Analysis of Conservation Alternatives

Analysis of alternatives

The following analysis presents results from evaluation of different program alternatives. The alternatives are based on conservation needs and recommendations identified through public forums and discussions held during the year 2000 by entities and institutions such as USDA, the Soil and Water Conservation Society, the National Association of Conservation Districts and the Wildlife Management Institute.

The models used in the analysis and described below considered cropland, CRP lands, pastureland, federal and non-federal grazing lands, irrigation water use (surface and pumped sources) and labor (family and hired). Crops covered in the models include barley, oats, rice, wheat, corn, sorghum, soybeans, cotton, potatoes, hay, tomatoes, oranges, grapefruit, sugar beets and sugar cane. Livestock includes cattle, dairy, hogs, poultry and sheep.

The analysis involved use of the economic Agricultural Sector Model (ASM) for estimating baseline conditions in the U.S. agricultural sector and then comparing results with the baseline. The baseline model solution is calibrated so that its estimated resource and commodity market outcomes are consistent with the commodity market conditions for 2000 as reported in the USDA Agricultural Outlook Baseline (USDA 2000c). Additional resource availability and management conditions were calibrated to data for year 1997 using the Census of Agriculture and the National Resources Inventory.

Auxiliary models linked to and employed in this analysis include the Environmental Policy Integrated Climate model (EPIC; also known as the Erosion Productivity Impact Calculator) and the Hydrologic Unit Model of the United States (HUMUS), which provide estimates of soil erosion, sediment delivery, nitrogen, and phosphorus leaching and runoff at both the field and watershed levels of aggregation. Design and production of analysis products from the systems were developed by NRCS in partnership with USDA's Agricultural Research Service and Texas A&M University. (See Appendix C for a detailed explanation of methods, procedures and sources of data incorporated in the analysis.)

The analysis products contain regional-level information for natural resource program managers, legislators and policy officials to use in their deliberations about new and expanded conservation program proposals. Results from the analysis show significant potential for improvements in soil, water and environmental condition measures through sustained and enhanced voluntary incentives for agricultural producers.

The ASM model output was linked with the results from other modeling systems as well as agency technical staff workload and cost data to provide information such as the following at state, regional and national levels:

- changes in levels of commodity production, costs, income and social welfare measures;
- changes in crop acres and land uses;

- changes in the mixes of crops across soils, tillage types and conservation practices;
- changes in levels of production and income by region that can be related to farm size and demographic producer groups using Census of Agriculture data;
- changes in crop acres and land use to estimate water quality impacts for selected scenarios using the HUMUS model;
- crop acreage distributions and management information combined with the per-acre results from biophysical models to show a variety of economic and environmental impacts such as erosion, sediment, phosphorus and nitrogen losses to surface water and groundwater; and
- technical and financial assistance needs associated with each alternative.

In the analysis, the BASE scenario represented current programs and current conditions as approximated by the USDA baseline for 2000, the 1997 Census of Agriculture, the 1997 National Resources Inventory and Conservation Reserve Program and buffer program data as of September 2000.

The analysis estimated the impact of the following selected conservation alternatives above the BASE scenario:

Increase buffers to two million miles (BUF2): Simulate imposed enrollment of sufficient buffer acres to reach the two-million-mile goal under the assumption of current rules for CRP, installation costs and rental rates.

Expand the Conservation Reserve Program to 45 million acres (CRP45): Simulate imposed enrollment of acreage to expand the Conservation Reserve Program to 45 million acres under the assumption of continuing with current rules.

Initiate a Grazing Lands Reserve Program (GLR)
GLRa: Fund Grazing Land Reserve at $50 million annually, distributed proportionate to acres.
GLRv: Fund Grazing Land Reserve at $50 million annually, distributed proportionate to value.

Double the national acreage in mulch and zero till (TILL2X) from 37 percent to 74 percent of cropland.

Cropland Stewardship Proposal (CSP)
CSP1: Redistribute $5.57 billion in payments within each state to cropland and pasture land that already incorporate sustainable resource management systems.
CSP2: CSP1 plus simulate imposition of erosion control on remaining cropland to conservation compliance levels.
CSP3: CSP1 plus simulate imposition of erosion control on remaining cropland to sustainable resource management systems.

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Simultaneous BUF2, CRP45 and CSP2. Implementation of buffers, CRP45 and CSP2 simultaneously to capture economies.

Simultaneous BUF2, CRP45 and CSP3. Implementation of buffers, CRP45 and CSP3 simultaneously to capture economies.

Increase funding for the Farmland Protection Program to $65 million annually (FPP65).*

Double the Wetlands Reserve Program acreage by enrolling 250,000 acres annually for five years (WRP250).*

Increase funding for the Forestry Incentives Program by $38 million a year (FIP38).*

Increase funding for the Wildlife Habitat Incentives Program to $50 million annually (WHIP50).*

Reduce resource degradation (Figure 17)

Analysts combined the results for several alternatives to estimate the economic, environmental and program impacts that would accrue to reduce the rate of resource degradation. This alternative included program elements discussed in most of the public forums held during 2000 and in reports that were issued up through September 2000. The alternative includes achieving conservation compliance levels on all land at the CSP2 level, completion of two million miles of conservation buffers, enrolling 250,000 additional acres per year in WRP, slightly expanding FPP to $65 million and FIP to $38 million annually, establishing WHIP at $50 million annually, initiating a modest grazing land reserve and enrolling 45 million acres in CRP. These initiatives respond to the need to improve water and soil quality, reduce soil erosion, conserve marginal lands and wetlands, improve the condition of private grazing lands and provide economic incentives for land stewardship.

This alternative (and the one below to improve resource health) incorporate cost information with results of the analysis indicating that total costs to meet expected demand for conservation would be an additional $2.4 billion, while estimated environmental benefits totaled $7.4 billion.** The benefits are significant, and overall long-term social costs would be balanced by reduced degradation to soil and water resources and fewer environmental risks.

Additional financial incentives needed were estimated at $2.0 billion.

* These alternatives were not explicitly modeled, but estimated impacts were developed based on program specifications and results of other scenarios.

** Estimated environmental benefits include soil, water, air quality and wildlife habitat benefits. The analysis presumes that additional acreage retired and conservation treatments are optimally located to maximize environmental benefits. Complete accounting and quantifiable estimates for all environmental benefits are not yet available in the literature. Of the benefit estimates that have been quantified for CRP, wildlife habitat accounts for just over 50 percent, water quality for 35 percent, soil productivity for 10 percent and air quality for 4 percent of the total. Recent analyses of national and regional benefits can be found in Claassen et al. (2001) and Feather et al. (1999).

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Technical assistance needs amounted to an additional $737 million for the federal share and $189 million for the partner share, totaling $0.9 billion. The overall benefit/cost ratio was 3.2.

Improve resource health (Figure 17)

To improve resource health, analysts added sustainable resource management systems on all cropland at the CPS3 level to the initiatives used in the alternative to reduce resource degradation described above. This alternative addressed the highest level of conservation considered in the analysis.

The total social costs increased to $6.4 billion per year, with estimated environmental benefits of $10.7 billion. Additional financial incentives totaled $2.7 billion. Technical assistance needs amounted to an additional $1.8 billion for the federal share and $0.8 billion for the partner share, totaling $2.8 billion. Technical assistance costs rose substantially because of requirements for intensive resource management systems under this scenario. The overall estimated benefit/cost ratio was 1.7.

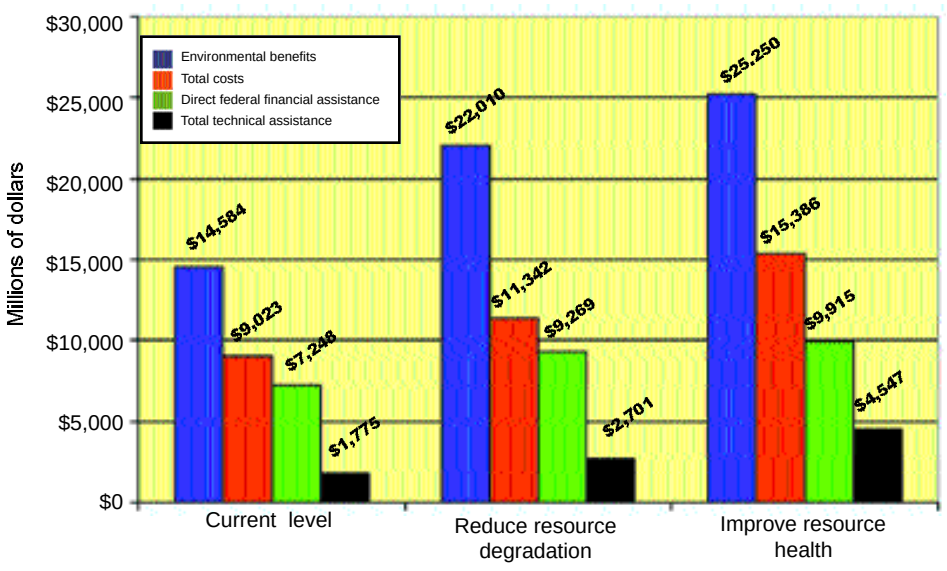
Discussion

To implement initiatives such as those presented above, USDA provides technical assistance, financial incentives, and research and educational services for conservation and environmental enhancement under a number of legislated authorities. The principal programs that deliver these services are described on pages 6 to 13.

Costs to accomplish the conservation and environmental enhancements presented in the analysis likely establish lower bound thresholds for several reasons. First, the principal means of simulating conservation accomplishments in the analysis is through imposition of successively higher levels of erosion control constraints or through requiring levels of the conservation practices (contouring, residue management, strip cropping and terraces) that are in the model system. Data on the costs and effects of intensive resource management systems, including costs for comprehensive nutrient and pesticide management systems, are not yet available at the regional levels of detail

FIGURE 17.

Benefits and costs to continue conservation investments at current levels, reduce resource degradation and improve resource health



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needed for incorporation into the modeling systems.

Second, modeled agricultural production costs did not include various non-modeled costs that are typically incurred as farmers change practices; for example, accelerated equipment replacement, losses associated with application of unfamiliar technology and incentives to cover the costs of changing to new and more intensive resource management systems.

Third, cost estimates for conservation practices are based on surveys of producers currently implementing the practices. Those estimates may not be representative of the conditions faced by producers who have not yet adopted the practice.

Fourth, the model used in this analysis (like any other model) does not include all options available to producers. As incentives change, both technology development and technology adoption occur, which lowers the cost of adoption and changes likely outcomes from the technologies that are currently available.

Alternatives

The remainder of this section provides additional details concerning each of the alternatives considered in this analysis.

BASE. Baseline conditions in the analysis match closely with current land use and economic and resource conditions as shown by the following:

- Just under 332 million acres of cropland planted.
- About 35 percent of cropland incorporating conservation tillage, strip cropping, contouring or terrace systems.
- About 32 million acres of land in the Conservation Reserve Program.
- About $7.2 billion in direct federal financial assistance to agricultural producers through CRP and AMTA payments.
- About $1.1 billion in federal technical assistance and support service costs for technology development, delivery and resource information such as inventories and soil and snow surveys.

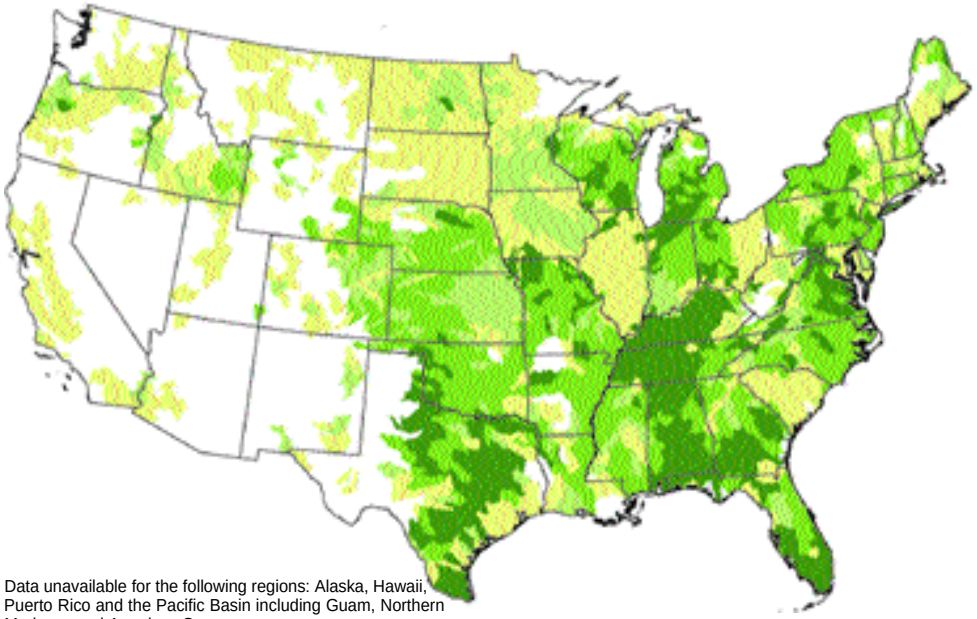
Extend the buffer program to achieve two million miles (BUF2; Figure 18, Table 5)

The annual cost to consumers/taxpayers to extend the buffer program to two million miles is $1.2 billion — $524 million as payments to producers and $673 million in higher farm gate commodity prices. However, producers receive both the government payments and the higher commodity prices, for a net gain of $529 million, so that the overall net financial cost to society is $668 million.

- Prices increase by 1.4 percent while production is down by 0.7 percent.
- Variable cost increases, but by less than do receipts, both in total and per acre.
- Net farm income is increased by 0.8 percent.
- The benefit/cost ratio is 4.1.
- With 4.5 million acres of additional cropped land placed into buffers, 0.4 million acres of previously idled cropland and 0.7 million acres of forest and

FIGURE 18.

Estimated percent reduction in total sediment yield (MAP 1), phosphorus yield (MAP 2) and nitrogen yield (MAP 3, next page) if buffers on cropland are increased to two million miles

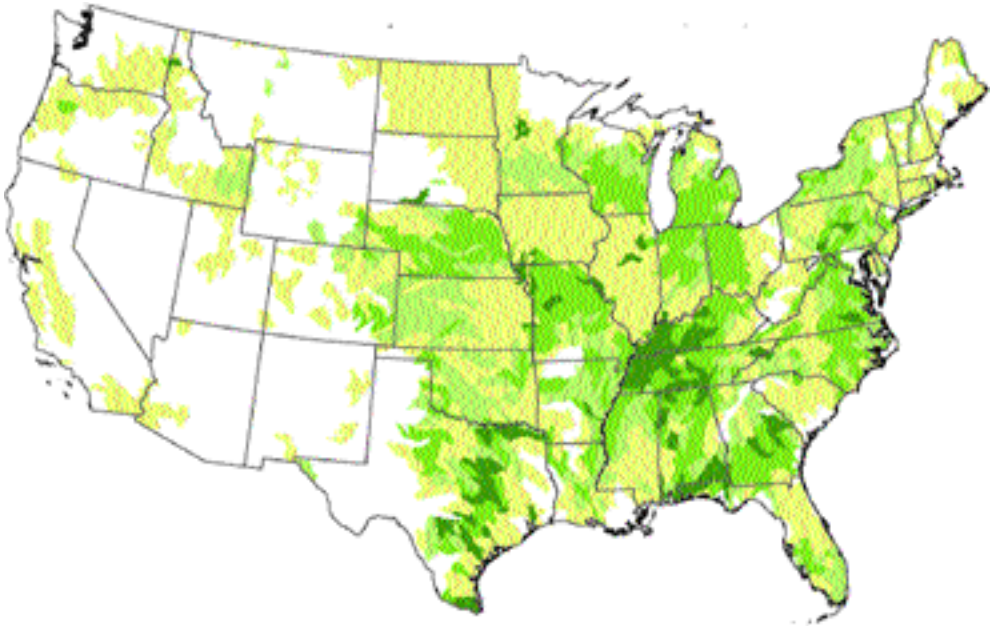


Data unavailable for the following regions: Alaska, Hawaii, Puerto Rico and the Pacific Basin including Guam, Northern Marianas and American Samoa.

MAP 1

Percent reduction

- 25 or more
  12.7% of watersheds
  40.1% of total reduction
- 15 to 25
  19.6% of watersheds
  38.4% of total reduction
- 10 to 15
  11.8% of watersheds
  13.2% of total reduction
- 2 to 10
  25.1% of watersheds
  7.9% of total reduction
- Less than 2
  30.8% of watersheds
  0.4% of total reduction



Data unavailable for the following regions: Alaska, Hawaii, Puerto Rico and the Pacific Basin including Guam, Northern Marianas and American Samoa.

MAP 2

Percent reduction

- 25 or more
  3.7% of watersheds
  21.9% of total reduction
- 15 to 25
  13.3% of watersheds
  39.9% of total reduction
- 10 to 15
  12.4% of watersheds
  18.2% of total reduction
- 2 to 10
  31.4% of watersheds
  19.5% of total reduction
- Less than 2
  39.2% of watersheds
  0.5% of total reduction

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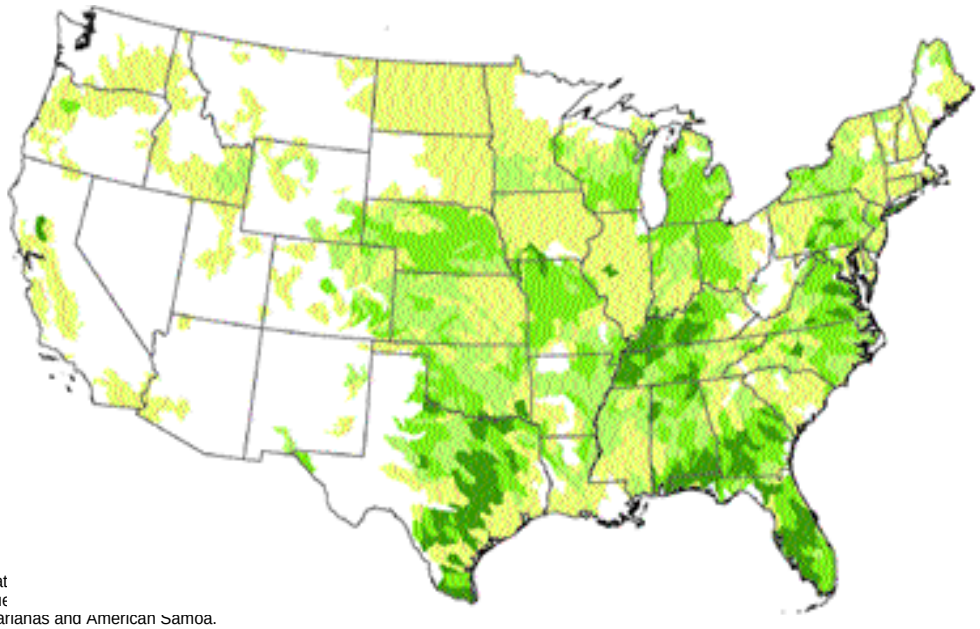

Dat
Pue
Marianas and American Samoa.

pasture land are converted to cropping in the model so that cropped land decreases by 3.5 million acres.

- Cropland rental value increases by $2.84 (3.9 percent) per acre.
- Effects of this program on the U.S. trade surplus are negligible (-/+0.01 percent).
- Regional impacts on producer income range from -2.4 percent ($238 million) in the Mountain states to 2.1 percent ($214 million) in the Pacific states.
- Impacts on levels of national resource use (cropland, irrigation water, grazing land and labor) are negligible (less than 1.5 percent).
- Reductions in potential pollutants to water bodies are 16 percent for sediment, 11 percent for nitrogen and 12 percent for phosphorus (see Figure 18).
- Technical assistance needs total

TABLE 5.

Impact of accomplishing two million miles of conservation buffers (buf2)

Estimated changes from baseline conditions (2000)

U.S. agricultural sector impact:	**Unit**	**Measure**
Producers	Million $	528.9
U.S. consumer	Million $	-673.1
U.S. taxpayers[2]	Million $	523.6
Total sector impact[2]	Million $	-667.7
Technical Assistance		
Federal	Million $	125.1
Partner	Million $	0.0
Total technical assistance	Million $	125.1
Total cost[2]	Million $	792.8
Estimated environmental benefits[3]	Million $	3288.1
Benefit cost ratio	Ratio	4.1
Producers'income	% change	0.81
Environmental impacts[6]		
Erosion	% change	n/a
Sediment	% change	-15.6
Total nitrogen	% change	-10.8
Total phosphorus	% change	-11.7

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

$125 million.

Expand CRP to 45 million acres (CRP45; Table 6)

The annual cost to consumers/taxpayers to extend the CRP program to 45 million acres is $2.1 billion — $713 million as payments to producers and $1,434 million in higher farm gate commodity prices. However, producers receive both the government payments and the higher commodity prices, for a net gain of $1,890 million, so that the overall net financial cost to society is $256 million.

- Prices increase by 3.6 percent while production is down by 1.9 percent.
- Variable costs increase, but by less than do receipts, both in total and per acre.
- Net farm income is increased by 2.9 percent.
- The benefit/cost ratio is 2.8.
- With 14.6 million additional acres of cropland placed in CRP in this analysis, 1.7 million acres of previously idled cropland and 0.8 million acres of forest and pasture are converted to cropping in the model, so that cropped land decreases by 12.1 million acres.
- Cropland rental value increases by $6.51 (8.9%) per acre.
- The trade surplus declines by $229 million (1.1 percent).
- Regional distribution of impacts varies slightly; CRP reduces cropping more on highly erodible land relative to other cropland classes.
- Potential environmental impacts of extending the CRP to 45 million acres include reduction of total erosion and sediment by seven percent, nitrogen by three percent and phosphorus by about five percent.
- Technical assistance needs total $291 million.

TABLE 6.

Impact of expanding the Conservation Reserve Program to 45 million acres (crp45)

Estimated changes from baseline conditions (2000)

U.S. agricultural sector impact:	**Unit**	**Measure**
Producers	Million $	1890.2
U.S. consumer	Million $	-1433.7
U.S. taxpayers[2]	Million $	712.9
Total financial cost[2]	Million $	-256.4
Technical Assistance		
Federal	Million $	290.9
Partner	Million $	0.0
Total technical assistance	Million $	290.9
Total cost[2]	Million $	547.3
Estimated environmental benefits[3]	Million $	1532.8
Benefit cost ratio	Ratio	2.8
Producers income	% change	2.91
Environmental impacts[6]		
Erosion	% change	-6.9
Sediment	%. change	-6.7
Total nitrogen	% change	-2.8
Total phosphorus	% change	-4.5

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

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Two options for a $50 million (annual) Grazing Land Reserve (Table 7)

The two Grazing Land Reserve options simulate enrollment of approximately two percent of the nation's pasture and private rangeland in a non-agricultural use reserve. Because the benefit/cost ratio relies heavily on erosion, which is not directly measured on rangeland, it does not accurately account for benefits on grazing lands. The national impacts on other land and water resources and on erosion are generally on the order of less than one percent.

In some regions, reducing the amount of grazing land means reduced livestock production and reduced feed production from cropland — hence, reduced erosion. In other regions, more feed is produced on cropland, and erosion increases slightly.

TABLE 7.

Impact of a $50 million (annual) Grazing Land Reserve Program

Estimated changes from baseline conditions (2000)

		GLRa	GLRv
U.S. agricultural sector impact:			
Producers	Million $	708.5	596.2
U.S. consumer	Million $	-641.0	-543.7
U.S taxpayers[2]	Million $	50.0	50.0
Total financial cost[2]	Million $	17.5	2.5
Technical Assistance			
Federal	Million $	12.6	12.6
Partner	Million $	8.5	8.5
Total technical assistance	Million $	21.1	21.1
Total cost[2]	Million $	38.6	23.7
Estimated environmental benefits[3]	Million $	-16.9	-31.3
Benefit cost ratio	Ratio	-0.4	-1.3
Producers Income	% change	1.1	0.9
Environmental impacts[6]			
Erosion	% change	0.1	0.1
Sediment	%. change	0.1	0.1
Total nitrogen	% change	0.0	0.1
Total phosphorus	% change	0.1	0.1

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

Allocation to states proportionate to state grazing acreage (GLRa; Table 7)

This acreage alternative costs consumers/taxpayers $691 million — $50 million in payments to producers and $641 million from higher farm gate commodity prices. However, farmers receive the payments and benefit from higher prices for a net gain of $709 million.

- Economic welfare for the United States increases by $17.5 million, while overall welfare at the world level declines at the expense of trading partners.
- Prices increase by 0.2 percent, while production is down by less than 0.1 percent.
- In the livestock sector, variable costs decrease as receipts increase.
- Net farm income is increased by 1.1 percent.
- The trade surplus increases by $36 million (0.2 percent).
- When $50 million annually is spent to enroll land in a grazing reserve with distribution proportional to acreage (GLRa), 0.8 million acres of cropland are converted to pasture land. However, just over one-half of this conversion comes from

previously idled cropland, and cropped acreage decreases by 0.4 million acres.
- Cropland rental value increases by $0.80 per acre.
- Estimated environmental impacts are less than 0.1 percent, since only about two percent of the land is affected.
- Technical assistance needs total $21 million.

Allocation to states proportionate to state grazing land value (GLRv; Table 7)

This value alternative costs consumers/taxpayers $646 million — $50 million in payments to producers and $544 million from higher farm gate commodity prices. However, farmers receive the payments and benefit from higher prices, for a net gain of $596 million, implying that the overall cost to society is near zero.

- Economic welfare for the United States increases by $2.5 million, while overall welfare at the world level declines at the expense of trading partners.
- Prices increase by 0.1 percent while production is down by less than 0.1 percent.
- In the livestock sector variable cost decreases as receipts increase.
- Net farm income is increased by 0.9 percent.
- Livestock producers benefit the most.
- The trade surplus declines by $17 million (0.1 percent).
- When $50 million annually is spent to enroll land in a grazing reserve with distribution proportional to rental value (GLRv), 0.6 million acres of cropland are converted to pasture land. However, just over one-half of this conversion comes from previously idled cropland, and cropped acreage decreases by 0.2 million acres.
- Cropland rental value increases by $0.80 per acre.
- Estimated environmental impacts are less than 0.1 percent, since only two percent of the land is affected.
- Technical assistance needs total $21 million.

Doubling of conservation tillage (TILL2X; Table 8)

The effects of doubling conservation tillage were simulated without explicitly addressing the policy or program mechanisms required to bring about that result. Acreages of both reduced tillage and zero tillage were forced to double in the model, with greater relative increases forced in areas that have lower historical rates of adoption.

The annual cost to consumers/taxpayers from forcing a doubling of conservation tillage is $6.1 billion dollars — $383 million in higher farm gate commodity prices and a loss in net farm income of $5.7 billion dollars (mostly attributed to limitations in the model that forced cropping on marginal lands). Financial assistance needs were just over an additional $1.8 billion, with total costs estimated at $9.8 billion. Benefits totaled $4.9 billion for a benefit/cost ratio of 0.5.

Actual costs in a volunteer program would likely be higher than the

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model estimates as producers face costs of accelerated equipment replacement, education and risk associated with adopting new technology. Also, technical assistance costs and government-sponsored technology development costs would likely be higher per acre than that observed for previous adopters, especially if adoption were forced to the level simulated in the model.

- The model was forced to simulate a proportionate increase in use of conservation tillage within each state with the proportion varying by state. In many situations, technological considerations such as crops grown in rotation for which conservation tillage is not an option (for example, potatoes) resulted in overall increases in crop acreage and/or use of less than optimal crop mixes and/or production technologies. Consequently, production was nearly stable, but at an increased cost. With higher costs and stable production, prices (revenue) change little as costs increase; consequently both producers and consumers lose.
- Even though on a per-acre basis conservation tillage may "pay for itself," in some cases crop yields are lower, and changes in overall cropping patterns occur because of crop mix, rotation and land availability constraints. It is expected that many of these costs would be moderated or even offset over time through education and financial and technical assistance.

TABLE 8.
Impact of doubling acreage of conservation tillage (till2x)

Estimated changes from baseline conditions (2000)

U.S. agricultural sector impact:	**Unit**	**Measure**
Producers	Million $	-5723.6
U.S. consumer	Million $	-383.0
U.S. taxpayers[2]	Million $	1801.9
Total financial cost[2]	Million $	-7908.4
Technical Assistance		
Federal	Million $	1158.4
Partner	Million $	786.6
Total technical assistance	Million $	1945.0
Total cost	Million $	9853.4
Estimated environmental benefits[3]	Million $	4960.4
Benefit cost ratio	Ratio	0.5
Producers income	% change	-8.80
Environmental impacts[6]		
Erosion	% change	-22.3
Sediment	%. change	-27.3
Total nitrogen	% change	-7.2
Total phosphorus	% change	-14.4

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

- Implementation of a single measure to address needs requires a technology in many parts of the country where it may not be practicable or feasible.
- Balanced systems of alternative management practices, rotations, cover crops, buffers and enduring practices would yield higher potential environmental and economic gains.
- In the modeled simulation in this analysis, variable costs increase by 7.9 percent, while production decreases by 0.9 percent.

- The benefit/cost ratio is 0.5.
- Prices increase by only 1.4 percent, and net farm income decreases by 8.8 percent.
- The trade surplus declines by $424 million (two percent).
- The $6,107-million cost to society divided by the 138 million acres adopting conservation tillage in this alternative implies a total adoption cost of $44.25 per acre.
- Meeting the conservation-tilled acreage constraint results in an artificial scarcity of cropland in some areas, resulting in an average rent increase of $35 per acre (48 percent).
- The net effect is conversion of 1.6 million acres of forest and pasture to cropping to meet the 0.8 million-acre increase in cropped and idled land.
- Cropland rental value increases by $35.11 per acre (48.0 percent).
- Impacts on levels of national resource use (cropland, irrigation water, grazing land and labor) are in the range of -4.3 percent (groundwater) to 1.5 percent (moderately erodible cropland).
- Regional impacts vary greatly. Erosion reduction ranges from 6.4 percent in the Appalachian region to 38.9 percent in the Pacific region.
- Producer income impact ranges from +2.4 percent in the Delta region to -22.6 percent in the Southern Plains region.
- Reductions in potential pollutants to water bodies are estimated at 15 percent for erosion, 19 percent for sediment, five percent for nitrogen and 10 percent for phosphorus.
- Direct financial assistance needs total $1.8 billion.
- Technical assistance needs total $2 billion.

Overall implications are that technical and financial assistance are needed to aid farmers in addressing all natural resource use management changes, including:

- tillage, supporting practices, rotations and resource management systems;
- change of cropping patterns across soils within a sub-region and across sub-regions;
- shifts in irrigation;
- establishing buffers; and
- protecting land idled in CRP by either developing reserve programs and/or developing alternative conservation management systems to continue use of land for production purposes.

Cropland stewardship proposal — Level 1 (CSP1)

Stewardship payments were interpreted in this analysis to provide rewards to producers who are already practicing sustainable resource management. Consequently, the payments were simulated as being added to farm income as a transfer in such a way as to not affect current resource management. No effects would result at national or regional levels, since the only effect is that $5.57 billion in direct payments to

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TABLE 9.
Average stewardship payment for acres of crop and pasture already adequately protected (csp1)

Farm production region	Crop and pasture adequately protected (%)	Current payments to producers (Billions $)	Estimated stewardship payment for crop and pasture already adequately protected ($ per acre)
Appalachian	75	0.20	7.22
Corn Belt	78	1.55	18.10
Delta States	83	0.54	21.65
Lake States	72	0.54	15.38
Mountain	69	0.37	11.67
Northeast	80	0.08	4.75
Northern Plains	79	1.19	15.83
Pacific	77	0.33	17.17
Southeast	78	0.15	7.65
Southern Plains	75	0.63	13.87
National Total	77	5.57	14.62

Note: Analysis precludes interregional redistribution of payments at this time but does allow redistribution within regions from all crop & pasture to land already adequately protected (i.e., eroding <T).

producers within states are reallocated to crop and pasture land already adequately protected.

Table 9 shows estimates of average payment levels for already existing stewardship by region, assuming no interregional redistribution of the current $5.57 billion in direct payments to producers.

Further comprehensive analysis is needed to estimate benefits and effects for incentive systems, resource management systems (including nutrient management, pesticide management, and wildlife habitat management) associated with stewardship provisions currently being discussed. Availability of data, modeling constraints and the time frame limited what could be included in this analysis.

Cropland stewardship proposal — Level 2; controlling all erosion to compliance levels (CPS2; Table 10)

The annual cost to consumers/taxpayers to extend erosion control at conservation compliance levels to all cropland is $981 million — $751 million of which stems from higher farm gate commodity prices and a net of $231 million of income losses to producers despite the higher prices.

- The cost is $1.78 per ton of erosion reduction for about 12 million additional acres treated with conservation techniques.
- Prices increase 1.2 percent as production declines by 0.4 percent.
- Total financial cost for the agricultural sector is just under $1.2 billion.

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- The benefit/cost ratio is 4.1.
- The trade surplus declines by $28 million (0.1 percent).
- Regional impacts on farm income range from -7.1 percent ($-711 million) in the Southern Plains region to 3.0 percent ($299 million) in the Pacific region.
- The erosion control constraint resulted in a decrease in acres cropped of 1.7 million acres; 0.4 million acres of this land is converted to forest and pasture use and the per-acre rent declines by $0.82.
- Idled land increases by 1.3 million acres, resulting in a decline in total rental revenue of $98.7 million (at base rent rate).
- Erosion is reduced by 31 percent (550 million tons):
  - where the erosion index is less than 8, by 10 percent (42 million tons)
  - where erosion index is between 8 and 20, by 46 percent (138 million tons)
  - where the erosion index is greater than 20, by 65 percent (115 million tons)
  - where in Classes IIIw-VIIIw (some is highly erodible land), by 57 percent (82 million tons)
- Regional reductions range from nine percent in the Delta region to 64 percent in the Southern Plains region.
- Cropped acreage drops by 11 percent for land with an erosion index greater than 20.
- National use of other resources changes by less than one percent, except for a three-percent increase in use of groundwater.
- Cropland with conservation tillage, strip cropping, contouring or terraces increases by 11.8 million acres per year.
- Potential environmental benefits reduce erosion by 31 percent, sediment by 33 percent, nitrogen by 13 percent and phosphorus by 20 percent.
- Total financial cost to the agricultural sector is $1.2 billion.
- Technical assistance needs total $467 million — $278 million for the federal share and $189 million for partners.

TABLE 10.

Impact of second-level cropland stewardship proposal: control all cropland to conservation compliance levels (csp2)

Estimated changes from baseline conditions (2000)

U.S. agricultural sector impact:	Unit	Measure
Producers	Million $	-230.7
U.S. consumer	Million $	-750.5
U.S. taxpayers[2]	Million $	218.4
Total financial cost[2]	Million $	-1199.5
Technical Assistance		
Federal	Million $	278.1
Partner	Million $	188.9
Total technical assistance	Million $	467.0
Total cost[2]	Million $	1666.5
Estimated environmental benefits[3]	Million $	6827.9
Benefit cost ratio	Ratio	4.1
Producers'income	% change	-0.35
Environmental impacts[6]		
Erosion	% change	-30.7
Sediment	%. change	-33.2
Total nitrogen	% change	-12.5
Total phosphorus	% change	-19.7

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

Analysis of Conservation Alternatives

Cropland stewardship proposal — Level 3; sustainable resource management on all cropland (CSP3; Table 11)

The annual cost to consumers/taxpayers to implement resource management systems is $2.9 billion. Under this scenario, consumers/taxpayers lose $5.1 billion because of higher commodity prices, while producers realize a net gain of $2.2 billion because the higher prices offset their variable cost increase.

- The cost is $3.45 per ton of erosion reduction for about 40 million additional acres treated with conservation techniques.
- Prices increase by 8.2 percent as production declines by 2.6 percent.
- Total costs are estimated at $6.3 billion.
- The benefit/cost ratio is 1.7.
- Crop variable cost is up nationally by 2.5 percent ($4.12) per acre and 1.5 percent overall, while sustainable level results in a decrease in cropland by 7.1 million acres, of which crop revenue is up 7.4 percent ($15.25 per acre).
- If all the crop variable cost increase were confined to the acres treated with new conservation techniques, then on those acres the per-acre increase would be 21 percent ($35).
- Controlling erosion to the one million acres are converted to forest and pasture use.
- Cropland rent value increases by $5.05 per acre (6.9 percent), but total rental revenues would decrease $442 million because of an additional six million acres of land that would be idled.
- Commodity prices increase by enough for producer revenue increases to exceed cost increases.
- Regional impacts on farm income range from -3.5 percent ($351 million) in the Southern Plains region to 9.9 percent ($995 million) in the Pacific region.
- Erosion is reduced by 47 percent (840 million tons):

TABLE 11.

Impact of third-level cropland stewardship proposal: sustainable resource management systems on all cropland (csp3)

Estimated changes from baseline conditions (2000)

U.S. agricultural sector impact:	**Unit**	**Measure**
Producers	Million $	2182.6
U.S. consumer	Million $	-5084.9
U.S. taxpayers[2]	Million $	954.7
Total financial cost[2]	Million $	-3857.0
Technical Assistance		
Federal	Million $	1451.5
Partner	Million $	985.6
Total technical assistance	Million $	2437.0
Total cost[2]	Million $	6294.0
Estimated environmental benefits[3]	Million $	10428.0
Benefit cost ratio	Ratio	1.7
Producers income	% change	3.36
Environmental impacts[6]		
Erosion	% change	-46.9
Sediment	%. change	-55.5
Total nitrogen	% change	-15.8
Total phosphorus	% change	-26.3

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

- where the erosion index is less than 8, by 22 percent (91 million tons)
- where the erosion index is between 8 and 20, by 70 percent (212 million tons)
- where the erosion index is greater than 20, by 90 percent (158 million tons)
- where in Class IIIw-VIIIw (some is highly erodible land), by 62 percent (88 million tons)

- Regional reductions range from 20 percent in the Delta region to 73 percent in the Southern Plains region.
- Cropped acreage drops by 29 percent for land with an erosion index greater than 20.
- National use of other resources changes by less than two percent, except for a seven-percent increase in use of groundwater.
- As much as 21 percent of the total acreage of a crop (potatoes is the extreme) is shifted from the most highly erodible land to less erodible land.
- Cropland with conservation tillage, strip cropping contouring or terraces increases by about 40 million acres per year.
- Potential environmental benefits reduce erosion by 47 percent, sediment by 56 percent, nitrogen by 16 percent and phosphorus by 26 percent.
- Total financial cost to the agricultural sector is $3.8 billion.
- Technical assistance needs total $2.4 billion — $1.5 billion federal and $0.9 billion partners.

Simultaneous BUF2, CRP45 and CSP2 (Table 12)

All of the previous alternatives were analyzed independently of one another to assess their individual effects. Additional model simulations were conducted to simultaneously analyze potential effects of concurrently achieving existing conservation buffer goals, expanding the CRP and accomplishing different levels of conservation enhancements on cropland.

The annual cost to the U.S. economy from simultaneously extending the buffer program to two million miles, expanding the CRP to 45 million acres and requiring erosion control on all cropland at the conservation compliance levels is estimated to be $1.85 billion. Total financial costs to society decrease by $200 million from the CSP2 level because of economies and efficiencies from simultaneous implementation of these programs. The benefits that accrue from reduced erosion and sediment are $7.43 billion, for a benefit/cost ratio of 4.0.

- Producers have a net benefit of $3.7 billion because of higher market prices and $1.6 billion in direct financial assistance.
- Consumers lose $3.0 billion because of higher market prices.
- Taxpayers spend, in addition to the $1.6 billion in direct financial assistance, $0.9 billion in technical assistance to producers.
- Crop prices increase by 5.7 percent, while production is down by 2.5 percent.
- Variable cost increases, but by less than do receipts, both in total and per acre.

Analysis of Conservation Alternatives

- Net farm income is increased by 5.6 percent.
- The U.S. trade surplus declines by 1.6 percent ($332 million).
- The CRP and buffers increase by a total of 19.6 million acres, but cropping is reduced by only 16.5 million acres because 1.9 million acres of previously idled cropland and 0.7 million acres of forest and pasture would become cropped.
- Cropland rent value increases by $7.82 (10.7 percent) per acre.
- Cropland erosion is reduced by 33.4 percent (598 million tons), with the largest reduction occurring on land with higher erosive potential or hazard. Other pollutant reductions include:
  - Sediment movement off farm fields is reduced 36.0 percent.
  - Total nitrogen and total phosphorus movement off farm fields (and/or through the root zone) is reduced 17.9 percent and 25.7 percent, respectively.
- The percent of cropland with applied conservation measures increases by six percent.
- Cropped acreage decreases by 4.7 percent and the lost rent on this land, valued at baseline rental rates, is $1.2 billion or 4.7 percent of base rent. However, this loss is partially offset by the rental payments received for the buffer and CRP enrollments.
- Use of groundwater for irrigation increases by 5.8 percent while use of surface water decreases by 1.1 percent.

TABLE 12.

Impact of second-level cropland stewardship proposal plus conservation buffers to two million miles and CRP at 45 million acres

Estimated changes from baseline conditions (2000)

U.S. agricultural sector impact:	**Unit**	**Measure**
Producers	Million $	3668.6
U.S. consumer	Million $	-3040.9
U.S. taxpayers[2]	Million $	1611.1
Total financial cost[2]	Million $	-983.4
Technical Assistance		
Federal	Million $	681.5
Partner	Million $	180.3
Total technical assistance	Million $	861.8
Total cost	Million $	1845.2
Estimated environmental benefits[3]	Million $	7426.1
Benefit cost ratio	Ratio	4.0
Producers' income	% change	5.64
Environmental impacts[6]		
Erosion	% change	-33.4
Sediment	%. change	-35.9
Total nitrogen	% change	-17.9
Total phosphorus	% change	-25.7

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

- Use of hired labor decreases by 0.6 percent, pasture use increases by 0.2 percent and changes in grazing land and family labor use are less than 0.1 percent.
- Direct financial assistance needs are estimated to total an additional $1.6 billion.
- Technical assistance costs total $862 million — $682 federal and $180 million from partner contributions.

Analysis of Conservation Alternatives

Simultaneous BUF2, CRP45 and CSP3 (Table 13)

The annual cost to the U.S. economy from simultaneously extending the buffer program to two million miles, expanding the CRP to 45 million acres and requiring erosion control on all cropland at resource management system levels is estimated to be $5.89 billion. Total financial costs to society decrease by $676 million from the CSP3 level because of economies and efficiencies from simultaneous implementation of these programs. The benefits that accrue from reduced erosion and sediment are $10.67 billion, for a benefit/cost ratio of 1.8.

- Producers have a net benefit of $6.3 billion because of higher market prices and the $2.3 billion in direct financial assistance.
- Consumers lose $7.2 billion because of higher market prices.
- Taxpayers spend, in addition to the $2.3 billion direct financial assistance, $2.7 billion in technical assistance to producers.
- Crop prices increase by 12.9 percent while production is down by 4.6 percent.
- Variable cost increases, but by less than do receipts, both in total and per acre.
- Net farm income is increased by 9.7 percent.
- The U.S. trade surplus declines by 3.3 percent ($702 million).
- The CRP and buffers increase by a total of 19.6 million acres, but cropping would be reduced by 20.9 million acres because erosion control measures on some previously cropped acreage would be costly.
- About 0.2 million acres of cropland would be expected to convert to pasture and forestland.
- Idled land would increase by 1.7 million acres, resulting in decreased cropland rental revenue of $121.2 million, although cropland rent value would increase by $13.92 (19 percent) per acre.

TABLE 13.

Impact of third-level cropland stewardship proposal plus conservation buffers to two million miles and CRP at 45 million acres

Estimated changes from baseline conditions (2000)

U.S. agricultural sector impact:	**Unit**	**Measure**
Producers	Million $	6285.4
U.S. consumer	Million $	-7209.6
U.S. taxpayers[2]	Million $	2257.3
Total financial cost[2]	Million $	-3181.5
Technical Assistance		
Federal	Million $	1780.7
Partner	Million $	926.7
Total technical assistance	Million $	2707.4
Total cost	Million $	5888.9
Estimated environmental benefits[3]	Million $	10666.5
Benefit cost ratio	Ratio	1.8
Producers' income	% change	9.67
Environmental impacts[6]		
Erosion	% change	-47.9
Sediment	%. change	-55.5
Total nitrogen	% change	-19.6
Total phosphorus	% change	-31.0

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

Analysis of Conservation Alternatives

- Cropland erosion is reduced by 47.9 percent (859 million tons), with the largest share of this occurring on land with higher erosive potential or hazard. Other pollutant reductions include:
  - Sediment movement off farm fields is reduced 55.5 percent.
  - Total nitrogen and total phosphorus movement off farm fields (and/or through the root zone) is reduced 19.6 percent and 31.0 percent, respectively.
- The percent of cropland with applied conservation measures increases by 14.7 percent.
- Cropped acreage decreases by 6.0 percent, and the lost rent on this land, valued at baseline rental rates, is $1.5 billion or 6.0 percent of base rent. However, this loss is partially offset by the rental payments received for the buffer and CRP enrollments.
- Use of groundwater for irrigation increases by 10.1 percent, while use of surface water decreases by 1.4 percent.
- Use of hired labor decreases by 0.8 percent, pasture and range land labor use decreases by 0.1 percent and 0.3 percent, while changes in grazing land and family labor use are less than 0.1 percent.
- Direct financial assistance needs are estimated at $2.3 billion.
- Technical assistance costs total $2.7 billion — $1.8 billion for the federal share and $.9 billion for partners.
- Technical assistance costs rise more than financial assistance relative to results at the CSP2 level because of significantly expanded requirements for intensive resource management systems.

Reduce resource degradation (Table 14)

Analysts combined the results for several alternatives to estimate the economic, environmental and program impacts that would accrue to reduce the rate of resource degradation. This alternative included program elements discussed in most of the public forums held during 2000 and in reports that were issued up through September 2000. The alternative includes achieving conservation compliance levels on all cropland at the CSP2 level, completion of two million miles of conservation buffers, enrolling 250,000 additional acres in WRP, slightly expanding FPP to $65 million, establishing WHIP at $50 million, increasing funding for FIP by $38 million, initiating a modest grazing land reserve and enrolling 45 million acres in CRP. These initiatives respond to the need to improve water and soil quality, reduce soil erosion, conserve marginal lands and wetlands, improve the condition of private grazing lands and provide economic incentives for land stewardship.

It was not possible to directly incorporate consequences from implementation of conditions for FPP, WHIP, FIP and WRP provisions in the modeling system, although cost information was available. This alternative (and the one below to improve resource health) incorporate cost information with results from the analysis for extending buffers to two

million miles, increasing CRP to 45 million acres and adopting CSP at levels 2 and 3.

An additional 1.3 million acres of wildlife habitat would be enhanced annually at $50 million for WHIP and 115,000 additional acres of farmland would be protected annually through $65 million in funding for FPP. WRP would enroll 250,000 acres annually for an additional $286 million per year.

The annual cost to the U.S. economy from simultaneously extending the buffer program to two million miles, expanding the CRP to 45 million acres and requiring erosion control on all cropland at conservation compliance levels is estimated to be $2.3 billion. The environmental benefits were not re-estimated from those in the simultaneous BUF2CRP45CSP2 scenario because of a lack of information, but they would be expected to increase proportionate to enhanced wildlife habitat and wetlands. The benefit/cost ratio is 3.2 without adjustments to the earlier benefit estimates.

All other agriculture sector impacts remain unchanged from that presented for simultaneous BUF2CRP45CSP2 with the exception of financial and technical assistance needs.

- Direct financial assistance needs are estimated to total an additional $2 billion.
- Technical assistance costs total $926 million — $737 for the federal share and $189 million in partner contributions.

TABLE 14.

Impact of implementation of second- and third-levels of cropland stewardship proposal plus conservation buffers to two million miles and CRP at 45 million acres, WRP at 250,000 acres, FPP at $65 million, WHIP at $50 million and FIP

Estimated changes from baseline conditions (2000)

		Reduce resource degradation glr, wrp, fpp whip and fip[1]	**Improve resource health** glr, wrp, fpp whip and fip[1]
U.S. agricultural sector impact:	**Unit**	**Measurement**	
Producers	Million $	3668.6	6285.4
U.S. consumer	Million $	-3040.9	-7209.6
Direct federal financial assistance	Million $	2020.7	2666.8
Total financial cost[2]	Million $	-1392.9	-3591.1
Technical Assistance			
Federal	Million $	737.4	1836.6
Partner	Million $	188.9	935.2
Total technical assistance	Million $	926.3	2771.9
Total cost	Million $	2319.3	6362.9
Estimated environmental benefits[3]	Million $	7426.1	10666.5
Benefit cost ratio	Ratio	3.2	1.7
Producers Income	% change	5.64	9.67
Environmental impacts[6]			
Erosion	% change	-33.4	-47.9
Sediment	%. change	-35.9	-55.5
Total nitrogen	% change	-17.9	-19.6
Total phosphorus	% change	-25.7	-31.0

See Table C-2 in Appendix C (pages C-11-C-14) for more detail and footnotes.

Improve resource health (Table 14)

To achieve a higher level of resource protection and improve resource health, analysts added sustainable resource management systems on all cropland at the CPS3 level to the initiatives needed to slow resource degradation. This scenario addressed the highest level of

conservation considered in the analysis.

The annual cost to the U.S. economy from simultaneously extending the buffer program to two million miles, expanding the CRP to 45 million acres and requiring erosion control on all cropland at sustainable resource management system levels is estimated to be $6.4 billion. Environmental benefits were not re-estimated from those in the simultaneous BUF2CRP45CSP3 scenario because of a lack of information, but they would be expected to increase proportionate to enhanced wildlife habitat and wetlands. The benefit/cost ratio is 1.7 without adjustments to the earlier benefit estimates.

All other agriculture sector impacts remain unchanged from those presented for simultaneous BUF2CRP45CSP3 with the exception of financial and technical assistance needs.

- Direct financial assistance needs are estimated at $2.7 billion.
- Technical assistance costs total $2.8 billion — $1.8 billion for the federal share and $.9 billion for partners.
- Technical assistance costs rise more than financial assistance relative to results at CSP3 because of significantly expanded requirements for intensive resource management systems.

Conclusion

Adoption of conservation practices by many of this nation's private landowners has helped to reduce the impacts of food and fiber production on soil, water and air quality. Conservation of the land's resources is an ongoing process, however. Much remains to be done to ensure healthy soils and clean water and air to support viable communities (both urban and rural), contribute to a strong economy and our national security and protect important environmental attributes such as wildlife habitat.

The increasing human population and prevailing public views challenge landowners and agribusinesses to produce food and fiber without harming the nation's natural resources. The public looks to the government to ensure that farmers and ranchers produce an abundance of safe food and fiber at affordable prices while protecting and sustaining the nation's natural resource base. Farmers and ranchers look to the government for technical and financial assistance, research and technology and an income safety net needed to meet the challenge.

An effective program to achieve natural resource conservation goals will consider these needs. Each program element should recognize the important connection among technical assistance, education, research and technology and economic incentives for landowners who practice high-level stewardship.

As an example, to reduce erosion rates on all cropland to acceptable levels will require conservation techniques across a variety of soils, terrains, crops and climates. It will be more challenging in some parts of the country than in others. Likely, many farmers and ranchers will request technical assistance to apply the conservation measures, and because "one size will not fit all," new or improved technology springing from research will be necessary. In some areas, financial incentives and assistance will help ease any economic burden of achieving the goal.

To meet the needs identified by the public and achieve resource conservation goals, this country must recommit to a conservation program — a program to ensure that private landowners, who are the stewards of 70 percent of this nation's land, have the technical assistance, research and financial incentives to sustain our soil, water, air and wildlife habitat in perpetuity.