition to rent, the USDA also pays for technical assistance and half the cost of establishing cover crops on acreage in the reserve.

Program operation costs for the CRP are substantial since cropland is rented from farmers over a 10-year period, and the Government provides one-half of the cost of establishing permanent vegetative cover on retired acreage. USDA also incurs various program administration costs. The Agricultural Stabilization and Conservation Service (ASCS) incurs costs associated with acceptance, verification, and selection of bids. The Soil Conservation Service (SCS) incurs costs of verifying the erodibility of land which is offered for CRP enrollment. Both SCS and the Forest Service (FS) pay technical assistance costs in the design of conservation plans for establishing permanent cover. Finally, the Extension Service (ES) incurs expenses to inform and educate the public concerning the existence and operation of the program.

### *Rental Costs*

Annual expenditures for rental payments reach a maximum of $2.5 billion from 1990 through 1995 when the full 45 million acres of cropland are retired (table 12). Expenditures for rental payments decline after 1995 as land initially enrolled begins to leave the program. Using a 4 percent rate of discount, the discounted value of CRP rental costs was estimated at $19.5 billion.

Rental payments may have to be raised to persuade more farmers to retire land. We adjusted our cost estimate to account for the possibility of rents going up. The discounted value of rental costs rises by

**Table 12—Projected CRP rental costs**

| Year | Projected | Present value[1] |
|---|---|---|
| | *$million* | |
| 1986 | 88 | 88.0 |
| 1987[2] | 778 | 748.1 |
| 1988 | 1,309 | 1,210.2 |
| 1989 | 2,020 | 1,795.8 |
| 1990 | 2,531 | 2,163.5 |
| 1991 | 2,531 | 2,080.3 |
| 1992 | 2,531 | 2,000.3 |
| 1993 | 2,531 | 1,923.4 |
| 1994 | 2,531 | 1,849.4 |
| 1995 | 2,531 | 1,778.2 |
| 1996 | 2,443 | 1,650.4 |
| 1997 | 1,753 | 1,138.7 |
| 1998 | 1,222 | 763.3 |
| 1999 | 511 | 306.9 |
| Total[3] | 25,310 | 19,496.4 |

[1] Discounted at 4 percent for 10 years.
[2] Excludes one-time corn bonus of $323 million.
[3] Totals may not add due to rounding.

Source: Tables 4 and 7.

[9] By reducing commodity stocks, the CRP creates a potential expenditure savings for the EEP. Conversely, the CRP increases commodity prices, increasing the differential between the U.S. and world prices for commodities. As this differential increases, EEP bonuses must increase to maintain a given level of exports. Thus, the direction of the change in EEP expenditures cannot be determined, although the net effect is expected to be negligible. Consequently, this analysis assumes that the CRP does not affect EEP costs since the goal of EEP is to maintain the U.S. share of agricultural trade and not to reduce the supply of excess commodities.

$1.3 billion if we assume that rental payments are 10 percent higher in 1989 and 20 percent higher in 1990 than the payment rates projected in our original analysis of CRP enrollment (table 6).

Over the life of the program total rental costs climb because the total amount of land enrolled in the program grows and because per-acre rental payments are expected to rise as the program expands. Rental rates will likely rise further during future signups in response to two factors. First, a fixed amount of land is eligible for CRP enrollment and, second, as more land enters the program, higher rental rates will be necessary to induce remaining landowners to participate. Since these landowners either did not elect or were not selected to participate in earlier signups, it is reasonable to assume that they require higher rental payments than current rules permit. Second, if the CRP increases net farm income, the opportunity cost of retiring land in the CRP will increase. Land devoted to farming is worth more when farm income is up. This places more upward pressure on CRP rental rates.

A bonus was offered to farmers who retired corn base during the fourth signup (February 1987) for the 1987 program year. A one-time payment of $2 per bushel for corn base was made as an inducement to retire corn base and to encourage CRP participation. This added about $323 million to the cost of the program. The bonus increased the amount of corn base acres enrolled during the February 1987 signup. For the second, third, and fifth signups 6.8 percent, 7.1 percent, and 5.5 percent, respectively, of the acreage enrolled represented corn base; while for the fourth signup 24.7 percent of the acres represented corn base (Dicks and others, 1988a). Of course, participating landowners may have been willing to retire the same land without the bonus. Others may have simply decided to advance their intended participation in the CRP to take advantage of the bonus. While it is difficult to assess the net impact that this bonus had on total enrollment, the bonus does appear to have influenced the decision to retire corn base during the fourth signup.

### *Technical Assistance and Cover Crops*

Spending for technical assistance and to establish cover crops was largest in 1987 when the greatest amount of land was retired. The discounted value of technical assistance and establishing cover crops was estimated to be $0.1 billion and $1.6 billion, respectively, for the entire program (table 13).

Technical assistance costs for the CRP are about $2.53 per acre based upon information from the USDA budget. While ASCS, SCS, and FS pay some program costs, they also save on the costs of other programs. Land enrolled in the CRP is removed from commodity programs administered by ASCS. Likewise, SCS and FS do not need to design and implement conservation plans for highly erodible land subject to the conservation compliance provisions if it is enrolled in the CRP. After 1995 the savings will fall, because cropland can be taken out of the CRP and conservation plans will be needed if the farmers plan to cultivate the land and wish to participate in USDA programs.

## CCC Commodity Program Savings

Direct costs to the CCC fall by about $12.2 billion as land that was producing program crops is set aside. The CCC saves $7.3 billion indirectly because the CRP boosts market prices and the CCC pays out less in deficiency payments.

**Table 13—CRP cost for technical assistance and cover crops**

| Year | Technical assistance | | Cover crops | |
|---|---|---|---|---|
| | Projected[1] | Present value[2] | Projected | Present value[2] |
| | | *$million* | | |
| 1986 | 5.2 | 5.2 | 76.0 | 76.0 |
| 1987 | 35.0 | 33.7 | 517.0 | 497.1 |
| 1988 | 28.2 | 26.1 | 417.0 | 385.5 |
| 1989 | 22.8 | 20.3 | 350.0 | 311.1 |
| 1990 | 22.8 | 19.5 | 350.0 | 299.2 |
| Total | 114.0 | 109.7 | 1,710.0 | 1,569.0 |

[1]Assumes $2.53 per acre for technical assistance.
[2]Discounted at 4 percent. Totals may not add due to rounding.

Source: Tables 4 and 7.

Under the CRP baseline scenario adopted in this report, the CCC realizes direct cost savings because production falls due to retired program base acreage, and indirect cost savings if market prices of program crops rise due to the CRP. However, under an alternative baseline which assumes that in the absence of the CRP the USDA would have expanded acreage reduction programs and paid land diversions to the level of supply control achieved by the CRP, there would be no effect on estimated CCC commodity program costs. The costs of the CCC programs would probably increase if annual acreage reductions and diversions were expanded. For farmers to be willing to retire additional land under annual retirement programs, the relative attractiveness of the programs would have to improve as an enticement for farmers to participate in the programs. Target prices and/or paid land diversion payments would have to increase. Estimation of these costs is beyond the scope of this analysis. However, these cost increases could exceed the costs of the CRP, especially during the later years of the program when stocks are lower and commodity prices are higher.

*Direct CCC Cost Savings*

Stopping production on land that once produced program commodities saves the CCC price support payments, storage costs, and other program costs. About $10.2-$12.2 billion will be saved over the life of the CRP (table 14). Savings grow as the program expands to the full 45 million acres. As market prices rise in response to the CRP, savings to the CCC begin to decline after 1993. If price increases after 1992 are excluded from the analysis, the net direct cost savings to the CCC falls to $10.2 billion.

The savings to the CCC depend on which commodity had been produced on the land. Corn acreage yields the largest total savings in the FAPSIM simulation (table 15). If more corn base were retired in place of barley base, for example, CCC would gain even more cost savings.

*Indirect CCC Cost Savings*

When commodity prices are higher, the CCC deficiency payment rate is lower. By cutting supply and boosting commodity prices, the CRP saves the CCC about $6.0-$7.3 billion in discounted value of deficiency payments (table 14).

The simulation predicts that market prices exceed loan rates after 1988. The indirect CCC savings are found by multiplying the change in market prices times program production. Program production is base acres less acres set aside in other supply reduction programs, times CCC participation rate, times CCC program yields. The result is net present value of reduced deficiency payments at $7.3 billion.

Commodity prices rise slowly in the early years of the program, until enough cropland base is retired to lower stocks of surplus commodities. After 1992, prices climb quickly in this simulation (table 7).

We made a second estimate under the assumption that commodity prices would not rise after 1992.

**Table 14—CCC cost savings under the CRP[1]**

| Year | Indirect | Direct | Total |
|---|---|---|---|
| | | *$million* | |
| 1986 | 47 | 11 | 58 |
| 1987 | 209 | 47 | 256 |
| 1988 | 334 | 76 | 410 |
| 1989 | 57 | 925 | 982 |
| 1990 | 478 | 809 | 1,287 |
| 1991 | 257 | 1,382 | 1,639 |
| 1992 | 861 | 1,292 | 2,153 |
| 1993 | 442 | 2,354 | 2,796 |
| 1994 | 1,250 | 1,325 | 2,575 |
| 1995 | 1,085 | 1,299 | 2,348 |
| 1996 | 996 | 1,192 | 2,188 |
| 1997 | 650 | 778 | 1,428 |
| 1998 | 400 | 479 | 879 |
| 1999 | 192 | 230 | 422 |
| Total | 7,259 | 12,200 | 19,459 |

[1]Present value of FAPSIM simulation results. Totals may not add due to rounding.

**Table 15—CCC cost savings under the CRP by commodity[1]**

| Commodity | Indirect | Direct | Total |
|---|---|---|---|
| | | *$million* | |
| Wheat | 2,983 | 3,309 | 6,292 |
| Corn | 1,893 | 7,097 | 8,990 |
| Sorghum | 209 | 295 | 504 |
| Barley | 215 | -40 | 175 |
| Oats | 33 | 4 | 37 |
| Cotton | 1,926 | 1,053 | 2,979 |
| Rice | 0 | 482 | 482 |
| Total | 7,259 | 12,200 | 19,459 |

[1]Present value of FAPSIM simulation results.

Indirect CCC cost savings fell to $6.0 billion under this restriction.

## Program Evaluation

The effects analyzed in the preceding sections of this report should be considered as parts of an overall pattern of economic tradeoffs set into motion by the CRP. Some of the individual effects, such as less crop production and soil erosion, represent changes in the quantity or quality of goods and services that comprise total national income or wealth. Others, including most costs for Government commodity programs, do not represent changes to real goods or services but are merely adjustments in transfer payments between sectors or regions of the economy.

### Evaluation Framework

To place the many different economic effects into a consistent framework, we chose the following perspectives for evaluating the CRP:

- How will the CRP affect total national income? This evaluation method, sometimes called economic efficiency or benefit-cost analysis, looks at national income in the present and near future. It covers only those effects that change the value of real goods and services.

- How will the CRP affect Government spending? Government cost savings and new expenses attributable to the program are considered in this framework. Most of these effects are adjustments or transfer payments between taxpayers and the Government, or between different Government programs. The effects examined in this framework usually do not overlap the national income framework.

- How will the CRP affect different regions and economic sectors? Enrollment is not uniform over regions, and the CRP's effects are not consistent across sectors of the economy. We looked at how regions and sectors fare in different stages of the program's implementation.

### National Income

The present value of net benefits for a 45-million-acre CRP was estimated to be $3.4-$11.0 billion. Estimating the full net national income effect of the CRP requires estimating all product and service value changes that occur with versus without the CRP. Value increases (benefits) include improved environmental conditions, decreased costs of surplus commodity production and storage, increased future supplies of timber, higher farm income, and fewer costs of administering traditional conservation programs. Value decreases (costs) of the program include higher per-acre production costs from restructured production of crops, CRP administrative costs, cost to establish cover crops (both Government and farmer shares), technical assistance costs, unemployment or underemployment of immobile production and marketing resources caused by reduced crop production, and increased consumer food costs.

For a number of reasons, our estimate of CRP net economic benefit should only be regarded as an approximation of the true net benefit of the program.

First, due to the methods used for analysis, the estimated effects on farm income and consumer costs do not exclusively reflect changes in economic welfare. Second, it was impossible to estimate all of the economic effects of the CRP. For example, potential economic effects resulting from changes in ground water quality, surplus crop costs, and unemployment or underemployment of production resources are not included. Estimates of the primary effects are shown in table 16. And third, the effects we did estimate are dependent to varying degrees upon the assumptions of the no-CRP baseline situation. Our baseline assumed that in the absence of the CRP, acreage reduction program and paid land diversion levels would remain at the legislated maximums that were in effect at the time of the analysis. Under alternative baseline assumptions, the magnitude of the estimated effects on net farm income and consumer food costs would undergo the most change, while the size of the other effects would likely be altered to a lesser degree. However, because net farm income and consumer food costs effects are largely offsetting, different baseline assumptions would probably not cause large changes in the estimated net economic benefit of the CRP.

### Government Spending

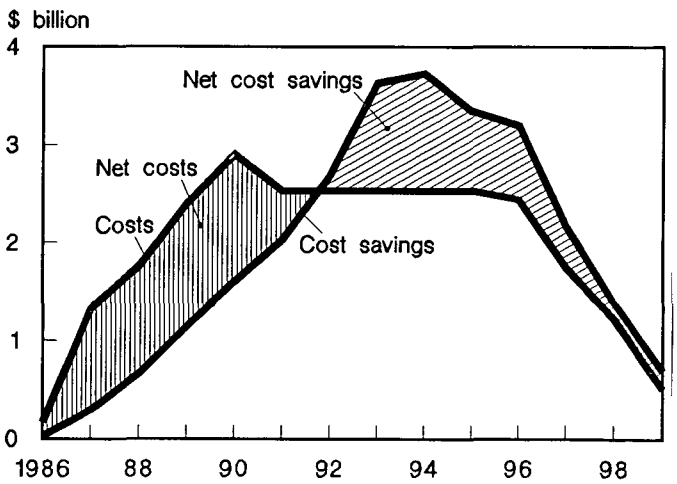
The CRP will cost the Government an estimated $2.0-$6.6 billion over the life of the program, even though estimated CCC cost savings offset most of the expenditures (fig. 6). In the early years of the CRP, program costs exceed CCC cost savings, since the Government pays rent and other costs while market prices of program crops have not yet risen sufficiently to affect CCC costs. After 1991, however, annual CCC cost savings start to exceed

the CRP costs (primarily rental payments). Over the 15-year life of the CRP, Federal Government costs are $21.5 to $22.8 billion compared with CCC cost savings of $16.2 to $19.5 billion. The net Government financial effect of the CRP is a cost increase of between $2.0 and $6.6 billion (table 17).

**Table 16—National income gains and losses from the CRP**

| Category | Value |
|---|---|
| | *$billion* |
| Gross income gains: | |
| Landowners: | |
| Net farm income | 9.2 to 20.3 |
| Timber production | 4.1 to 5.4 |
| Natural resources/environment: | |
| Soil productivity | .8 to 2.4 |
| Surface water quality | 1.9 to 5.3 |
| Filter strip water quality | 0 to .3 |
| Wind erosion | .4 to 1.1 |
| Wildlife | 3.0 to 4.7 |
| Gross income losses: | |
| Consumer costs | (12.7 to 25.2) |
| Establishing cover crops: | |
| Landowner's share | (1.6) |
| Government's share | (1.6) |
| Technical assistance cost | (.1) |
| Net program benefit | 3.4 to 11.0 |

Figure 6
**USDA costs for the CRP**




Savings to the CCC would increase if CRP land were to remain out of crop production after 1995. If rental rates are higher than estimated in 1989 and 1990 as an inducement for increased program participation, the net expense of the program will rise.

Our estimate of the net Government expense of the CRP is only one approximation of the true net Government expense of the program. As with the net economic benefit estimate, it was not possible to include estimates of all of the potential Government cost effects of the CRP. More importantly, though, estimates of Government cost effects are greatly influenced by acreage reduction program levels assumed in the no-CRP baseline situation. Different assumptions about the level of acreage reduction programs in the absence of the CRP will result in different estimates of net Government expense.

In a separate analysis performed after the 1988 drought, Barbarika and Langley estimated the present value of the CRP's net Government expense to be approximately $9.7 billion. Their estimate was the result of a similar set of models, but used different assumptions concerning expected supply-demand-price conditions and CCC programs than did our analysis. They assumed lower commodity stock levels, higher market prices, lower acreage reduction and paid diversion levels, and lower CCC program outlays stemming from the effects of the 1988 drought. Most significantly, they assumed that acreage reduction/paid diversion levels would have been higher in the absence of the CRP. These assumptions reduce the CCC cost savings attributable

**Table 17—Government expenditures and cost savings for the CRP**

| Category | Value |
|---|---|
| | *$billion* |
| Gross Government expenses: | |
| CRP program costs: | |
| Rental payments | 19.5 to 20.8 |
| Corn bonus payments | .3 |
| Cover crops | 1.6 |
| Technical assistance | .1 |
| Gross Government cost savings: | |
| CCC cost savings: | |
| Direct | 10.2 to 12.2 |
| Indirect (price effect) | 6.0 to 7.3 |
| Net Government CRP expense | 2.0 to 6.6 |

to the CRP and thus cause their estimate of net Government expense to exceed our estimate.

## Regional and Sectoral Economic Effects

The CRP will reduce economic activity significantly in the agricultural production and agricultural input sectors. Effects on the agricultural processing, household, and other sectors will be minor. Because enrollment in the CRP is concentrated in the Northern Plains, Southern Plains, and Mountain States, these areas will bear the brunt of the economic downturns linked with the CRP.

Agricultural production is forecast to fall 3 percent after the CRP is fully in place. Agricultural input industries decline by 2 percent. The household sector loses one-tenth of 1 percent in total income, total gross output, and employment. The agricultural processing sector declines even less.

### *Variations Over Time*

Economic effects on geographic regions and other sectors differ in each of the following three stages of the program:

1) the first year, in which production stops and part of producers' rental income goes to establish cover crops;

2) 9 years when rental payments flow in;

3) after the 10th year, when rental payments stop and the land may go back to agricultural uses.

Total income and employment fall at first, as cropland is retired from production, participants receive rental payments, and cover crops are established. Establishing cover crops generates activity to partly offset the effects of falling farm production. During the next 9 years, the economic activity in the processing, household, and other sectors is slightly higher than in the first period since revenue from rental payments is not used to plant ground cover. The agricultural input sector continues to decline in the second period because there is no more activity generated by cover crops.

When rental payments end, economic activity declines even further. The decline would be tempered if the CRP lands were returned to agricultural production as haying or grazing land or as cropland.

### *Agricultural Production and Related Industries*

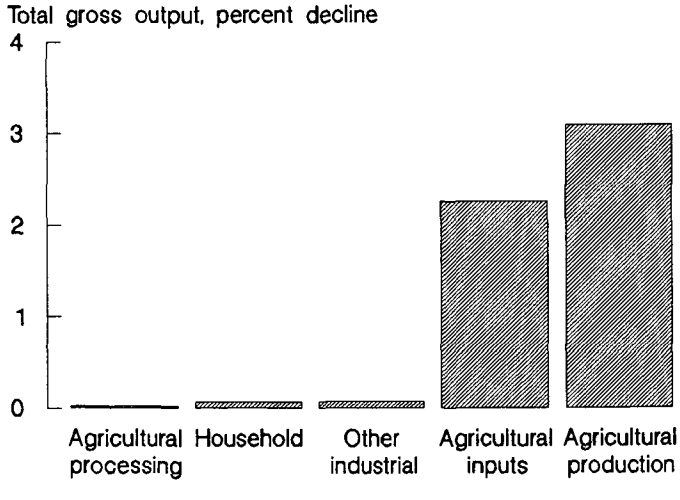
An input-output model developed by the Forest Service called IMPLAN was the basis for the estimate of how the CRP affects other economic sectors (Dicks and others, 1988a) (fig. 7). Agricultural production is forecast to fall 3 percent after the CRP is fully implemented. Agricultural input industries decline by 2 percent. The CRP will have a minor percentage effect on the economic activity in the agricultural processing, household, and other industrial sectors. Total income, total gross output, and employment fall by about one-tenth of 1 percent in the household sector, and by even less in the processing sector of the economy (fig. 7).

Manufactured input industries such as fertilizer, other chemicals, fuel and energy, and seeds are tied to crop acreage and commodities planted in the immediate geographic area. Input use falls as CRP enrollment increases and planted acreage declines. Fertilizer use declines by more than 12 percent by 1990 (fig. 8). Manufactured input industries rebound somewhat as other land is brought into production in response to rising commodity prices. Similar trends were noted for other inputs.

### *Regional Variations*

Regions that depend on farming and have high rates of enrollment in the CRP feel the economic effects most. Because a high percentage of eligible land is enrolled in the CRP in the Northern Plains, Southern

Figure 7
**Economic activity slows under the CRP**



Plains, and Mountain States, the economic impact is greatest in these regions. Economic effects are significant in the Lake States and the Corn Belt as well, because the land that enrolled in the program is quite productive and the drop in production from retiring the land is correspondingly high.

When we looked at smaller, more farm-dependent geographic areas, the decline in economic activity was greater. Northeastern Montana suffers more than the Mountain States region overall (fig. 9). The problem for areas where enrollment is concentrated intensifies as the CRP expands to 45 million acres.

Recovery after the 10 years in the reserve are over depends on how the land is used. If the land is used for haying and grazing, regions with large livestock sectors such as the Southern Plains and Mountain States can recover quickly because seeds and fertilizers will not be needed to bring the land back into agricultural production.

## Changing the Emphasis of the CRP

If the CRP were redirected to target other than highly erodible land, the economic results of the program would change (tables 18 and 19). Emphasizing forestry with a 45-million-acre CRP would boost the timber industry but decrease consumer food costs and cut farm income relative to the current program. Focusing on environmental goals would raise the environmental gains. Expanding the CRP to 65 million acres would help landowners and yield natural resource gains but expand the budget.

The following analysis indicates the direction of changes expected from reorienting the program, compared with what is estimated for the current program. No attempt was made to quantify each of the effects under different program goals.

### Forestry Emphasis in the CRP

Redirecting the CRP to meet or exceed the goals of the FSA to plant trees on 12.5 percent of enrolled CRP cropland would reduce program costs and shift the regional distribution of enrolled acreage. Most of the added forest acreage would be in the Southeast and Delta regions. Additional participation may also occur in the Appalachian and Lake States.

For the first five signups, average CRP rental rates in the Southeastern States were below the national average rental rate. Enrolling additional acreage in these regions would reduce average rental costs, unless a premium or bonus were needed to induce additional program participation in a smaller geographic area. Costs to plant the trees would likely remain at current levels since costs for trees in the Southeast have been less than or equal to costs for planting other cover crops, primarily grasses and legumes. However, Dicks and others (1988b) report that establishment costs for trees are considerably higher in other regions. If CRP land were converted to trees in these other regions, establishment costs might increase.

Enrollment of additional acreage in the Southeast and Delta regions would reduce the estimated

Figure 8
**Fertilizer use drops under the CRP**

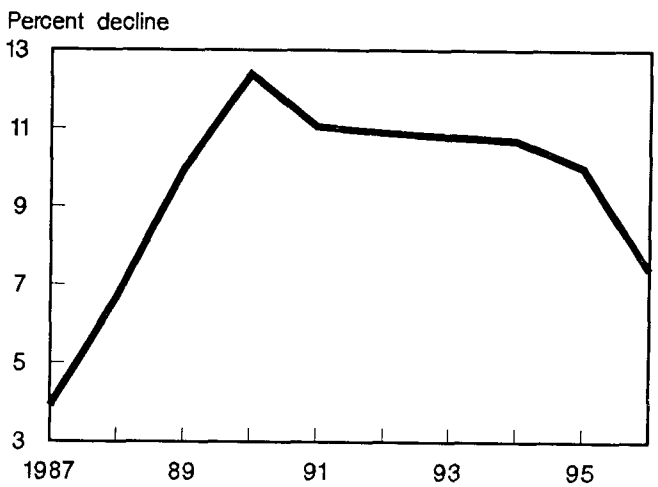
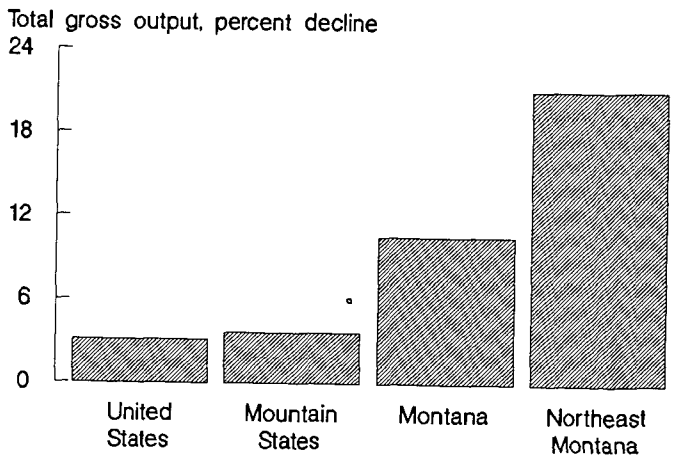



Figure 9
**Regional effect of CRP on agricultural production varies by concentration of enrollment**



increase in market prices of program crops since fewer program crop (base) acres would be enrolled. The Southeast, Northeast, and Delta regions enrolled the lowest ratio of base acres to total acres in CCC programs of all U.S. regions. Because participation in CCC programs is lower in these regions, direct CCC cost savings after the land is retired would be lower. These regions also grow relatively less corn, which has the highest CCC costs of all program commodities. Since the increase in market prices would be lower due to the smaller reduction in program crop production, indirect savings would also be lower.

Other effects of enrolling additional acres for tree planting include: 1) since market prices of program commodities would rise by a lesser amount, net farm income and consumer food costs would increase by a lower amount; 2) forest production would increase; 3) more CRP land would remain in retirement past the 10-year contract period; and 4) to the extent that forests increase recreational activities such as hunting or lead to water-quality improvements, environmental benefits from the CRP would increase. However, per-acre water-quality and hunting benefits tend to be higher for land retired in the Corn Belt, Lake States, and Northeast regions than in the Southeast and Delta regions.

### Environmental Emphasis in the CRP

Targeting the CRP toward environmental goals would entail retiring more land in the Corn Belt and Lake States and the Chesapeake Bay drainage basin. This option increases the gains associated with water-quality improvement. The increase of water-quality benefits of up to $300 million from filter strips illustrates the magnitude of potential environmental gains. Improved wildlife habitat yields the greatest benefits per acre in these regions.

Increasing CRP enrollment in these regions would greatly increase CRP rental costs; however the net impact on CCC program costs is not clear. If a substantial amount of base acres, particularly corn base, were retired under an environmental CRP, the market price of corn would increase by a greater amount than predicted for the current CRP. In addition to the direct CCC cost savings from retiring the corn base, the indirect savings to the CCC could be larger. If corn prices rose, farmers would demand higher rental payments to offset the lost income from corn production as an incentive to participate. A rise in the market price of corn coupled with higher rental rates would lead to greater increases in net farm income. When commodity prices rise, consumer costs also rise, thereby partially or wholly offsetting the gains from increases in farm income.

Reduced production of corn would cut foreign trade and hurt input supply firms. Foreign sales of corn are an important component of U.S. trade in agricultural commodities. Use of manufactured inputs is relatively high for corn production compared with input use for other program commodities. If corn production were substantially reduced, agribusiness firms would face decreased sales.

### Expansion to 65 Million Acres

Expanding the CRP to 65 million acres instead of the current target of 45 million acres would produce similar types of effects to the forestry and environmental alternatives discussed above. However, the

**Table 18—Changes in national income from alternative CRP's**

| Category | Forestry | Environmental | Expanded |
|---|---|---|---|
| | *Direction of impact* | | |
| Landowners: | | | |
| Net farm income | - | + | + |
| Timber production | + | - | + |
| Natural resource gains: | | | |
| Soil productivity | ? | + | + |
| Surface water quality | ? | + | + |
| Filter strip water quality | - | + | + |
| Wind erosion | - | - | 0 |
| Wildlife | ? | + | + |
| Irrigation pumping | - | - | 0 |
| Consumer costs | + | - | - |
| Administrative costs: | | | |
| Establishing cover crops | ? | ? | + |
| Technical assistance | ? | ? | + |

**Table 19—Changes in Government expenditures from alternative CRP's**

| Category | Forestry | Environmental | Expanded |
|---|---|---|---|
| | *Direction of impact* | | |
| CRP program costs: | | | |
| Rental payments | - | + | + |
| Corn bonus payments | 0 | 0 | 0 |
| Establishment cost-share | ? | ? | + |
| Technical assistance | ? | ? | + |
| CCC cost savings: | | | |
| Direct | - | + | + |
| Indirect (price effect) | - | + | + |

magnitudes of the adjustments would be greater. The pool of eligible acres would have to be expanded to include both forestry production and environmental goals unless other acreage reduction programs were lifted. Rental rates would probably rise substantially as an incentive for program participation. Market prices for agricultural commodities would also rise. Expansion of the CRP beyond 45 million acres could reduce the Secretary of Agriculture's discretionary ability to control agriculture production. Long-term retirement of a significant amount of additional land could restrict timely expansion of crop production to meet major shortfalls in commodity stocks. Such shortfalls can be caused by factors such as the drought of 1988.

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# Appendix: Background and Operation of the CRP

Some of the CRP's goals and operating features are similar to those of previous USDA land retirement programs. This section reviews earlier programs and provides detail on the CRP.

## Previous Land Retirement Programs

The USDA has implemented land retirement programs in the past. Looking at these precursers to the CRP offers some clues about the CRP's methods and goals upon its implementation in 1985.

### *Soil Bank Program*

The CRP has its roots in the Soil Bank Conservation Reserve Program administered by USDA from 1956 to 1962. Under the voluntary Soil Bank, farmers were encouraged to enroll any land used for field crop production for 3-10 years (10-15 years for trees). In return, farmers received annual rental payments and 80 percent of the cost of installing a permanent land cover. No limits were placed upon the amount of land a farmer was allowed to enroll. In fact, those willing to enroll their entire farm were offered a 10-percent rental bonus. Lands placed into the Soil Bank could not be used for commercial purposes such as haying, grazing, Christmas tree production, or fruit production.

Among conservationists, the Soil Bank is considered a great success. The long-term retirement of farmland under the Soil Bank was immensely valuable to wildlife due to habitat diversification and the creation of escape and winter cover and nesting sites. Tree planting resulted in especially long-term conversions. In all, 2.1 million acres were planted to trees. A followup study in 1976 showed that 89 percent of the tracts and 86 percent of the acreage were still planted to trees (Alig, 1980).

While the conservation effects of the Soil Bank are often extolled, the program failed to accomplish its primary objective, which was to reduce crop surpluses. Crop surpluses continued because approximately one-quarter of the maximum 29 million acres enrolled in the Soil Bank had been in relatively nonerosive pasture or hay, which were not in oversupply. Agricultural production also increased on land not enrolled in the program.

The Soil Bank also caused local economic stress. A high proportion of land was retired in some counties, and rural areas that were heavily dependent upon crop production became economically depressed.

### *Payment-in-Kind Program*

The 1983 Payment-in-Kind (PIK) Program, which was implemented to combat overproduction resulting from record crops in 1981 and 1982, was also important in setting the stage for the CRP. Production fell, due to PIK coupled with reduced export demand and the 1983 drought. As the largest and most expensive set-aside program in the Nation's history, PIK drew national attention to the costs and long-term effectiveness of commodity programs. This led to questions concerning whether commodity programs tied to production encouraged farmers to plant more acreage to commodity crops. Frequently farmers planted inherently erosive crops that allowed soil erosion on highly erodible soils (American Farmland Trust, 1984; and USDA, ERS, 1985).

Environmental gains were small under PIK. Erosion was reduced by only 1.8 tons per acre, far less than could have been achieved had erosion reduction been a primary goal (Colacicco and others). Wildlife benefits were meager. Since PIK was an annual program, many farmers did not establish cover crops on their enrolled lands, and some farmers received payments for idling land on one farm while bringing additional acreage into production on another farm (CRS, 1984). PIK, more than any other factor or event, alerted conservation and environmental groups to the fact that as long as conservation and commodity programs remained separate and worked at cross-purposes, agricultural soil erosion would continue. Consequently, the push for integrating soil conservation goals with farm commodity programs was born.

## CRP Legislative History

Congress authorized the CRP on December 17, 1985, under Subtitle D, Title XII of the Food Security Act of 1985 (FSA, Public Law 99-198). Following the President's signature on December 23, 1985, the act went into effect. The Secretary of Agriculture has broad discretion in determining the regulations necessary to implement the specific provisions of the subtitle (Dicks and Reichelderfer; and Reichelderfer and Boggess). USDA issued interim rules and regulations for the CRP on March 13, 1986, and final rules and regulations on February 11, 1987.

## CRP Rules

Enrollment is limited by law to 25 percent of the cropland in a county. The 25-percent limit reduces

the amount of highly erodible cropland potentially available for the CRP to about 70 million acres (table 1). This restriction limits economic damage in areas heavily dependent on crop production. The limit may be waived by the Secretary of Agriculture if expanded enrollment would not significantly harm the local economy. The limit has been waived in selected counties where CRP land is planted to trees. Many of these areas depend on forestry production, and planting trees will boost future economic activity.

At least two-thirds of a field must meet one of three basic criteria to be considered highly erodible cropland: 1) the soil must be in land capability class VI-VIII; 2) the soil must be in land capability class II-V and be eroding at a rate exceeding three times the soil tolerance rate (T), or exceeding two times T if the cropland is to be planted to trees or if subject to severe gully erosion; or 3) the soil must have an erodibility index (EI) greater than eight and be eroding at greater than T. The EI is defined as the product of the rainfall (R), erodibility (K), and length and slope (LS) factors from the Universal Soil Loss Equation divided by T (Lee and Goebel).

The Secretary of Agriculture may also include lands, such as filter strips, that are not highly erodible if they contribute to environmental damage off the farm, or that may lose productivity due to soil salinity if permitted to remain in production.

Landowners or operators wanting to participate in the CRP must agree to implement a plan approved by the local conservation district to place highly erodible cropland into grasses, trees, or other acceptable conserving uses for 10 years. They must further agree not to harvest, graze, or make other commercial use of the forage unless the Secretary permits, as in a drought or similar emergency. The conservation plan must describe the measures and practices required, the commercial use, if any, to be permitted, and the amount of cropland base and allotment history, if any, to be permanently retired.

The amount of the reduction in cropland base acreage and allotment history during the life of the contract is based on the ratio between acreage placed in the reserve and total cropland acreage on the farm for those crops that have production adjustment programs in place. The Secretary may preserve the cropland base and allotment history unless the owner and operator agree to retire that cropland base and allotment history permanently.

To induce farmers to participate, USDA must pay an annual fee sufficient to compensate for the conversion of highly erodible land to grasses and trees and the retirement of any cropland base and allotment history. The annual rental payments may be made in cash or in kind and may be made prior to the implementation of the contract by owners or operators. The total payment cannot exceed $50,000 per year, and does not affect the total amount of payments that are available under other Government programs. USDA must make the payments as soon as possible after October 1 of each year. The Secretary must also provide technical assistance and 50 percent of the cost of establishing conservation practices. These payments must be made as soon after the expenses occur as is feasible.

Land on which ownership has changed in the 3-year period preceding the first year of the contract is ineligible for the CRP unless the land was acquired by inheritance or prior to January 1, 1985, or where the Secretary determines that the land was not purchased for the purpose of being placed in the reserve. Ownership is not a requirement for eligibility provided the person has operated the land for the 3-year period preceding the first year of the contract and will continue to control the land for the duration of the contract.

The Secretary may modify or terminate an individual contract if the owner or operator agrees to the change and if the action is in the public interest. If the contract is violated, the owner or operator forfeits all rights to past, present, and future rental and cost-share payments or must accept adjustments to payments that the Secretary determines appropriate. On transfer of ownership or lease, the new owner or operator has the option to continue the current contract, enter into a new contract, or refuse to participate.

To place highly erodible cropland into the CRP, a farmer applies at the county Agricultural Stabilization and Conservation Service (ASCS) office during the designated signup period. The farmer indicates the amount of land to be enrolled, the yearly rental payment (rental bid), the proposed land cover, and the Commodity Credit Corporation (CCC) crop base which would be reduced during the life of the CRP contract.

Once all applications for a particular signup period have been received, ASCS determines maximum acceptable rental rates (MARR's) for predesignated areas referred to as pools. After verifying that

eligibility conditions have been met, county ASCS committees review each application. An application is accepted if the rental bid does not exceed the established MARR and if the rental bid is consistent with market rents for comparable cropland.

The CRP has been modified several times to induce additional program participation. A one-time bonus of $2 per bushel of retired corn base equaling about $180 per acre was offered during the fourth signup in February 1987 (Dicks, 1987b). This offer was not extended for subsequent signups. Beginning with the sixth signup, in February 1988, eligibility was expanded to encourage tree planting and to improve water quality. MARR's were also increased in several regions (Osborn). Cropland where at least one-third of the field is eroding at a rate in excess of 2T is eligible if the land is planted to trees. Land that is within about 100 feet of a stream, lake, or wetland is eligible for CRP enrollment to function as filter strips without regard to the erosion rate. Filter strips contribute to water quality by trapping sediments and nutrients that erode from adjacent fields before they reach water.

### CRP Relationship to Other Programs

The CRP is part of an FSA package that addresses both environmental quality problems and the production of surplus commodities. Eligibility for commodity program benefits, such as commodity loans and deficiency payments, depends on meeting conservation provisions that are being phased in through 1995. The effectiveness of the conservation provisions depends upon the attractiveness of Federal price and income support programs. If Federal commodity support programs become less attractive due to such factors as higher market prices or increased set-aside requirements, the conservation provisions will become less effective.

The "sodbuster" provision discourages farmers from converting highly erodible lands to cropland unless conservation practices are installed. The "swampbuster" provision discourages farmers from converting additional wetlands to cropland. Violation of either provision results in the loss of USDA program benefits.

The conservation compliance provision restricts future eligibility for Federal farm programs if existing highly erodible cropland is farmed without an approved conservation plan. Farmers must have plans approved by January 1, 1990, and fully implemented by January 1, 1995, to preserve eligibility for most farm programs.

The conservation easements provisions allow producers to cancel the outstanding principal on any loan made or held by the Farmers Home Administration (FmHA) in exchange for an easement on wetlands, highly erodible lands, or lands deemed suitable by the Secretary.

The CRP is an integral part of this package of conservation provisions. The CRP provides landowners a means of retiring erodible land in order to meet the conservation compliance provisions. In turn, conservation compliance results in a more cost-effective CRP, because farmers subject to conservation compliance are willing to accept lower rental payments for retiring their highly erodible cropland. Finally, land retired under the CRP is somewhat more likely to remain in retirement after the 10-year contract period since most of it will be subject to conservation compliance if it is returned to crop production in the future.

The CRP also works in conjunction with the annual acreage reduction program (ARP) to control the production of surplus crops. The ARP's require farmers to set aside a certain proportion of their land as a condition for receipt of deficiency payments. Annual adjustments in the ARP levels permit the Secretary to control USDA program expenditures. As CRP acreage increases, the need to set aside cropland on an annual basis decreases.

### Factors Affecting CRP Enrollment

The primary factors affecting participation are whether or not the landowner or operator meets ownership eligibility criteria and whether or not the cropland conforms to the CRP definition of highly erodible. Once eligibility is established, the farmer must determine if he or she is better off farming the land, renting the land to the Federal Government under the CRP, or selling or renting the land for other uses (Boggess; Ervin and Dicks).

Conservation compliance provisions may also be a factor in the decision to participate in the CRP. One way to satisfy the compliance provisions is to place highly erodible land in the CRP. This decision is influenced by the expected costs of controlling erosion, the relative profitability of the land, and the farmer's expectations of future USDA program payments. At the end of the CRP contract this land may be planted to crops if adequate conservation practices are implemented within 1 year.

Four characteristics of landowners who are likely to bid land into the CRP were identified by Esseks and Kraft:

> 1) the owner's willingness to accept that his/her land had erosion problems; 2) the owner's age—those close to retirement were less likely to bid, presumably because the 10-year CRP contracts were seen as obstacles to selling the land; 3) whether the owner was also an operator—owner-operators were more likely to bid than nonoperators, probably because the former were closer to the land and better appreciated its suitability for the CRP; 4) whether an owner had recently (in the past 5 years) received technical assistance from USDA's Soil Conservation Service—recipients were more likely to bid than nonrecipients, perhaps because that connection inclined the farmer to be better plugged into the information flows about the CRP, and also to be more comfortable about entering into a contractual arrangement with USDA.

While participation in SCS programs increases the likelihood of participation in the CRP, the effect of participation in ASCS commodity programs on CRP participation is unclear. Farmers with base acreage allocations for ASCS commodity programs must retire a proportionate amount of the base. Presumably this affects the relative profitability of their farm. They have the option of selecting the crop base that is to be retired. Magleby and Dicks report that farmers choose to retire their least profitable base first (barley, oats, and sorghum base). Taff and Runge argue that the requirement to retire base acres may not have lowered CCC program costs and may have reduced farmer participation. They argue that similar reductions in planted acreage would result without the base retirement requirements due to the current set-aside programs. Dicks and others (1988b) found that CCC program participants tend to enroll larger blocks of acreage in the CRP than nonparticipants. Presumably, CCC program participants farm larger areas and thus have more land to enroll.

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