Analysis of 1990 Farm Bill Conservation Options

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EXECUTIVE SUMMARY

This report summarizes the ARIMS analysis for the 1990 Farm Bill Conservation Initiatives Work Group. Three major tasks were completed. First, ARIMS was updated to reflect the short-run nature of possible 1990 farm bill policies. Specifically, ARIMS now incorporates a more differentiated set of land resources and crop production technology to match the requirements of the 1985 Food Security Act. Second, baseline solutions for 1990, 1995, and 2000 were estimated. The solutions included the conservation titles of the 1985 Food Security Act. The baselines differed in the specification of acres in the Conservation Reserve Program (CRP) and in conservation compliance provisions. The 1990 baseline had a 40-million-acre CRP requirement; the 1995 baseline has a 40-million-CRP plus conservation compliance; and the 2000 baseline has an eight-million CRP with conservation compliance. Third, two alternative farm bill policy options were evaluated. The water quality option involved adding 10 million acres to the 40-million-acre CRP enrollment in the 1995 baseline. The selection of the 10 million acres was based on potential water quality impacts. The Trees for the U.S. program evaluated the conversion to trees of 37 million targeted acres of cropland and marginal pasture land.

Key results of the analysis include the following. First, cropland use in the baselines is similar to the 1982 NRI level. The implication is that since total cropland use reported in the 1982 NRI was close to historically high levels, environmental restrictions may have a substantial impact on resource use in the agricultural sector. Second,

due to conservation compliance, national erosion levels declined between 30 and 60 percent. Another implication is that the 1995 and 2000 baselines suggest a shift away from straight row and fall plowing practices to less erosive contour and strip-cropping methods. Third, production costs declined from 1990 to 1995 due to significantly lower livestock costs. Fourth, an overriding factor in differences between the baselines and the second RCA was the downward change in projected yield increases due to technology trends. Finally, the results of the two policy options were not significantly different from the baseline projects. There were minor decreases in erosion, cropland use, tillage and conservation practices, and production costs. The largest regional impact for the Trees for the U.S. program occurred in the Delta and Southeast regions due to the largest restriction in land use.

INTRODUCTION

Early in 1989, the Secretary of Agriculture directed the formation of a 1990 Farm Bill Conservation Initiatives Work Group (FBCW). Coordinating responsibilities were assigned to the Strategic Planning and Policy Analysis Division of the Soil Conservation Service (SCS), with membership consisting of representatives from nine agencies of the U.S. Department of Agriculture (USDA), the U.S. Department of Interior, and the U.S. Environmental Protection Agency (EPA). The FBCW organized several subgroups to address specific resource issues such as water quality, Conservation Reserve Program (CRP), and wetlands restoration. Each subgroup developed farm bill goal statements and specific policy options.

Several of the major national-level policy options developed by the FBCW were evaluated at the Center for Agricultural and Rural Development (CARD) through the long-standing CARD/SCS Cooperative Research Agreement. At CARD the Agricultural Resources Interregional Modeling System (ARIMS) was updated, advanced, and used to establish baselines for 1990, 1995, and 2000 and to evaluate the selected policy alternatives. The method of analysis was an extension of that used for the Second Resource Conservation Act Appraisal (Second RCA) (USDA 1989; see English et al. 1989).

This report summarizes the analysis conducted for the FBCW: (a) how the ARIMS model was updated to more accurately reflect possible 1990 farm bill policy scenarios; (b) baseline solutions for 1990, 1995, and 2000; and (c) results of two alternative policy scenarios, water quality and the

Trees for the U.S. program. First, ARIMS as calibrated for the Second RCA was enhanced to more accurately reflect the shorter-run nature of the farm bill policy conditions (as opposed to the long-run resource and productivity issues). The short-run adjustments primarily involved calibrating input/output coefficients and adjusting flexibility constraints on technology adoption and production distribution shifts. ARIMS was also modified to increase its capacity to track factors affecting water quality. These modifications to ARIMS are documented. (See English et al. 1989 for original model.) Appendix B lists changes made in ARIMS from the Second RCA version and the 1990 farm bill analysis version.

Baseline solutions for 1990, 1995, and 2000 were then estimated, with approximate representations of the conservation titles of the 1985 Food Security Act (85FSA) (U.S. Congress 1985). Required advancements in ARIMS to reflect the conservation titles included changes in model structure and parameter specification to represent existing policy provisions and external conditions. Specifically, the baseline solutions reflected projections for national level commodity markets and resource allocations. ARIMS yield levels and yield growth rates were calibrated to current levels and expectations. The CRP enrollment was specified at 40 million acres for the 1990 and 1995 baselines with acreages from the first eight sign-ups included directly and future sign-up projected with other CARD models.

In the 2000 baseline CRP acreage was allowed back into production, inversely to enrollment as contracts expired. Inclusion of the Conservation Compliance (CC) and CRP title required splitting the model land base into highly erodible (HEL) and nonhighly erodible (nHEL) components. Cropping, idling with vegetative cover, and CRP activities were developed separately for treatment of HEL and nHEL cropland. This expanded detail in the cropping sector resulted in ARIMS expanding to 11,000 rows and 160,000 activities.

Using the baseline, ARIMS and the supporting data sets were used to predict the alternative outcomes for two selected policy alternatives: expanding the CRP to improve water quality and the Trees for U.S. program. ARIMS results estimate agricultural production costs and land and water resource use outcomes for the exogenously imposed policy changes. The analysis with ARIMS is comparatively static in nature and producer incentives required for voluntary adoption of conservation compliance are incorporated in the system.

The next section of this report describes the conservation baseline runs, the evaluation procedures, empirical results, and comparison with results of earlier analyses and available survey data (e.g., Second RCA, 82NRI, FAPRI, and NASS). The third section explores the results of the two alternative farm bill policy scenarios: the 10-million-acre water quality CRP addition and Trees for the U.S.

Baseline Runs

Evaluation Procedures

ARIMS provides estimates of the minimum cost of crop and livestock production and transportation for the United States subject to policy, technology, and resource availability conditioning assumptions.

Specifically included in this specification of ARIMS were a more differentiated set of land resources and crop production technology to match the requirements of the conservation titles of the 1985 Food Security Act (U.S. Congress 1985) and adjusted yield growth technology and policy assumptions. The land resource differentiation is explained in detail following a review of the other conditioning parameters.

Five major sets of conditioning parameters for ARIMS are:

1. Commodity demand levels were consistent with baseline demand levels adopted by FBCW for use in this analysis and taken as fixed demands for ARIMS.
2. Yield growth rates for crop commodities from the 1986-base to each of the 1990, 1995, and 2000 established baselines were based on statistical trends estimated at CARD for use in the FAPRI (1989) domestic and international market baseline.
3. A Conservation Reserve enrollment of 40 million acres was assumed with area and land quality distribution to match the data for the first eight sign-ups and with further enrollments predicted using available supporting CARD models.
4. Adoption of conservation and zero tillage limits were based on recent survey information for 1990 and on the Second RCA assumptions for 1995 and 2000 baselines.
5. Individual regional crop acreage change bounds were based on deviations from recent historical statistics.

Below we review each of the five conditioning items in detail. Other constraints not mentioned but given in the available ARIMS documentation as specified for the Second RCA were unchanged for the baseline runs.

Commodity Demands. Commodity demand levels incorporated in ARIMS were determined by a complex set of supply, demand, and trade models accounting for economic changes throughout the world. The national-level commodity demands used for the baseline are given in Table 1. The only conceptual difference between these demands and those of the Second RCA are that seed demands are explicitly included and that imports, where projected, are included.

Distribution of the national-level demand estimates to the 31 Market Regions (MRs) in ARIMS follows the Second RCA except for seed (English and Huang 1984). The market region National Interregional Agricultural Projection System (NIRAP), Second RCA per capita consumption, and Bureau of Economic Analysis (BEA) population distribution projections were utilized with values for 1995 being a linear interpolation of the Second RCA 1990 and 2000 values. Exports and imports were allocated to the market regions with the same weights as in the Second RCA. Seed distribution by market region was based on planted acreages by crop. For each MR, domestic consumption, net exports, and seed use were calculated separately and then added.

Yield Technology. Yields in ARIMS are based on several factors for each analysis. First, average yields are obtained from the most recent available National Agricultural Statistical Service (NASS) statistics. Estimated factors from physical and biological models are used to index these average yields to the resource qualities and management options available in ARIMS with normalization based on external estimates of the prevalence of these resources and management techniques for a base year. Second, the yields are projected from the statistics with technological

Table 1. Demand projections used for this analysis

Commodity	Unit		Food, Industrial	Feeds	Net Exports	Subtotal	Seeds
Wheat	Mil. bu	1990	750	175	1375	2300	105
		1995	799	200	1625	2624	106
		2000	850	200	1875	2925	115
Soybeans	Mil. bu	1990	193	761	909	1863	95
		1995	212	797	1048	2057	95
		2000	229	831	1239	2299	100
Corn	Mil. bu	1990	1322	4500	1998	7820	18
		1995	1537	5025	2198	8760	18
		2000	1787	5300	2448	9535	18
Barley	Mil. bu	1990	170	205	65	440	15
		1995	171	210	40	421	14
		2000	170	260	65	495	15
Oats	Mil. bu	1990	77	320	-29	368	33
		1995	86	330	-24	392	34
		2000	98	355	-24	429	35
Sorghum	Mil. bu	1990	24	525	220	769	1
		1995	19	510	200	729	1
		2000	18	550	225	793	2
Peanuts[a]	Mil. bu	1990	3396	0	698	4094	8
		1995	3637	0	698	4335	210
		2000	3807	0	698	4505	200
Cotton	Mil. bale	1990	7.1	0	6.5	13.6	200
		1995	8.0	0	7.5	15.5	0
		2000	8.5	0	8.1	16.6	0
Beef[a]	Mil. cwt	1990	241	0	-12	229	0
		1995	255	0	-9	246	0
		2000	283	0	-7	276	0
Pork[a]	Mil. cwt	1990	170	0	-7	163	0
		1995	167	0	-9	158	0
		2000	174	0	-9	165	0
Broilers[a]	Mil. cwt	1990	175	0	11	186	0
		1995	199	0	12	211	0
		2000	218	0	13	231	0
Turkey[a]	Mil. cwt	1990	45	0	1	46	0
		1995	49	0	1	50	0
		2000	54	0	1	55	0
Dairy	Mil. cwt	1990	1559	0	-20	1539	0
		1995	1643	0	-18	1625	0
		2000	1742	0	-16	1726	0

[a]Peanuts are in cwt in ARIMS while beef and pork are converted from carcass weight to liveweight for ARIMS (carcass numbers here). Broilers and turkeys are in the exogenous sector of ARIMS and were left at previous RCA values.

growth factors. Livestock yield assumptions from the Second RCA process were maintained for the baseline with increases in feed conversion and production efficiency values for 1995 taken as a linear interpolation of the Second RCA 1990 and 2000 values.

Crop yields for the baseline were based on the average of NASS 1986/87 published statistical county-level yields. Indices for land quality and management techniques were maintained from the Second RCA analysis. For yield growth, the technological trend portions were taken from the CARD/FAPRI projection models (the price responsiveness portion of the FAPRI rates was not considered). These rates are provided in Table 2, along with the Second RCA growth rates for comparison.

Highly Erodible Land Base Definition. Accounting for the conservation titles of the 85FSA in ARIMS required some simplifying assumptions. Differentiating the ARIMS land base by one additional characteristic nearly doubles the number of constraints in the model. Differentiating the ARIMS land base also requires specifying land use activities for each new land type, so the number of cropping activities must also nearly double. Originally ARIMS contained three types of land by producing area (PA) and land group: dryland, land irrigated with surface water, and land irrigated with groundwater. For this study the ARIMS dryland was split into HEL and nHEL while the original irrigated land specification was maintained. Also, the land eligibility criteria for the CRP and the land characteristics of HEL for CC were jointly modeled, as explained in this section.

The original CRP eligibility criteria included land that had historically been eroding at levels high relative to the tolerance level

Table 2. Technology change factors for crop yields in ARIMS

Crop	Second RCA[a]	90 Farm Bill ARIMS[b]
	Percent/Year	
Barley	1.89	1.50
Corn	1.89	1.60
Corn Silage	1.89	1.60
Cotton	1.01	1.70
Legume Hay	1.02	1.02
Nonleg. Hay	1.02	1.02
Oats	1.89	0.80
Peanuts	1.27	1.45
Sorghum	1.89	1.10
Sorghum Silage	1.89	1.10
Soybeans	2.65	1.10
Sunflowers	1.18	1.03
Spring Wheat	2.28	1.30
Winter Wheat	2.28	1.30

[a]Calculated by dividing the predicted "most probable" Second RCA yield change for 1982-90 by the number of years.

[b]These values used with a continuous time growth yield function for the farm bill options analysis.

(T) and/or in Land Use Capability classes IV, VI, VII, and VIII. The Erosion Index (EI) criteria were added later but did not supersede the earlier criteria. The original CC law defines HEL as land with EI values greater than or equal to eight, due to either wind (CI/T = EI) or water erosion (RKLS/T = EI) where T is the soil loss tolerance level and CI and RKLS are the potential soil loss factors for wind and water, respectively. In addition to these criteria, field heterogeneity was considered such that some noneligible acres are also enrolled in the CRP. Likewise, some nHEL must be treated with CC along with HEL since it occurs in the same parcel of land.

The ARIMS dryland was split into HEL and nHEL based on EI greater than or equal to eight. Irrigated land was all assumed to be nHEL. The HEL designation within ARIMS accounted for both water erosion and wind erosion, but in a simpler fashion than the actual 85FSA. Each dryland quality group in each PA was designated as either having a wind HEL or a water HEL problem, depending on which was the more severe problem. The relative severity of the two forces were compared by weighting per acre wind and water erosion rates by the proportion of total acres in each PA and land group classified as wind HEL and water HEL, respectively. In other words, within a given PA and land group, both wind and water problems were not subject to CC since this would have caused an excessive further expansion of model rows and columns.

English (1989) estimated 28.6 million acres HEL due to wind forces and 62.5 million acres due to water forces based on 1982 National Resources Inventory (82NRI) data. The 1995 and 2000 land base specifications of ARIMS differ from the 82NRI due to nonfarm conversions and other factors. For HEL due to water forces the 82NRI proportions of HEL and nHEL by PA and land group were used to split the 1995 ARIMS land base into HEL and nHEL. The unsplit or total 1995 land base was determined as an interpolation between 85RCA 1990 and 2000 model specifications. The acres of HEL due to wind were taken directly from English since CARD had no factors to use with the 82NRI in determining HEL and nHEL for wind. With all of these land base adjustments, the 1990 Farm Bill ARIMS specification for 1995 includes 12.3 million acres of HEL treated for wind erosion and 55.5 million acres of HEL treated for water erosion. This ARIMS HEL in CRP and its treatment for CC are explained in later sections.

According to the 82NRI, there are 32 million acres of land that is HEL but with erosion levels below that level making it eligible for the Conservation Reserve Program (CRP). Also, the 82NRI indicates about 30 million acres of land eligible for the CRP based on erosion levels, but not classified as HEL because the EI was less than eight. No attempt was made in ARIMS to account for either of these phenomena.

The 40-Million-Acre CRP. Conservation reserve (CRP) enrollments by land group are determined exogenously to ARIMS. ARIMS makes an endogenous determination of whether land for CRP enrollment, by PA and land group, comes from cropland that is rain-fed, irrigated by surface water, or irrigated by groundwater. Data on CRP enrollment by county and Land Capability Class/subclass were only available for the first eight sign-ups at the time ARIMS was calibrated for the baseline. The additional portion of the 40-million-acre CRP base was predicted using CARD models.

The future CRP sign-up allocation method at CARD considered sign-up trends, distribution of eligible acres, counties at the 25 percent CRP maximum limit, and other ARIMS fixed land use requirements. A quadratic programming model with a criterion function representing a weighted mix of the adjusted available acres for sign-up and the past sign-up trends was applied to find county and land group future enrollments (Frohberg et al. 1989). Aggregation across counties then resulted in the PA and land group CRP values for ARIMS. Actual and estimated state-level CRP enrollment information is provided in Table 3. Shown in Table 3 are the sign-ups, past and future, as well as the distribution of remaining eligible land.

For the 2000 baseline 80 percent of the cropland enrolled in the CRP by February 1989 is assumed released from the program and available for cropland use. The 80 percent value was chosen because about two-thirds of the CRP acres represent commodity base acres and would likely come back into production when the contracts expire, given FAPRI projected prices and 1990 bill commodity titles that extend 1985 parameters, while 6 percent have been planted to trees and will likely remain in timber production (80 is a mid-figure).

As explained earlier, the land resource in ARIMS was separated into HEL and nHEL components based on EI criteria. A further split of the land resources according to historical erosion and/or land use capability class would have expanded the model to an unmanageable size. Therefore, CRP enrollments were assumed to come partly from HEL and partly from nHEL.

In specifying the split of CRP between HEL and nHEL for ARIMS, it was decided that all possible HEL be placed in CRP, then the remainder of the CRP was filled out with nHEL for each producing area and land group. This

Table 3. Conservation reserve baseline for ARIMS 1990 farm bill

Region	Total Enrolled (Eighth Sign-up)	Est. Future Sign-up	Est. Final Enrolled	Adjusted Eligible Area Total	Adjusted Eligible Area Remaining	9th Signup
			Thousand Acres			
United States	30,593	9,407	40,000	70,343	39,750	3,330
Northern Plains	7,957	1,496	9,453	12,858	4,901	1,476
Kansas	2,548	800	3,348	4,897	2,349	314
Nebraska	1,226	582	1,809	3,552	2,326	123
North Dakota	2,596	2	2,598	2,600	4	542
South Dakota	1,588	112	1,699	1,809	221	497
Southern Plains	4,753	1,512	6,265	9,229	4,476	325
Oklahoma	1,066	348	1,414	2,110	1,044	90
Texas	3,687	1,165	4,851	7,119	3,432	235
Mountain States	5,966	1,244	7,210	9,371	3,405	472
Arizona	0	0	0	160	160	0
Colorado	1,824	343	2,168	2,639	815	129
Idaho	748	207	955	1,318	570	43
Montana	2,454	589	3,042	3,974	1,520	266
Nevada	2	3	6	114	112	1
New Mexico	476	22	498	518	42	5
Utah	230	33	263	303	73	3
Wyoming	232	47	279	345	113	25
Corn Belt	4,295	2,339	6,634	16,583	12,288	432
Illinois	547	422	969	3,789	3,242	87
Indiana	313	229	542	1,924	1,611	52
Iowa	1,789	937	2,726	5,930	4,141	181
Missouri	1,442	593	2,035	3,532	2,090	63
Ohio	205	158	362	1,408	1,203	49
Lake States	2,415	725	3,140	5,579	3,164	216
Michigan	170	113	282	844	674	26
Minnesota	1,728	285	2,014	2,381	653	102
Wisconsin	516	327	844	2,354	1,838	88
Pacific	1,609	508	2,117	3,313	1,704	92
California	177	112	290	804	627	6
Oregon	507	130	637	853	346	10
Washington	899	266	1,165	1,656	757	76

Table 3. Continued

Region	Total Enrolled (Eighth Sign-up)	Est. Future Sign-up	Est. Final Enrolled	Adjusted Eligible Area Total	Adjusted Eligible Area Remaining	9th Signup
Southeast	1,479	399	1,878	2,864	1,385	92
Alabama	499	155	654	953	454	20
Florida	114	72	185	510	396	9
Georgia	618	151	770	1,012	394	45
South Carolina	247	20	267	287	40	18
Appalachian	995	614	1,609	4,869	3,874	62
Kentucky	397	220	618	1,438	1,041	19
North Carolina	125	98	223	907	782	12
Tennessee	407	231	638	1,531	1,124	23
Virginia	66	62	128	788	722	8
West Virginia	1	1	2	205	204	0
Delta	945	399	1,344	2,622	1,677	140
Arkansas	196	132	329	1,006	810	29
Louisiana	105	51	156	313	208	28
Mississippi	644	216	860	1,303	659	83
Northeast	179	170	350	3,055	2,876	23
Connecticut	0	0	0	44	44	0
Delaware	1	1	2	25	24	0
Maine	36	13	49	77	41	2
Maryland	11	14	25	293	282	5
Massachusetts	0	0	0	49	49	0
New Hampshire	0	0	0	21	21	0
New Jersey	0	1	2	126	126	0
New York	50	57	108	1,050	1,000	4
Pennsylvania	80	84	164	1,301	1,221	12
Rhode Island	0	0	0	4	4	0
Vermont	0	0	1	65	65	0

rule resulted in approximately 65 percent of the national 40-million-acre CRP's being HEL.

The allocation of CRP across resource units will be held constant across the 1990, 1995, and 2000 runs. Since ARIMS makes a decision on whether and how to irrigate land that returns into production after its CRP contract expires, these allocations may not be identical in the baseline and corresponding policy model runs. This shifting is difficult to control since ARIMS may also convert land from dry to irrigated and vice versa.

Conservation and Zero Tillage. Conservation and zero tillage adoption upper bounds for 1990 were set at 120 percent of the survey values reported for 1987 (CTIC 1988). Values for 1995 and 2000 for conservation tillage and zero tillage upper bounds were based on the Second RCA assumptions. The Second RCA assumption for conservation tillage was that, by the year 2010, 100 percent of cropland could be cultivated by this method. For 2000 it was assumed that only 90 percent of the cropland would be adaptable to conservation tillage. In this study, values for 1995 were taken as a linear interpolation between the 1990 and 2000 values.

In setting upper bounds on zero tillage for the Second RCA, the question was one of technical feasibility of acres planted to zero tillage rather than one of producer adaption behavior for determination of upper bounds on future cropland acres in zero tillage. Again, for this study the 1995 values are linear interpolations of 1990 and 2000 values.

Conservation Compliance. As already explained, specifying HEL and CC in ARIMS required some simplifying assumptions. All irrigated land was assumed to be nHEL. All dryland HEL land was designated by PA and land group as either having a dominant water or wind erosion problem. This resulted in required treatment of 12.3 million acres of HEL for wind erosion and 55.5 million acres of HEL for water erosion. This HEL is less than the 118 million acres identified in the 82NRI but is the result of modeling capacity limits for ARIMS and the lack of wind erosion equation factors at CARD.

The method of calculating erosion in ARIMS is also changed from that used in the Second RCA. For water erosion in the Second RCA for each area and land group, a representative soil was chosen and its RKLS factors used with the Erosion Productivity Impact Calculator (EPIC) (Putman and Dyke 1987). For this study acreage-weighted average RKLS values for HEL and nHEL are calculated from the 82NRI and combined with the cropping activity management factors (C and P) in EPIC to generate Universal Soil Loss Equation (USLE) estimates for HEL and nHEL. CARD had no factors to calculate differing wind erosion estimates by HEL and nHEL and so a single 82NRI per acre HEL and nHEL average erosion estimate was used for both land classes.

The second major assumption made in specifying ARIMS was that 100 percent treatment of all HEL would occur with Alternative Conservation Systems (ACSs) (or with methods with at least as low an erosion rate). The erosion limits (either for water or wind forces) for each producing area and land group were derived by English (1989) based on Soil Conservation Service Field Office Technical Guides.

Simulation of CC required the addition of new crop producing activities in the model. Each original ARIMS crop production activity was checked to determine if it could meet the regional and land group ACS erosion limit (wind or water as appropriate) obtained from English. If a crop activity could meet the erosion limit a duplicate was made, given a new name, and inserted into ARIMS as a production option for HEL. Although different levels of wind erosion exist for the different conservation and tillage practices in ARIMS, only one explicit practice is designated for wind erosion control, and that only in selected areas. In PAs where wind erosion is the dominant force, strip-cropping activities are designed and designated for wind erosion control rather than for water erosion (English et al. 1989).

Land converted to cropping from forest and/or range land (4 to 7 million acres in the baseline run) is all assumed to be nHEL. It is assumed that farmers are aware of the Sod Buster provisions of the 85FSA and only the better land is converted to cropland. Swampbuster provisions were ignored in this study since a national set of factors for differentiating the ARIMS land base by these provisions was not available.

Empirical Results: The 1990, 1995, and 2000 Baselines

The most striking result of the baseline evaluations was that in 1990, 1995, and 2000, cropland utilization was found to be near the 82NRI level when cropping, CRP, and commodity program idled land are accounted for (see later sections for further analysis). The 82NRI cropland use level reflects a time of high crop commodity demand and is generally thought to be near the economic limit for cropland use, implying that bringing more land into production would require much higher commodity prices, which in turn would result in significant environmental degradation. In the 1995 baseline, more than 5 million acres of pasture/range and forest land were converted to cropland nationally while only 36 million acres used in the 82NRI were idled nationally. Since unmodeled agricultural commodity policy land set-asides would account for much of that idle land, the cropland base appears fairly tight. This implies that increases in environmental restrictions could have substantial impacts on resource use patterns for the agricultural sector.

When the entire cropland base of the 82NRI is accounted for, the 1995 baseline shows a substantial decrease in erosion, primarily due to the CC and CRP titles of 85FSA (see Table 14). Total erosion decreases were 8.4 percent for that caused by wind, 56.0 percent for sheet and rill caused by water, and 38.0 percent for the sum of water and wind, while per acre reductions were nearly equivalent in percentages to the total reductions.

Soil Erosion. Soil erosion estimates for the 1990 baseline range from between an average 2.5 tons per acre in the Northeast to 12.8 tons per acre in the Southern Plains region. The national average rate of soil loss from cropland is 5.9 tons per acre. In the regions east of the Mississippi River, where sheet and rill erosion predominate, the Southeast region is estimated to have the highest level of water erosion. In the West, where wind erosion is more prevalent, the Southern Plains and the Mountain regions have the highest rates. National and regional estimates of soil erosion for the baseline are given in Table 4.

Soil erosion estimates for the 1995 baseline reflect model specification requiring conservation treatment of highly erodible land

Table 4. Interreggional comparison of per acre and total annual erosion estimates for baselines: 1990, 1995, and 2000

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
Cropland Erosion					-------- Tons per Acre --------						
Sheet and Rill											
1990	2.3	2.9	4.5	4.0	2.6	1.7	1.6	2.2	1.1	1.4	2.2
1995	2.7	3.8	3.3	3.9	2.6	1.8	1.5	2.4	1.2	1.4	2.2
2000	2.6	3.7	3.5	4.1	2.6	1.7	1.6	2.5	1.3	1.5	2.2
Wind											
1990	0.3	0.7	1.2	1.1	0.8	1.7	4.7	10.6	10.1	3.1	3.7
1995	0.3	0.8	1.1	1.1	0.8	1.7	4.6	10.4	8.9	3.1	3.6
2000	0.3	0.8	1.1	1.1	0.8	1.7	4.7	10.5	8.4	3.0	3.6
Per acre Total											
1990	2.5	3.7	5.6	5.1	3.3	3.4	6.3	12.8	11.2	4.4	5.9
1995	2.9	4.5	4.4	5.0	3.4	3.5	6.1	12.8	10.1	4.5	5.8
2000	2.9	4.5	4.7	5.2	3.4	3.4	6.3	13.1	9.6	4.5	5.8
Regional Total for Cropland					-------- 1000 Tons --------						
1990	36250.0	63264.0	42779.0	75040.0	247972.0	101098.0	473357.0	386228.0	306665.0	62276.0	1794930.0
1995	42024.0	81149.0	33205.0	74229.0	258689.0	104525.0	461329.0	408679.0	278552.0	67346.0	1809727.0
2000	41945.0	82586.0	36417.0	72786.0	265536.0	106085.0	495009.0	423617.0	278696.0	69936.0	1872614.0
CRP											
Sheet and Rill					-------- Tons per Acre --------						
1990	0.4	0.4	0.3	0.3	0.5	0.3	0.7	0.4	0.4	0.3	0.5
1995	1.8	1.7	0.8	1.4	2.2	1.1	1.0	0.7	0.8	0.9	1.4
2000	1.8	1.8	0.9	1.4	2.2	1.2	2.8	0.8	1.1	1.3	1.7
Wind											
1990	0.0	0.2	0.8	0.8	0.0	0.0	0.1	0.0	0.3	0.0	0.2
1995	0.0	0.2	0.8	0.8	0.0	0.0	0.1	0.0	0.3	0.0	0.2
2000	0.0	0.2	0.8	0.8	0.0	0.0	0.1	0.0	0.3	0.0	0.2
Idle Land											
Sheet and Rill											
1990	1.9	1.8	0.8	0.7	1.7	1.4	2.1	0.7	1.0	0.3	1.3
1995	2.0	1.6	0.9	0.7	1.8	1.3	3.0	0.6	0.7	0.4	1.3
2000	1.8	1.8	0.8	0.8	2.0	1.3	2.6	0.7	0.9	0.6	1.4
Wind											
1990	0.0	0.0	0.6	0.2	0.1	0.0	0.4	0.0	0.4	0.2	0.2
1995	0.0	0.0	0.7	0.2	0.1	0.0	0.5	0.0	1.1	0.2	0.2
2000	0.0	0.1	0.6	0.2	0.1	0.0	0.3	0.0	0.7	0.1	0.2

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

(HEL). At the national level, the 1995 baseline projects erosion to average 5.8 tons per acre, down 2.0 percent from the 1990 estimate. Regional erosion estimates range from 2.9 tons per acre in the Northeast to 12.8 tons per acre in the Southern Plains. Compared to 1990 baseline levels, 1995 estimates for erosion in the East show changes between 3 percent higher in the Corn Belt to 21 percent lower in the Southeast. In the West, however, implementation of conservation compliance would appear less effective in regions that experience significance wind erosion.

Erosion estimates for the 2000 baseline indicate soil loss rates are similar to the 1995 baseline. In some regions, estimates of erosion are slightly higher stemming from additional HEL available for production after termination of the CRP.

Cropland Utilization. Total cropland devoted to crop and livestock production was 332.7 million acres in the 1990 baseline, 339.0 million acres in the 1995 baseline, and 347.1 million acres in the 2000 baseline. Table 5 shows both national and regional estimates of cropland use, CRP enrollment, and idled land in green cover. Between 1990 and 2000 approximately 14.5 million additional acres of cropland were needed to meet commodity demand and were subject to resource use restrictions of the 1985 conservation titles. Detailed estimates (not reported here) indicate that, of the 32 million acres of cropland released from the CRP by the year 2000, 25 percent, or 8 million acres, were allocated to cropland uses, the rest being idled. In the Southeast, Northern Plains, and the Corn Belt, roughly 40 percent of the CRP land released might be devoted to cropland uses.

Table 5. Interregional comparison of estimated land use for baselines: 1990, 1995, and 2000

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					---------------- Thousand Acres ----------------						
Total Cropland in Production											
1990	15873	18896	10751	17409	76756	33347	77695	32411	29577	20056	332770
1995	15570	19606	10622	17535	78811	33966	78355	33760	29901	20949	339015
2000	15513	20257	10680	17026	80994	34718	81387	33912	31177	21519	347183
Land in CRP											
1990	343	1640	1860	1305	6543	3117	9587	6277	7188	2138	39999
1995	343	1640	1860	1305	6543	3117	9587	6277	7188	2138	39999
2000	69	328	372	261	1309	623	1917	1255	1438	428	8000
Green Cover (idle)											
1990	284	2107	5190	2320	9606	7208	4265	6799	2601	944	41324
1995	345	918	4884	2710	7916	6488	3545	6504	2221	802	36332
2000	491	1319	5853	4042	10552	7853	8350	11699	6132	1642	57932

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

<u>Production of Selected Crops</u>. Table 6 presents the national and regional estimates for amounts of cropland used for the production of selected crops. In general, crop acreage increases are the largest between the 1990 and 1995 baselines. National results indicate that imposition of conservation compliance increased cropland planted to corn, soybeans, cotton, and nonlegume hay, attesting to poorer performance (lower yields) from those crops produced under conservation methods. Wheat acreage increased most between the 1995 and 2000 baselines and is related to the release of CRP land. In comparing 1995 with 2000 baseline levels, there is some indication of comparative advantage for the Corn Belt as the increase in corn acreage is equivalent to the national increase. Likewise, the Northern Plains region shows some comparative advantage in the production of wheat by having 2 million additional acres of wheat or about one-half of the national increase.

Estimates of cropland used for soybean production were 53.4, 56.1, and 57.9 million acres for the 1990, 1995, and 2000 baselines. The Corn Belt, Lake States, and western regions all show increases in soybean production while Eastern regions show a decline. The increase is largest in the Corn Belt and Northern Plains, accounting for nearly all of the estimated change at the national level.

Results indicate regional shifts; changes in cropland for cotton, legume hay, and nonlegume hay are minor compared to the cash grains. National estimates indicate the cotton acreage is relatively stable as CC is implemented and less land is assumed fixed in the CRP. Estimates show 1.5 million acres less legume hay produced in the 2000 baseline, and 1 million acres more nonlegume hay. Regional results show 1 million acres

Table 6. Interregional comparison of estimated acres of selected crops for baselines: 1990, 1995, and 2000

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					Thousand Acres						
Corn Production											
1990	4629	4052	1633	3927	29942	10721	9897	3524	1766	193	70284
1995	4815	4746	1602	4017	30799	10889	9522	4105	2292	216	73003
2000	5079	4647	1515	3625	31805	10831	8778	4951	2514	187	73931
Wheat Production											
1990	537	1394	714	924	4408	3817	25079	7972	8771	5480	59096
1995	471	1742	750	1160	4853	3802	25606	7969	8892	6166	61409
2000	458	1875	1027	1158	5440	4094	27720	7472	9705	6616	65566
Soybean Production											
1990	2225	4159	2384	5565	28344	4854	5088	573	167	0	53359
1995	1901	3999	2332	5240	29914	5285	6474	867	136	0	56149
2000	1912	4190	2355	5004	30602	5376	7296	972	223	0	57930
Cotton Production											
1990	0	1563	346	1211	146	0	0	6797	197	798	11059
1995	0	1620	377	1292	135	0	0	7300	60	798	11582
2000	0	1743	379	1352	142	0	0	7278	57	798	11749
Legume Hay											
1990	3678	1386	507	2194	4928	1819	258	345	3179	2424	20593
1995	3670	964	546	1877	4188	1791	166	296	2970	2248	18723
2000	3608	1138	503	1960	3953	1920	207	277	2899	2115	18581
Nonlegume Hay											
1990	1178	2992	815	98	1355	2922	14677	3253	2771	723	30974
1995	1178	3342	840	45	1919	2843	14464	3358	3038	827	31854
2000	1226	3271	845	35	1709	2902	14509	3445	2997	978	31917

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

less legume hay in the Corn Belt alone. Cropland used for legume hay production in the Appalachian region falls between the 1990 and the 1995 baselines, but increases in the 2000 baseline. Nonlegume hay production is higher in most regions in the 1995 baseline compared to 1990, the exceptions being in the Delta, Lake States, and Mountain regions. Results for the 2000 baseline shows acres of nonlegume hay increasing in some regions and falling in others in association with the magnitude of land released from the CRP.

Cost of Production. Estimates of total production costs given in Table 7 include both crop and livestock production costs. National aggregate total production costs were $58.4, $58.0, and $59.7 billion for the baselines. Regional changes largely stem from shifts in total cropland in production and the amount of livestock produced. Regional estimates show falling costs in the East tied to lower livestock production. Regional estimates of total production costs that did go up (Delta, Lake States, and Southern Plains), are where livestock costs were higher. Increases in total production cost for the 2000 baseline reflect more land in production.

Crop production costs increase steadily for the baselines. Aggregate cost of production for the crop sector was $35.2 billion, $35.8 billion, and $36.4 billion for the baselines. Estimates for the Northern Plains region, however, show a reduction in costs despite an increase in cropland use. Per acre variable cost increased slightly for corn in each successive baseline, while variable cost per acre of soybeans, wheat, and cotton are slightly lower in the 2000 baseline.

Table 7. Interregional comparison of estimated costs for baselines: 1990, 1995, and 2000

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					------- Million Dollars -------						
Production Costs											
1990	3787.0	3886.3	2301.0	3473.8	14858.6	5031.4	7935.4	6129.8	3706.2	3675.2	58403.5
1995	3728.5	3879.4	2241.8	3575.9	14677.4	5124.8	7686.2	6304.1	3555.3	3815.7	58025.2
2000	3785.3	4108.4	2300.2	3601.2	15419.9	5256.7	7947.8	6314.5	3699.6	4046.5	59716.6
Crop Costs											
1990	1615.5	2128.4	1066.0	1866.2	9591.0	3363.2	5884.4	3300.2	2106.9	1586.4	35266.6
1995	1622.4	2240.1	1070.2	1915.5	9780.5	3452.3	5857.0	3468.8	2125.0	1639.0	35840.3
2000	1670.0	2345.6	1096.7	1849.2	10116.1	3537.5	5996.6	3493.1	2206.7	1669.8	36444.5
Livestock Costs											
1990	2171.5	1757.9	1235.0	1607.7	5267.6	1668.2	2051.0	2829.5	1599.3	2088.8	23136.9
1995	2106.1	1639.2	1171.6	1660.4	4896.8	1672.4	1829.1	2835.4	1430.3	2176.7	22184.9
2000	2115.3	1762.9	1203.6	1751.9	5303.7	1719.2	1951.2	2821.4	1492.9	2376.7	23272.1
Land Improvement											
1990	0.3	6.7	8.1	9.4	34.0	2.0	109.7	57.3	17.3	8.5	253.3
1995	0.3	6.2	9.1	6.2	34.1	1.9	98.9	45.7	8.4	4.0	214.9
2000	0.3	6.8	8.7	7.3	34.2	1.9	113.9	45.7	17.0	7.4	243.3
Transportation											
1990	---	---	---	---	---	---	---	---	---	---	3851.8
1995	---	---	---	---	---	---	---	---	---	---	4091.0
2000	---	---	---	---	---	---	---	---	--	---	4421.7

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Input Use. Baseline estimates for fertilizer use and total fertilizer costs reflect increased cropland in production as well as higher crop nitrogen demands associated with higher yields (Table 8). Total nitrogen use (Table 8) for each baseline converts to average use rates for all crops of 52.1 pounds per acre in the 1990 baseline, and 55.3 and 56.4 pounds per acre for the 1995 and 2000 baselines. Fertilizer use per unit of yield is constant across time for each production technology.

The estimates of total cost for pesticides, machinery, and labor inputs given in Table 9 indicate a substitution of pesticides for machinery and labor inputs associated with higher levels of conservation treatment in the 1995 and 2000 baselines. Costs of irrigation water estimated for the baseline show water use relatively stable in the Western regions. In minor use areas of the East, however, water use is projected to be slightly higher.

Use of Conservation Practices. Table 10 illustrates the baseline estimates of the amount of cropland using alternative conservation practices. In the 1990 baseline 270.1 million acres of cropland used straight row-cropping methods. Imposing conservation compliance on the 1995 and 2000 baselines resulted in 5.0 million acres more contour and strip-cropping. Given that total cropland use expanded, it appears that for the 1995 and 2000 baselines, additional cropland used to meet commodity demand came into production using conservation treatment. In general, however, the total amount of cropland in production using contour and strip-cropping patterns was minor compared to the level of use of straight row-cropping patterns.

Table 8. Interregional comparison of estimates for fertilizer cost and use in the baselines: 1990, 1995, and 2000

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Thousand Dollars -----						
Fertilizer Cost											
1990	280.4	343.6	138.1	341.4	1557.0	478.7	924.3	493.6	308.1	180.8	5046.0
1995	286.1	408.0	161.6	409.6	1704.0	522.2	957.8	515.5	337.6	208.4	5510.8
2000	308.8	438.6	178.3	397.3	1853.5	565.9	994.9	522.0	382.1	216.7	5858.1
					------ Thousand Tons ------						
Total Nitrogen Use											
1990	282.7	501.8	326.6	615.4	1913.9	755.4	1898.8	1150.9	586.4	643.8	8675.9
1995	264.5	595.8	339.4	757.7	2137.1	811.9	1952.0	1168.4	638.6	715.3	9380.6
2000	276.9	621.6	341.7	734.4	2325.3	866.2	1997.5	1167.6	718.0	746.3	9795.5
Total Phos. Used											
1990	177.8	207.8	96.6	213.7	1059.3	288.5	530.0	240.6	235.9	112.3	3162.7
1995	185.0	229.6	111.8	229.4	1141.7	311.9	532.3	260.0	236.5	117.4	3355.6
2000	195.6	252.0	125.3	231.8	1248.7	339.2	570.7	262.7	260.7	115.3	3602.0
Total Potash Used											
1990	556.8	492.5	198.9	350.9	2117.5	492.9	308.2	115.1	49.4	83.6	4765.8
1995	579.1	526.7	223.7	354.0	2191.4	533.8	330.3	129.8	64.1	86.0	5018.9
2000	613.0	573.0	246.2	355.6	2384.8	579.2	354.0	141.1	74.7	87.8	5409.4

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 9. Interregional comparison of pesticide, machinery, and labor cost estimates for the baselines: 1990, 1995, and 2000

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Million Dollars -----						
Pesticide Cost											
1990	165.5	343.3	199.1	244.9	1267.2	441.8	487.1	414.9	162.5	192.8	3919.3
1995	173.4	357.1	208.4	242.4	1331.8	463.1	523.4	462.9	149.8	198.1	4110.4
2000	182.0	374.9	213.5	235.5	1392.2	477.0	544.0	459.2	155.5	188.9	4222.6
Machinery Cost											
1990	264.9	380.8	183.2	338.4	1652.1	603.6	1111.4	653.7	446.7	314.9	5949.9
1995	259.8	380.0	174.7	328.6	1608.8	600.9	1073.5	681.2	445.9	321.6	5875.1
2000	261.4	394.5	174.1	318.6	1615.5	600.2	1087.2	685.5	450.5	328.9	5916.6
Labor Cost											
1990	137.6	166.1	86.7	158.5	702.9	253.9	473.4	294.6	159.6	138.4	2571.9
1995	135.7	166.2	82.7	152.4	684.7	255.1	459.3	299.7	156.9	139.2	2531.8
2000	136.0	172.7	80.9	149.1	687.8	256.5	467.0	300.7	158.8	140.8	2550.1
Water Cost											
1990	0.3	30.7	1.6	87.7	21.2	4.3	619.5	660.4	608.7	723.8	2758.3
1995	0.4	52.7	21.9	117.0	19.7	7.7	619.3	562.5	592.1	676.0	2669.3
2000	0.6	55.8	19.3	105.8	20.9	8.8	564.4	484.0	596.1	607.4	2463.1

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 10. Interregional comparison of conservation practices used for cropping in the baselines: 1990, 1995 and 2000

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					------- Thousand Acres -------						
Straight Row											
1990	14116	15729	5937	14472	70271	29359	64243	21349	23566	11066	270107
1995	11970	14973	5914	14315	67736	29493	64443	23770	20018	12381	265014
2000	12273	14802	6141	13430	67396	29853	66893	24343	20242	13064	268437
Contour Row											
1990	213	946	72	153	187	0	0	214	1871	374	4032
1995	2093	2100	112	213	4275	425	256	199	1867	673	12212
2000	2123	2887	162	367	6297	680	506	129	1081	394	14626
Strip Cropping											
1990	21	0	0	4	6	0	86	97	1035	2099	3349
1995	285	242	15	15	438	34	142	44	5037	1342	7593
2000	196	282	0	25	801	146	526	72	6904	1473	10425
Terracing											
1990	18	535	1567	201	4185	191	10819	8616	820	251	27203
1995	18	536	1567	202	4129	191	11048	7954	722	251	26617
2000	18	582	1521	203	4140	191	11077	7917	718	251	26617

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Use of Tillage Practices. Baseline estimates for the amount of cropland in production using alternative conservation tillage practices, given in Table 11, also reflect imposition of conservation compliance in the 1995 and 2000 baselines. By comparing 1990 with 1995 baseline estimates, it is evident that the specified soil loss limits in conservation compliance resulted in significant shifts away from fall and spring plowing practices. National estimates show a 41.9 million acre reduction for conventional fall and spring plowing, and an increase of 48.1 million acres for cropland using conservation and zero tillage practices. Changes in estimates for the 2000 baseline indicate the same relationship where additional cropland needed to meet demand uses conservation and zero tillage practices.

Regional results indicate that the adoption of conservation tillage was the dominant strategy to control erosion. Significant increases occurred in the Appalachian, Southeast, and Northern Plains regions where conservation tillage of cropland in the 1995 baseline is higher by 102, 528, and 53 percent, compared to the 1990 baseline. While zero tillage practices are effective in reducing erosion, estimates from the baseline indicate that it is more feasible to use zero tillage in the East than it is in western regions.

Comparisons with Second RCA, 82NRI, FAPRI, and NASS

Since ARIMS is a normative model providing a prescriptive efficient resource allocation for the specified conditioning parameters, it is useful to compare its solution to published statistics and other projections. Both the current ARIMS version and the Second RCA version

Table 11. Interregional comparison of tillage practices used for cropping in the baselines: 1990, 1995, and 2000

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					------- Thousand Acres -------						
Fall Plowing											
1990	3175	1779	1120	1703	9118	8486	13612	1844	11786	4941	57563
1995	2346	358	745	27	2764	5480	10785	3620	13109	4878	44112
2000	2424	651	1270	21	1070	4344	10193	3588	12030	4501	40091
Spring Plowing											
1990	7576	10236	5578	10775	25584	10741	31457	19498	4192	6315	131950
1995	7411	8815	2988	10913	16559	11045	20124	16429	3071	6136	103491
2000	7112	8743	2247	9692	11548	10285	18671	14495	2831	6568	92190
Cons. Tillage											
1990	2137	2717	291	1840	33682	9285	27571	7467	9899	2307	97194
1995	2514	5510	1828	2944	51350	12309	42215	11423	10823	3410	144324
2000	2740	5296	1868	3450	59120	14702	46978	13619	13347	3820	164939
Zero-Tillage											
1990	1480	2478	588	513	6265	1038	2509	1468	1416	228	17984
1995	2095	3167	2046	861	5904	1310	2765	495	641	224	19509
2000	2335	3863	2439	863	6896	1539	3161	760	737	292	22884

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

used the 82NRI as information on resource availability and use. Both model versions also used county-level yield and acreage statistics published by the NASS (1988), even though different years were involved. For comparison purposes the "most probable technology" and "moderate export" Second RCA runs are used.

Some differences in solutions can be inferred from changing model structure. Changes made in ARIMS since the Second RCA version are listed in Appendix A. The major change was in the crop yield calculations. Other changes involved acreage and production changes in the period between 1980 and 1987. The Second RCA crop yields were based on the best two-year average NASS yields of 1979-80. The version in this study has the average of 1986-87 NASS yields for the base. In the Second RCA, crop yield changes from the baseline to years of 1990, 2000, 2010, and 2030 were estimated by experts (English et al. 1984). For this study annual crop yield growth rates are from FAPRI (1989). These alternative assumptions are shown in Table 2. The biggest impact of these changing yield assumptions was to increase dramatically the land requirement for cropping. The increase in crop use then has an impact on other aspects of the comparison such as erosion and production cost.

Commodity Demand and Supply. Commodity demand and supply comparisons from the Second RCA, the FAPRI projections, and the baseline used for this study are given in Table 12. Since demands are taken as exogenous for ARIMS and supply always meets demand in the solution, the factors generating these demand levels are not discussed here. The FAPRI and baseline projections are nearly equivalent. The biggest changes

Table 12. Production and utilization comparison across evaluations

Crop	Category	Second RCA (1990)	Second RCA (2000)	FAPRI (95/96)	FarmB (1995)
Corn	Supply	7604	8800	9970	8780
	Beg. Stocks			1529	
	Production	7604	8800	8438	8780
	Imports			3	
	Domestic Use	4728	4596	5934	6332
	Exports	2876	4204	2527	2448
	Total Use	7604	8800	8460	8780
	End Stocks			1510	
Sorghum	Supply	908	1522	1039	730
	Beg. Stocks			235	
	Production	907	1522	754	730
	Imports				
	Domestic Use	640	1153	473	530
	Exports	268	369	291	200
	Total Use	908	1522	764	730
	End Stocks			276	
Soybeans	Supply	2416	3126	2450	2152
	Beg. Stocks			337	
	Production	2416	3126	2113	2152
	Imports				
	Domestic Use	1359	1483	1421	1104
	Exports	1057	1643	688	1048
	Total Use	2416	3126	2109	2152
	End Stock			341	
Wheat	Supply	2716	3200	3500	2730
	Beg. Stocks			784	
	Production	2716	3200	2696	2730
	Imports			20	
	Domestic Use	918	884	1065	1105
	Exports	1798	2316	1689	1625
	Total Use	2716	3200	2754	2730
	End Stocks			764	
Beef	Supply	22838	24203	26429	25499
	Beg. Stocks			293	
	Imports	1122	920	2200	900
	Production	21716	23283	23936	24599
	Consumption	22838	24203	26147	25499
	Domestic			25178	
	Exports			968	
	End Stocks			282	
Pork	Supply	16459	17184	17222	16673
	Beg. Stocks			300	
	Imports	185	551	1200	900
	Production	16274	16633	15722	15773
	Consumption	16459	17184	16915	16673
	Domestic			16615	
	Exports			300	
	End Stocks			308	
Dairy	Supply	134	133	153	164
	Imports				2
	Fluid Consum.			60	
	Mfg Milk use			84	
	Net gov. rem.			1	

NOTE: Units are in millions of pounds except for milk, which is reported in billions of pounds. To convert ARIMS liveweight to FAPRI carcass weight, factors of 0.525 and 0.7125 were used for beef and pork, respectively.

between the Second RCA and current projections are in domestic use and export estimates, particularly in the feed sections.

Acreage and Crop Yield Comparisons. As shown in Table 13 the effect of lowering crop yield growth rates was to drastically increase the current land requirement relative to those of the Second RCA. The Farm Bill projections nearly match the FAPRI projections, which are positive in nature, based on NASS statistics. The important point to note is that the cropland base is fairly tight considering that most idle land is involved in government paid or required diversions. Despite "potential cropland" surveys showing more than 150 million acres of suitable land not currently cropped, historical cropped acreage has not been much above these levels. Economic models indicate that drastic increases in crop prices would be required to induce such high levels of cropping.

Erosion and Tillage/Conservation Practice Comparisons. Table 14 indicates that erosion is expected to decline about 38 percent (both in total and on a per acre basis) for 1995 relative to 82NRI over all cropland. Decreases in wind erosion are 8 to 12 percent while water erosion decreases are 56 percent. Comparisons to Second RCA are not valid since erosion estimates for idle land were not computed in that study and the method of calculation changed, as explained earlier. Most of this erosion reduction is likely attributable to the 85FSA provisions.

Tillage and conservation practice definitions in the 82NRI do not match those in the Second RCA so comparisons could not be made. Comparisons to the Second RCA are given in Table 15 but since crop acreages were changing so drastically it is hard to attribute erosion

Table 13. Average/yield projection comparison across evaluations

Crop		NRI (1982)	Second RCA (1990)	Second RCA (2000)	FAPRI (95/96)	FarmB (1995)
Barley	acres	8.0	7.1	7.0	10.5	10.0
	yield		62.3	78.7	58.1	55.6
Corn Grain	acres	90.7	62.0	57.4	73.6	73.0
	yield		122.7	153.4	127.2	120.0
Corn Silage	acres		1.1	1.8		4.7
	yield		15.1	20.3		14.2
Cotton	acres	16.4	9.5	6.7	11.9	11.6
	yield		1.2	1.9	1.2	1.3
Legume Hay	acres	13.8	19.4	11.8		19.0
	yield		3.9	4.6	2.6	4.2
Nonleg. Hay	acres	18.9	17.2	2.0		31.8
	yield		1.7	2.0	2.6	1.7
Oats	acres	9.1	5.1	1.1	10.9	9.1
	yield		56.5	72.4	61.9	46.5
Peanuts	acres	1.7	1.0	0.9		1.3
	yield		47.7	63.2		36.2
Sorghum	acres	17.2	11.7	14.9	12.0	11.8
	yield		77.7	101.9	69.0	61.9
Sorghum Silage	acres		0.1	0.1		0.3
	yield		3.4	5.6		12.1
Soybeans	acres	66.6	53.7	50.1	60.6	56.1
	yield		45.0	62.4	35.8	40.9
Summer Fallow	acres	27.5	17.0	7.7		18.2
Sunflowers	acres	3.6	2.5	2.0		2.8
Wheat	acres	88.3	57.0	51.1	79.1	61.4
	yield		47.4	62.1	40.4	44.1
Total (14 crops)		381.5	264.4	214.6	258.6	311.4
Exogenous crops		34.8	28.1	27.1	12.1	27.6
All hay		52.4			62.8	
TOTAL ALL CROPS		416.3	292.5	241.7	333.5	339.0
ARP/PDD/0-92					17.7	
CRP					40.0	40.0
Idle or slack			117.6	161.2		37.0
Total idle			117.6	161.2	57.7	77.0
Potent. Converted			0.0	0.0	0.0	5.0
TOTAL ALL CROPLAND		416.3	410.2	402.9	391.2	415.3

NOTE: Units are in millions. Acreage/yield table explanations, according to FAPRI characteristics: exogenous crops include sunflower, peanuts, edible beans, tobacco, rye, flaxseed, rice and sugar; planted acreage for all except sugar, tobacco, rye, and hay; yields based on harvested acres.

Table 14. Erosion comparison across evaluations

Program	acres	Wind Total	Wind /acre	Sheet & Rill Total	Sheet & Rill /acre	Total Total	Total /acre
1982 NRI							
Cultiv. Cropland	377	1238	3.3	1804	4.8	3042	8.1
All Cropland	421	1249	3.0	1843	4.4	3092	7.3
Second RCA (1990) Endo. Crops	266	1030	3.9	989	3.8	2019	7.7
Second RCA (2000) Endo. Crops	215	656	3.0	789	3.7	1446	6.7
Farm Bill (1995)							
Endo. Crops	311	1112	3.60	690	2.20	1809	5.80
CRP	40	6.3	0.16	56.8	1.42	64	1.58
Idle	36	8.8	0.24	48.6	1.29	55	1.53
Total	387	1134.1	2.90	795.8	2.10	1929	5.0
% change, NRI base		-8.4	-12	-56	-56	-36	-38

NOTE: Units are millions and tons/acre.

Table 15. Conservation practice and tillage comparison across evaluations

Tillage Practice		Second RCA (1990)	Second RCA (2000)	FarmB (1995)
Straight Row				
Fall Plow		34	1	38
Spring Plow		82	45	96
Conservation		101	112	114
Zero		12	17	16
	Total	228	184	265
Contouring				
Fall Plow		0	0	2
Spring Plow		2	1	3
Conservation		0	1	7
Zero		0	0	1
	Total	4	2	13
Strip Cropping				
Fall Plow		2	0	2
Spring Plow		1	1	1
Conservation		2	1	5
Zero		0	0	1
	Total	5	2	9
Terracing				
Fall Plow		1	0	2
Spring Plow		7	2	4
Conservation		16	21	19
Zero		3	4	2
	Total	27	27	27
Total				
Fall Plow		37	10	44
Spring Plow		93	48	103
Conservation		119	135	144
Zero		16	21	20
	Total	265	215	311

NOTE: Millions of acres.

reductions directly to management changes. In fact, the largest changes shown in Table 15 are increases in spring plowing for the current study.

Variable Production Cost Comparisons. Per unit variable production costs for crops are contrasted in Table 16. The FAPRI values are based on harvested acres while all the ARIMS runs are based on planted acres. All ARIMS runs are in 1982 dollars while the FAPRI values are in 1989 values. The farm bill costs are higher than those of the Second RCA, partially due to lower yields.

Policy Scenarios: Water Quality and Trees for U.S.

The 10-Million-Acre Water Quality CRP Addition

Table 17 provides the acres by PA and land group to be enrolled in the 10-million-acre water quality CRP expansion. The FBCW subgroup intended for 50 percent of the acreage to come from corn, 20 percent from soybeans, and 9 percent from wheat. However, such crop acreage reductions conflict with the theoretical basis of ARIMS and so crop reductions were not specified. The targeting of acres by possible water quality problem was accounted for in ARIMS.

Eligibility was broad with respect to erosion rates, since even limited erosion levels could cause significant water quality problems in some locations. Eligibility was limited to cropland that had the potential for impairing use (or potential uses) of surface water. Eligibility, at the time of program implementation, would be coordinated with state water quality officials to take advantage of identified agricultural nonpoint pollution problems and plans.

Table 16. Variable production cost comparison across evaluations

Crop	Unit	Second RCA (1990)	Second RCA (2000)	FAPRI (95/96)	FarmB (1995)
Barley	bushel	1.72	1.26	1.43	1.70
Corn Grain	bushel	1.31	1.08	1.56	1.32
Corn Silage	ton	6.33	6.14	6.59	8.15
Cotton	bale	190.50	130.03	309.14	173.63
Legume Hay	ton	33.56	28.16		33.99
Nonleg. Hay	ton	35.45	27.50		33.54
Oats	bushel	1.49	1.21	1.25	1.88
Peanuts	cwt	7.35	5.74		8.51
Sorghum	bushel	1.43	1.02	1.59	1.66
Sorghum Silage	ton	25.00	19.00		6.50
Soybeans	bushel	2.68	2.00	2.64	2.81
Wheat	bushel	1.95	1.54	2.03	2.10

NOTE: Dollars per unit.

Table 17. Distribution of 10 million water quality CRP acres

	Acres (1000s) by ARIMS Land Group							
PA	1	2	3	4	5	6	7	8
1	0.0	1.1	30.3	0.0	0.0	1.5	26.0	0.0
2	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0
3	0.8	2.3	1.7	0.0	0.0	0.0	3.1	2.5
4	1.7	8.1	3.1	0.0	0.0	1.1	4.8	1.1
5	2.6	6.2	6.9	4.8	0.0	3.2	4.5	1.6
6	0.0	4.3	7.6	1.2	0.0	2.5	4.1	2.5
7	5.1	64.1	103.1	39.5	0.0	5.1	32.1	10.3
8	10.8	25.0	10.6	4.8	0.0	2.3	14.1	0.9
9	16.0	216.9	122.0	61.7	0.0	19.9	79.0	30.9
10	12.6	198.6	289.6	125.8	0.0	19.1	53.6	90.0
11	0.8	60.3	48.9	40.5	0.0	3.6	6.7	34.4
12	1.5	72.4	67.7	38.3	0.0	5.6	7.8	37.9
13	0.0	44.1	44.7	41.7	0.0	1.2	3.5	23.3
14	0.0	25.9	46.3	46.6	0.0	3.8	0.0	34.4
15	0.0	18.2	26.8	20.1	0.0	2.3	0.0	2.2
16	0.0	0.0	1.5	10.7	0.0	6.7	0.3	0.0
18	0.0	15.3	28.2	28.0	0.0	3.1	0.0	7.0
19	0.0	7.7	14.8	8.8	0.0	5.8	0.0	21.6
20	0.0	2.8	10.0	14.0	0.0	2.3	0.0	8.2
21	0.0	19.2	27.5	14.7	0.0	1.8	1.1	58.4
23	0.0	38.5	15.4	10.5	0.0	1.3	2.9	13.2
24	0.5	61.7	22.2	10.9	0.0	1.6	2.5	3.3
25	0.0	66.4	62.6	26.5	0.0	11.6	7.8	12.5
26	0.0	2.4	9.7	1.6	0.0	0.0	0.0	0.0
27	0.0	11.4	19.7	8.9	0.0	0.0	6.6	3.1
28	1.1	5.2	20.1	3.0	0.0	0.0	27.5	0.8
29	2.8	71.9	94.8	44.0	0.0	0.0	35.6	9.8
30	1.1	27.4	51.0	19.4	0.0	0.0	7.8	5.8
31	0.0	39.2	50.8	20.1	0.0	1.2	13.9	15.4
32	0.0	1.4	17.1	25.3	0.0	1.2	0.0	19.4
33	0.0	1.7	5.6	9.9	0.0	0.0	0.8	8.1
34	0.6	41.5	93.6	95.1	0.0	0.0	2.6	80.5
35	1.2	17.8	47.3	66.8	0.0	0.0	5.2	46.1
36	1.3	12.1	45.3	36.7	0.0	0.9	0.0	8.4
37	0.0	13.5	24.0	20.9	0.0	0.0	1.4	18.9
38	0.0	28.9	41.3	15.6	0.0	0.8	1.2	17.6
39	0.0	74.4	161.4	23.6	0.0	7.7	4.8	34.5
40	0.0	94.5	128.3	99.4	0.0	6.9	1.9	65.3

Table 17. Continued

PA	Acres (1000s) by ARIMS Land Group							
	1	2	3	4	5	6	7	8
41	0.0	214.0	434.5	227.0	0.0	2.4	18.4	188.4
42	0.0	34.6	103.9	98.1	0.0	0.6	6.7	58.6
43	0.0	11.5	55.0	60.3	0.0	0.6	2.2	58.1
44	2.7	48.8	96.7	94.6	0.0	0.0	5.6	91.9
45	1.4	45.4	85.2	56.0	0.0	0.0	25.7	38.8
46	0.0	7.1	8.0	1.3	0.0	0.0	4.7	0.0
47	0.0	0.0	5.4	1.9	0.0	0.0	0.0	0.0
53	0.9	24.1	20.9	62.5	0.0	0.0	0.0	6.4
55	0.0	0.0	0.0	8.0	0.0	0.0	0.0	22.9
56	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
57	0.0	19.1	665.3	188.9	0.0	0.0	6.7	53.3
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
59	0.0	0.0	0.0	1.3	0.0	0.0	0.0	8.6
60	0.0	12.0	251.8	67.5	0.0	1.5	3.2	39.5
61	0.0	0.0	3.3	0.0	0.0	0.0	0.0	2.6
64	0.0	4.1	5.8	0.0	0.0	2.4	0.0	0.0
66	0.0	0.0	1.7	1.4	0.0	0.0	0.0	4.2
68	0.0	0.0	0.0	5.0	0.0	0.0	0.0	3.3
69	0.0	2.2	4.0	0.0	0.0	0.0	0.0	1.1
70	0.0	3.9	2.3	0.4	0.0	5.9	0.0	3.7
71	0.0	11.4	6.1	9.8	0.0	0.0	2.5	1.3
72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
73	0.0	8.3	4.3	15.9	0.0	0.0	4.7	3.2
75	4.4	2.7	0.0	2.6	0.0	0.0	0.0	0.0
76	0.0	2.8	16.2	4.1	0.0	3.3	0.0	3.3
92	0.0	0.0	0.0	36.4	0.0	0.0	0.0	3.3
93	0.0	14.5	127.0	52.9	1.5	13.7	4.5	35.3
94	0.0	0.0	0.0	0.2	0.0	0.0	0.0	3.0
95	0.0	0.0	81.2	137.7	0.0	0.8	0.0	49.3
96	0.0	12.5	13.9	2.4	0.0	0.0	2.2	2.4
100	0.0	0.0	0.0	5.4	0.0	0.0	0.0	5.7
101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
102	0.0	0.0	0.9	0.0	0.0	0.0	0.0	9.8
103	0.0	0.0	1.4	2.4	0.0	0.0	0.0	42.9
104	0.0	0.0	0.1	13.0	0.0	0.0	0.0	20.7

NOTE: Cropland acres in PAs not listed were not involved in this program.

The 37-Million-Acre Trees for U.S. Pasture Reduction

The Trees for U.S. program had two goals: a reduction in carbon dioxide levels (a tying up of the carbon for the life of the trees) and a conversion of pasture land deemed marginal from an environmental standpoint to a better use, trees. The 20-million-acre option included 19.1 million acres of pasture and 0.8 million acres of cropland and would offset current annual emission of carbon dioxide by 5 percent. The 37-million-acre option included 4.6 million acres of cropland and 32.2 million acres of pasture and would offset current annual carbon dioxide emission by 10 percent. Only the 37-million-acre option was evaluated with ARIMS. Also, ARIMS only estimates the production and transportation cost impacts in the remaining agricultural sector caused by reallocating these productive resources.

Pasture Land Reductions. In ARIMS, pasture production and resources are by ecosystem rather than by PA. The 82NRI pasture levels are weighted to ecosystems according to Forest Service guidelines, and alternative condition and productivity classes are specified. ARIMS contains a range of management options with bounds on their adoption given by the Forest Service.

Each ecosystem pasture production activity has its output split to appropriate MRs with fixed weights. In each MR pasture feeding activities are specified. ARIMS contains two classes of flexibility constraints for this sector. An upper bound on grass-fed beef is specified to reflect maximum levels likely to be bounded. In each ecosystem 60 percent of the acreage utilized in the 82NRI period must continue to be utilized.

Since the mapping from ecosystems to PAs is so complex and ecosystems are based on vegetative characteristics rather than location, some specialized assumptions were required. First, the inherent weighting schemes were used to determine pasture land availability by MR, which were then converted to "feeding capacity" based on inherent nonlegume hay yields. The pasture land availabilities and desired reductions are shown in Table 18. Second, the desired pasture acreage reductions were converted to "feeding reductions," again with the nonlegume hay yields. A new constraint was then imposed, limiting the sum of all feeding activities for pasture in each MR to the "feeding capacity" minus the "feeding reduction."

Cropland Reductions. The desired PA cropland reductions were allocated across land groups according to the notion that the least productive lands would be enrolled first. The order of least productive land groups was assumed to be 8, 6, 4, and 3 with the HEL in each coming out before the nHEL (reductions in other land groups were not required).

Results: Policy Scenarios

ARIMS was first used to evaluate the impacts of adding 10 million acres to the CRP with distribution selected by potential water quality impacts. Of the 10 million acres, 8.0 million came from previously idled cropland, 1.3 million from cropped acreage in the baseline, and 0.7 million from conversion of pasture/range land. Impacts of the increased CRP (targeted to water quality) for cropping patterns and resource use were also found to be minimal at the national and regional levels.

Table 18. Allocation of Trees for U.S. land in ARIMS model

Market Region	Cropland 20-mil.-acre run	Cropland 37-mil.-acre run	Rangeland 20-mil.-acre run	Rangeland 37-mil.-acre run	Rangeland Slack, 2000 Baseline[a]
1	0	10	0	520	--
2	0	136	0	1698	--
3	48	460	1103	1750	1881
4	224	1509	1475	2901	3119
5	59	208	1484	1777	3758
6	54	297	1263	2681	3202
7	24	89	469	734	922
8	0	116	1057	3675	4344
9	70	644	1958	3306	3878
10	122	231	1127	1546	2308
11	19	59	380	861	591
12	0	0	26	55	2597
13	10	303	1844	2529	3636
14	69	335	3591	4099	7259
15	0	0	461	720	6695
18	1	40	1442	1767	17154
19	111	146	1425	1624	10601
National	802	4582	19105	32243	

NOTE: Values are in thousands. Baseline model solution is constrained by an upper limit on grass-fed beef and lower limits by market region forcing at least 60 percent of pasture acreage use reported in 1982 National Resources Inventory.

[a] Slack also occurs in market regions not shown.

ARIMS was also formulated to evaluate the agricultural production cost and resource use implications of the Trees for U.S. program considered to ameliorate global warming. Two scenarios were considered: 20- and 37-million-acre marginal pasture and cropland to tree conversions (5 and 10 percent, carbon dioxide emission offsets). It was determined that sufficient slack or underutilized pasture land was available to imply that impacts of the conversion would be minimal; the 37-million-acre run with ARIMS was completed with negligible national level cropping pattern and resource use impacts. The 37 million acres of trees required shifting or replacement of the feed, from livestock, of only 3 million acres of pasture that had been used in the baseline. The region with the largest impact, the Eastern Texas area, showed a shift of 10 percent in pasture forage production. The replacement of this forage for livestock feed was diffuse, with only minor adjustments occurring in either livestock numbers or in rations.

The 10-Million-Acre Water Quality CRP Addition. Analysis of this water quality scenario involved adding 10 million acres to the 40 million acre CRP enrollment in the 1995 baseline. Total CRP enrollment in the policy scenario would then be 50 million acres. Selection and distribution of the 10 million acres was based on potential water quality impacts.

Given that 10 million acres is less than 3 percent of the cropland used in the 1995 baseline, and that idle land is available for production, results at the national level were found to be minimal. Based on the distribution of land targeted for enrollment into the conservation reserve, however, regional results are important to help evaluate implications of the water quality scenario.

Results indicate that for the 1995 water quality scenario, average per acre sheet and rill erosion rates are lower for all regions. Table 19 shows that the national average erosion estimate fell 2.7 percent compared with the baseline. Estimates for most regions were less than the national reduction, however, except for the Northeast, Appalachian, and Delta regions. The largest impact of the water quality scenario is seen in the Northeast region, where an 18.1 percent reduction in per acre sheet and rill erosion resulted. Wind erosion results show both increases and decreases in erosion at the regional level. Again, the Northeast appears to be affected the most, having 8.9 percent higher per acre wind erosion.

Total per acre erosion, which is the sum of wind plus sheet and rill, also declined at the national level. The only region where estimates show higher erosion is the Pacific region, where higher wind erosion overshadowed the decrease in sheet and rill erosion. It is important to recognize that a primary reason for reduction of erosion in the Northeast is that not only was less cropland in production, but there was also a shift to more soil-conserving crops. Results of the water quality scenario for estimates of land utilization are found in Table 20.

At the national level, estimates show that of the 10 million acres added to the CRP, 1.3 million came from cropland in production, and 8.0 million acres came from idled land. While there was 0.4 percent less cropland used nationally, all but four regions had slightly more cropland used. The Northeast and the Appalachian regions were estimated to have the largest reduction. In the Northeast region, 1.9 million acres were

Table 19. Interregional comparison of per acre and total annual erosion estimates for the 1995 baseline and the water quality scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
Cropland Erosion					Tons per Acre						
Sheet and Rill											
1995	2.7	3.8	3.3	3.9	2.6	1.8	1.5	2.4	1.2	1.4	2.2
1995 WQ	2.2	3.6	3.2	3.8	2.6	1.8	1.5	2.4	1.2	1.4	2.2
% diff 95WQ/95	-18.1	-4.8	-1.4	-3.1	-1.9	-0.6	-0.6	-0.4	-2.5	-2.5	-2.7
Wind											
1995	0.3	0.8	1.1	1.1	0.8	1.7	4.6	10.4	8.9	3.1	3.6
1995 WQ	0.3	0.8	1.1	1.1	0.8	1.7	4.5	10.1	8.9	3.2	3.6
% diff 95WQ/95	8.9	2.3	0.7	-2.4	-0.1	-0.8	-0.1	-2.5	-0.2	4.5	0.0
Per Acre Total											
1995	2.9	4.5	4.4	5.0	3.4	3.5	6.1	12.8	10.1	4.5	5.8
1995 WQ	2.5	4.4	4.3	4.9	3.3	3.4	6.1	12.5	10.0	4.6	5.7
% diff 95WQ/95	-15.7	-3.7	-0.9	-2.9	-1.5	-0.7	-0.2	-2.1	-0.5	2.3	-1.0
Regional Total for Cropland (1000 tons)											
1995	42024.0	81149.0	33205.0	74229.0	258689.0	104525.0	461329.0	408679.0	278552.0	67346.0	1809727.0
1995 WQ	30613.0	74888.0	33196.0	76352.0	254575.0	105426.0	461566.0	398841.0	281014.0	66782.0	1783253.0
% diff 95WQ/95	-27.2	-7.7	0.0	2.9	-1.6	0.9	0.1	-2.4	0.9	-0.8	-1.5
CRP Land											
Sheet and Rill											
1995	1.8	1.8	0.8	1.4	2.2	1.1	2.0	0.7	0.8	0.9	1.4
1995 WQ	2.3	2.2	0.9	1.5	2.5	1.1	2.2	0.7	0.9	0.9	1.6
% diff 95WQ/95	29.7	24.7	5.1	4.3	10.5	8.8	7.2	0.7	1.7	-1.2	14.2
Wind											
1995	0.0	0.2	0.8	0.8	0.0	0.0	0.1	0.0	0.3	0.0	0.2
1995 WQ	0.0	0.2	0.8	0.8	0.0	0.0	0.1	0.0	0.3	0.1	0.1
% diff 95WQ/95	0.0	-18.1	11.1	6.7	-24.1	0.0	-3.8	4.3	-1.7	14.3	-5.3
Idle Land											
Sheet and Rill											
1995	2.0	1.6	0.9	0.7	1.8	1.3	3.0	0.6	0.7	0.4	1.3
1995 WQ	2.3	1.4	0.8	0.7	1.5	1.3	2.3	0.6	0.7	0.4	1.1
% diff 95WQ/95	15.3	-14.1	-0.2	-5.4	-20.3	-0.7	-22.2	0.3	-9.8	-2.7	-14.9
Wind											
1995	0.0	0.0	0.7	0.2	0.1	0.0	0.5	0.0	1.1	0.2	0.2
1995 WQ	0.0	0.0	0.7	0.3	0.1	0.0	0.5	0.0	1.3	0.1	0.3
% diff 95WQ/95	0.0	6.7	6.1	30.2	42.0	0.0	12.4	3.4	11.7	-37.3	18.4

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

NOTE: All values are rounded.

Table 20. Interregional comparison of estimated land use for the 1995 baseline and the water quality scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
	------------ Thousand Acres ------------										
Total Cropped Land											
1995	15570	19606	10622	17535	78811	33966	78355	33760	29901	20949	339015
1995 WQ	13604	18793	10689	18412	78728	34443	78571	33653	30283	20494	337670
% diff. 95WQ/95	-12.6	-3.9	0.6	5.0	-0.1	1.4	0.3	-0.3	1.3	-2.2	-0.4
Land in CRP											
1995	343	1640	1860	1305	6543	3117	9587	6277	7188	2138	39999
1995 WQ	2716	2926	2218	1804	9576	4281	10067	6421	7313	2701	50023
% diff. 95WQ/95	691.5	78.4	19.2	38.2	46.3	37.3	5.0	2.3	1.7	26.3	25.1
Green Cover											
1995	345	918	4884	2710	7916	6488	3545	6504	2221	802	36332
1995 WQ	181	614	4461	1106	5055	4858	2812	6541	1988	689	28303
% diff. 95WQ/95	-47.7	-33.2	-8.7	-59.2	-36.1	-25.1	-20.7	0.6	-10.5	-14.1	-22.1

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

removed from cropland. A 2.3-million-acre CRP contribution from this area required a lot of land from the cropland base because idle land was scarce. In contrast, the Corn Belt contributed 3.0 million acres to the CRP, but because they have significant idle land to draw from, the amount of cropland in production changed little.

Production of selected crops changed very little for the scenario. National estimates, shown in Table 21, indicate a 1 percent or less difference from the baseline. In regions where land availability was already tight, such as the Northeast, corn and soybean production was reduced more than 25 percent. A clue to why per acre erosion fell significantly in this area comes from results showing less land in row crops and more land in the production of wheat and nonlegume hay, both less erosive crops than corn or soybeans.

Total production costs are nearly unchanged at the national level compared to the baseline. Estimates of crop production costs (Table 22) show that, while the overall regional impact was quite small, some regions show lower costs due to less land in crop production while others increased. Total crop costs for the Northeast region declined because of a net reduction in cropland use. In the Delta and Mountain regions, estimates of crop costs were projected to be higher, not only because cropland use increased, but because the production of corn, cotton, and soybeans increased relative to other crops.

Changes in fertilizer use and other production inputs for the scenario, shown in Tables 23 and 24, reflect the changes in the level of total cropland use. National-level results estimates reveal that changes from the baseline are negligible. Estimates for the Northeast indicate

Table 21. Interregional comparison of estimated acres of selected crops for the 1995 baseline and the water quality scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
	------------ Thousand Acres ------------										
Corn Production											
1995	4815	4746	1602	4017	30799	10889	9522	4105	2292	216	73003
1995 WQ	3547	4380	1612	4668	30861	11249	9501	4121	2324	216	72479
% diff. 95/95WQ	-26.3	-7.7	0.6	16.2	0.2	3.3	-0.2	0.4	1.4	0.0	-0.7
Wheat Production											
1995	471	1742	750	1160	4853	3802	25606	7969	8892	6166	61409
1995 WQ	498	1528	746	1161	4502	3932	25606	7974	8942	5826	60715
% diff. 95/95WQ	5.9	-12.3	-0.5	0.2	-7.2	3.4	0.0	0.1	0.6	-5.5	-1.1
Soybean Production											
1995	1901	3999	2332	5240	29914	5285	6474	867	136	0	56149
1995 WQ	1271	3986	2377	5391	29989	5380	6476	884	164	0	55919
% diff. 95/95WQ	-33.2	-0.3	1.9	2.9	0.3	1.8	0.0	2.0	21.2	0.0	-0.4
Cotton Production											
1995	0	1620	377	1292	135	0	0	7300	60	798	11582
1995 WQ	0	1514	377	1421	134	0	0	7282	60	798	11586
% diff. 95/95WQ	0.0	-6.6	0.0	10.0	-0.2	0.0	0.0	-0.2	0.0	0.0	0.0
Legume Hay											
1995	3670	964	546	1877	4188	1791	166	296	2970	2248	18723
1995 WQ	3546	963	499	1834	4323	1764	139	295	3231	2250	18844
% diff. 95/95WQ	-3.6	-0.1	-8.6	-2.3	3.2	-1.5	-16.0	-0.4	8.8	0.1	0.6
Nonlegume Hay											
1995	1178	3342	840	45	1919	2843	14464	3358	3038	827	31854
1995 WQ	1312	3297	841	48	1855	2804	14640	3254	3025	830	31906
% diff. 95/95WQ	11.3	-1.3	0.2	8.9	-3.4	-1.4	1.2	-3.1	-0.4	0.4	0.2

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 22. Interregional comparison of estimated costs for the 1995 baseline and the water quality scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Million Dollars -----						
Production Costs											
1995	3728.5	3879.4	2241.8	3575.9	14677.4	5124.8	7686.2	6304.1	3555.3	3815.7	58025.2
1995 WQ	3462.7	3773.0	2250.6	3734.0	14751.1	5131.7	7706.9	6329.5	3649.1	3754.7	58118.6
% diff 95WQ/95	-7.12	-2.74	0.39	4.42	0.5	0.13	0.27	0.4	2.63	-1.59	0.16
Crop Costs											
1995	1622.4	2240.1	1070.2	1915.5	9780.5	3452.3	5857.0	3468.8	2125.0	1639.0	35840.3
1995 WQ	1361.7	2134.4	1079.3	2078.7	9785.3	3526.8	5881.2	3491.7	2180.7	1598.4	35927.7
% diff 95WQ/95	-16.07	-4.72	0.85	8.51	0.04	2.15	0.41	0.66	2.61	-2.47	0.24
Livestock Costs											
1995	2106.1	1639.2	1171.6	1660.4	4896.8	1672.4	1829.1	2835.4	1430.3	2176.7	22184.9
1995 WQ	2101.0	1638.6	1171.3	1655.3	4965.8	1604.9	1825.8	2837.8	1468.4	2156.3	22190.9
% diff 95WQ/95	-0.24	-0.03	-0.02	-0.3	1.4	-4.03	-0.18	0.08	2.66	-0.93	0.02
Land Improvement											
1995	0.3	6.2	9.1	6.2	34.1	1.9	98.9	45.7	8.4	4.0	214.9
1995 WQ	0.3	6.1	8.6	8.1	34.1	1.9	101.4	45.9	11.6	3.9	221.9
% diff 95WQ/95	-0.74	-1.95	-5.39	30.45	0	0.07	2.5	0.34	37.77	-1.67	3.26
Transportation											
1995	---	---	---	---	---	---	---	---	---	---	4091.0
1995 WQ	---	---	---	---	---	---	---	---	---	---	4107.2
% diff 95WQ/95	---	---	---	---	---	---	---	---	---	---	0.39

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 23. Interregional comparison of estimates for fertilizer cost and use in the 1995 baseline and the water quality scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Thousand Dollars -----						
Fertilizer Cost											
1995	286.1	408.0	161.6	409.6	1704.0	522.2	957.8	515.5	337.6	208.4	5510.8
1995 WQ	234.1	386.9	161.1	465.9	1718.2	537.6	964.6	536.1	339.6	198.2	5542.2
% diff. 90/95WQ	-18.17	-5.17	-0.28	13.73	0.82	2.94	0.71	4.00	0.59	-4.89	0.57
					------- Thousand Tons -------						
Total Nitrogen Use											
1995	264.5	595.8	339.4	757.7	2137.1	811.9	1952.0	1168.4	638.6	715.3	9380.6
1995 WQ	216.3	560.9	342.1	863.9	2150.1	837.2	1963.5	1208.2	640.3	698.0	9480.5
% diff. 90/95WQ	-18.2	-5.9	0.8	14.0	0.6	3.1	0.6	3.4	0.3	-2.4	1.1
Total Phos. Used											
1995	185.0	229.6	111.8	229.4	1141.7	311.9	532.3	260.0	236.5	117.4	3355.6
1995 WQ	151.7	218.2	109.8	251.5	1143.1	316.9	536.9	270.7	243.0	115.8	3357.4
% diff. 90/95WQ	-18.0	-5.0	-1.8	9.6	0.1	1.6	0.9	4.1	2.7	-1.4	0.1
Total Potash Used											
1995	579.1	526.7	223.7	354.0	2191.4	533.8	330.3	129.8	64.1	86.0	5018.9
1995 WQ	514.7	507.2	223.0	396.3	2233.8	537.0	330.3	129.6	64.2	84.3	5020.4
% diff. 90/95WQ	-11.1	-3.7	-0.3	12.0	1.9	0.6	0.0	-0.2	0.1	-1.9	0.0

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 24. Interregional comparison of pesticide, machinery, and labor cost estimates for the 1995 baseline and the water quality scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Million Dollars -----						
Pesticide Cost											
1995	173.4	357.1	208.4	242.4	1331.8	463.1	523.4	462.9	149.8	198.1	4110.4
1995 WQ	142.7	339.6	212.4	264.4	1330.8	471.8	524.6	458.4	152.9	196.9	4094.4
% diff 95WQ/95	-17.7	-4.9	1.9	9.1	-0.1	1.9	0.2	-1.0	2.0	-0.6	-0.4
Machinery Cost											
1995	259.8	380.0	174.7	328.6	1608.8	600.9	1073.5	681.2	445.9	321.6	5875.1
1995 WQ	224.3	364.2	175.8	350.6	1606.8	613.8	1077.4	681.7	461.4	314.1	5870.0
% diff 95WQ/95	-13.7	-4.2	0.7	6.7	-0.1	2.2	0.4	0.1	3.5	-2.3	-0.1
Labor Cost											
1995	135.7	166.2	82.7	152.4	684.7	255.1	459.3	299.7	156.9	139.2	2531.8
1995 WQ	118.0	159.6	82.7	160.5	682.3	259.9	461.3	301.0	162.2	137.3	2524.9
% diff 95WQ/95	-13.0	-3.9	0.0	5.4	-0.3	1.9	0.4	0.4	3.4	-1.4	-0.3
Water Cost											
1995	0.4	52.7	21.9	117.0	19.7	7.7	619.3	562.5	592.1	676.0	2669.3
1995 WQ	0.4	56.6	21.4	145.1	25.8	7.7	638.0	598.3	640.7	675.4	2809.5
% diff 95WQ/95	0.0	7.5	-2.1	24.0	31.2	0.0	3.0	6.4	8.2	-0.1	5.3

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

reductions in input costs of 18.1 percent for fertilizer, 17.7 percent for pesticides, 13.7 percent for machinery, and 13.0 percent for labor. On the other hand, where cropland use in the Delta region increased, input cost increased by 13.7 percent for fertilizer, 9.1 percent for pesticides, 6.7 percent for machinery, and 5.4 percent for labor.

Impacts of the water quality scenario on the use of tillage and conservation practices in crop production are shown in Tables 25 and 26. National projections for use levels of alternative tillage practices indicate less than a 1 percent change from the 1995 baseline. At the regional level, relatively large percentage differences from the baseline were estimated in some regions where erodible land requiring conservation treatment came into production to replace land placed in the CRP program. Thus, results show less fall and spring plowing and more use of conservation or zero tillage practices. In the Delta region, use of cropping practices in all categories increased, because idle land without a signficiant erosion problem entered production.

Modeling of the water quality scenario resulted in some interesting impacts on national and regional estimates for the use of conservation practices, particularly the level of use of contour- and strip-cropping methods. While the estimates of cropland acres using straight row practices indicate small changes from the baseline, changes in the use of contour and strip cropping are more pronounced.

Given that total cropland acres using contour and strip cropping are few compared to the use of straight row patterns, results show significant reductions in most regions, except for contour use in the Mountain region and strip-cropping practices used in the Southern Plains and Southeast.

Table 25. Interregional comparison of tillage practices used for cropping in the 1995 baseline and the water quality scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Thousand Acres -----						
Fall Plowing											
1995	2346	358	745	27	2764	5480	10785	3620	13109	4878	44112
1995 WQ run	2157	222	735	39	1879	5537	11179	3962	13143	5180	44033
% diff 95WQ/95	-8.06	-37.99	-1.34	44.44	-32.02	1.04	3.65	9.45	0.26	6.19	-0.18
Spring Plowing											
1995	7411	8815	2988	10913	16559	11045	20124	16429	3071	6136	103491
1995 WQ run	5890	9043	2966	11341	17558	11497	20086	15847	3477	5395	103100
% diff 95WQ/95	-20.52	2.59	-0.74	3.92	6.03	4.09	-0.19	-3.54	13.22	-12.08	-0.38
Cons. Tillage											
1995	2514	5510	1828	2944	51350	12309	42215	11423	10823	3410	144324
1995 WQ run	2235	4915	1946	3361	51178	12293	42097	11491	10780	3399	143696
% diff 95WQ/95	-11.10	-10.80	6.46	14.16	-0.33	-0.13	-0.28	0.60	-0.40	-0.32	-0.44
Zero Tillage											
1995	2095	3167	2046	861	5904	1310	2765	495	641	224	19509
1995 WQ run	2118	2918	2027	881	5580	1294	2742	559	625	219	19262
% diff 95WQ/95	1.10	-7.86	-0.93	2.32	-5.49	-1.22	-0.83	12.93	-2.50	-2.23	-1.27

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 26. Interregional comparison of conservation practices used for cropping in the 1995 baseline and the water quality scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----------- Thousand Acres -----------						
Straight Row											
1995	11970	14973	5914	14315	67736	29493	64443	23770	20018	12381	265014
1995 WQ	11366	14704	5989	15215	68745	30081	64857	23688	20248	12145	267038
% diff 95WQ/95	-5.1	-1.8	1.3	6.3	1.5	2.0	0.6	-0.3	1.1	-1.9	0.8
Contour Row											
1995	2093	2100	112	213	4275	425	256	199	1867	673	12212
1995 WQ	857	1745	101	202	3458	342	150	169	2133	459	9617
% diff 95WQ/95	-59.0	-16.9	-9.8	-5.0	-19.1	-19.5	-41.6	-14.9	14.3	-31.8	-21.3
Strip Cropping											
1995	285	242	15	15	438	34	142	44	5037	1342	7593
1995 WQ	159	111	19	5	183	7	13	68	4917	1337	6820
% diff 95WQ/95	-44.2	-54.1	33.2	-63.6	-58.2	-80.6	-91.0	53.9	-2.4	-0.4	-10.2
Terracing											
1995	18	536	1567	202	4129	191	11048	7954	722	251	26617
1995 WQ	18	538	1567	200	4109	190	11086	7934	727	251	26617
% diff 95WQ/95	0.0	0.4	-0.1	-1.2	-0.5	-0.3	0.3	-0.3	0.8	0.0	0.0

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

These deviations from the general results are associated with erosion abatement measures used to meet sheet and rill erosion limits in the East and wind erosion limits in the West. Decreases in the use of strip cropping in the Southeast were related to its use with soybean and corn production. Increases in cropping on the contour in the Mountain region, and increases in strip cropping in the Southern Plains also were related to more corn and soybean acreage in those regions compared to the baseline.

The 37-Million-Acre Trees for U.S. Pasture Reduction. The second policy scenario evaluated targeting 37 million acres of cropland and marginal pasture land for conversion to trees. The policy option included 4.6 million acres of cropland and 32.2 million acres of pasture land removed from crop and livestock production, based on an environmental concern. Discussion of the results is in terms of impacts on erosion, production cost, transportation cost, and input use, as compared to the 2000 baseline.

The 37-million-acre trees scenario resulted in small impacts on the projected rate of erosion. National level results indicate that resource use restrictions, associated with the scenario, produced less than a 1 percent erosion reduction (Table 27). Erosion estimates for the Eastern region of the United States, however, show impacts that are an order of magnitude greater than other regions. Total per acre erosion reduction was 4.0, 2.6, 5.6, and 2.8 percent, compared to the 2000 baseline for the Northeast, Appalachian, Southeast, and Delta regions. With the exception of the Delta region in the East, total erosion was reduced in connection with less cropland in production. Per acre erosion for the other regions

Table 27. Interregional comparison of per acre and total annual erosion estimates for the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
Cropland Erosion					----------- Tons per Acre ----------						
Sheet and Rill											
2000	2.6	3.7	3.5	4.1	2.6	1.7	1.6	2.5	1.3	1.5	2.2
2000 TFU	2.5	3.6	3.3	4.0	2.6	1.7	1.5	2.5	1.3	1.5	2.2
% diff 20TFU/20	-4.3	-3.2	-7.6	-2.9	-0.9	-0.1	-1.0	-0.6	-0.3	0.0	-1.4
Wind											
2000	0.3	0.8	1.1	1.1	0.8	1.7	4.7	10.5	8.4	3.0	3.6
2000 TFU	0.3	0.8	1.1	1.1	0.8	1.7	4.7	10.4	8.4	3.0	3.6
% diff 20TFU/20	-1.3	0.4	0.8	-2.7	0.4	0.2	0.1	-0.7	0.1	0.0	-0.1
Per acre Total											
2000	2.9	4.5	4.7	5.2	3.4	3.4	6.3	13.1	9.6	4.5	5.8
2000 TFU	2.8	4.3	4.4	5.0	3.4	3.4	6.3	13.0	9.6	4.5	5.8
% diff 20TFU/20	-4.0	-2.6	-5.6	-2.8	-0.6	0.1	-0.2	-0.7	0.0	0.0	-0.6
Regional Total (1000 tons)											
2000	41945.0	82586.0	36417.0	72786.0	265536.0	106085.0	495009.0	423617.0	278696.0	69936.0	1872614.0
2000 TFU	39793.0	78877.0	34059.0	74352.0	264649.0	106206.0	492167.0	425275.0	278458.0	69935.0	1863770.0
% diff 20TFU/20	-5.1	-4.5	-6.5	2.2	-0.3	0.1	-0.6	0.4	-0.1	0.0	-0.5
CRP											
Sheet and Rill											
2000	1.8	1.8	0.9	1.4	2.2	1.2	2.8	0.8	1.1	1.3	1.7
2000 TFU	1.8	1.8	0.9	1.4	2.2	1.2	2.8	0.8	1.1	1.3	1.7
% diff 20TFU/20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind											
2000	0.0	0.2	0.8	0.8	0.0	0.0	0.1	0.0	0.3	0.0	0.2
2000 TFU	0.0	0.2	0.8	0.8	0.0	0.0	0.1	0.0	0.3	0.0	0.2
% diff 20TFU/20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Idle Land											
Sheet and Rill											
2000	1.8	1.8	0.8	0.8	2.0	1.3	2.6	0.7	0.9	0.6	1.4
2000 TFU	1.6	1.6	0.8	0.7	2.1	1.4	2.6	0.7	0.9	0.6	1.4
% diff 20TFU/20	-12.1	-12.5	-1.1	-6.7	2.3	1.0	-0.8	-3.0	0.7	0.0	1.6
Wind											
2000	0.0	0.1	0.6	0.2	0.1	0.0	0.3	0.0	0.7	0.1	0.2
2000 TFU	0.0	0.0	0.6	0.2	0.1	0.0	0.4	0.0	0.7	0.1	0.2
% diff 20TFU/20	0.0	-45.5	2.5	-2.6	-8.4	0.0	13.1	7.1	-0.5	0.0	0.4

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

was lower because of a change in the proportions of crops in the crop mix. In the Northeast, Appalachian, and Southeast regions, results indicate fewer acres in cash grain and cotton row crops, and higher production of legume hay forage, which is a relatively less erosive crop.

Cropland use estimates for the scenario given in Table 28 indicate that, although some of the 37 million acres allocated to trees came from available cropland, total cropland in production increased by almost 300,000 acres nationally. Regional impacts are nearly negligible except for the Delta region estimates showing an increase in cropland use of more than 700,000 acres or 4.2 percent more than the baseline. Increases in cropland use in this region resulted from demand for commodities needed to support the livestock sector and exports, conditioned by ample idle land being available for production.

Acres devoted to producing some select crops changed very little. National results show percentage differences for the baseline of less than 1 percent, except for legume hay. For the crops listed in Table 29, the Delta region stands out again in terms of relative changes in the levels of cropland use. Acres of corn, soybeans, cotton, and legume hay increased significantly compared to other regions in response to bounds on pasture availability for livestock feed.

National and regional estimates of total crop and livestock costs for the scenario given in Table 30 show very little impact in changes from the baseline estimates. In general Eastern regions have lower total cost estimates because the lower total costs of livestock production outweigh increases in crop production costs. In the Western region, total production costs are higher because livestock total costs are higher and

Table 28. Interregional comparison of estimated land use for the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					Thousand Acres						
Total Cropped Land											
2000	15513	20257	10680	17026	80994	34718	81387	33912	31177	21519	347183
2000 TFU	15343	19900	10608	17747	81203	34734	81099	34275	31147	21519	347575
% diff. 20TFU/20	-1.1	-1.8	-0.7	4.2	0.3	0.0	-0.4	1.1	-0.1	0.0	0.1
Land in CRP											
2000	69	328	372	261	1309	623	1917	1255	1438	428	8000
2000 TFU	69	328	372	261	1309	623	1917	1255	1438	428	8000
% diff. 20TFU/20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Green Cover											
2000	491	1319	5853	4042	10552	7853	8350	11699	6132	1642	57932
2000 TFU	318	528	4150	2880	10174	7583	8520	11239	6161	1642	53194
% diff. 20TFU/20	-35.3	-60.0	-29.1	-28.7	-3.6	-3.4	2.0	-3.9	0.5	0.0	-8.2

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 29. Interregional comparison of estimated acres of selected crops for the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					---------------- Thousand Acres ----------------						
Corn Production											
2000	5079	4647	1515	3625	31805	10831	8778	4951	2514	187	73931
2000 TFU	4907	4641	1641	4017	31370	10874	8796	4994	2516	187	73942
% diff. 20/20TFU	-3.4	-0.1	8.4	10.8	-1.4	0.4	0.2	0.9	0.1	0.0	0.0
Wheat Production											
2000	458	1875	1027	1158	5440	4094	27720	7472	9705	6616	65566
2000 TFU	456	1613	830	995	5613	4130	27668	7529	9687	6616	65137
% diff. 20/20TFU	-0.5	-14.0	-19.2	-14.0	3.2	0.9	-0.2	0.8	-0.2	0.0	-0.7
Soybeans Production											
2000	1912	4190	2355	5004	30602	5376	7296	972	223	0	57930
2000 TFU	1853	4100	2458	5127	30450	5348	7200	974	227	0	57736
% diff. 20/20TFU	-3.1	-2.2	4.4	2.5	-0.5	-0.5	-1.3	0.2	1.7	0.0	-0.3
Cotton Production											
2000	0	1743	379	1352	142	0	0	7278	57	798	11749
2000 TFU	0	1626	379	1399	142	0	0	7421	57	798	11822
% diff. 20/20TFU	0.0	-6.7	0.0	3.4	0.0	0.0	0.0	2.0	0.0	0.0	0.6
Legume Hay											
2000	3608	1138	503	1960	3953	1920	207	277	2899	2115	18581
2000 TFU	3801	1231	521	2240	4579	1999	219	283	2899	2115	19887
% diff. 20/20TFU	5.4	8.2	3.4	14.3	15.8	4.1	5.8	2.2	0.0	0.0	7.0
Nonlegume Hay											
2000	1226	3271	845	35	1709	2902	14509	3445	2997	978	31917
2000 TFU	1096	3315	730	26	1644	2818	14368	3560	3005	978	31540
% diff. 20/20TFU	-10.6	1.3	-13.6	-24.7	-3.8	-2.9	-1.0	3.3	0.3	0.0	-1.2

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 30. Interregional comparison of estimated costs for the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					---------------- Million Dollars ----------------						
Production Costs											
2000	3785.3	4108.4	2300.2	3601.2	15419.9	5256.7	7947.8	6314.5	3699.6	4046.5	59716.6
2000 TFU	3752.8	4025.2	2148.5	3419.6	15397.9	5311.4	8221.7	6798.2	3751.0	3834.5	59877.1
% diff. 20/20TFU	-0.85	-2.02	-6.59	-5.04	-0.14	1.04	3.44	7.65	1.39	-5.23	0.26
Crop Costs											
2000	1670.0	2345.6	1096.7	1849.2	10116.1	3537.5	5996.6	3493.1	2206.7	1669.8	36444.5
2000 TFU	1648.0	2296.0	1099.1	1951.9	10100.8	3539.8	5973.2	3548.4	2203.5	1675.1	36526.8
% diff. 20/20TFU	-1.3	-2.1	0.2	5.5	-0.2	0.1	-0.4	1.6	-0.1	0.3	0.2
Livestock Costs											
2000	2115.3	1762.9	1203.6	1751.9	5303.7	1719.2	1951.2	2821.4	1492.9	2376.7	23272.1
2000 TFU	2104.8	1729.2	1049.3	1467.7	5297.2	1771.6	2248.5	3249.8	1547.5	2159.4	23350.4
% diff. 20/20TFU	-0.5	-1.9	-12.8	-16.2	-0.1	3.1	15.2	15.2	3.7	-9.1	0.3
Land Improvement											
2000	0.3	6.8	8.7	7.3	34.2	1.9	113.9	45.7	17.0	7.4	243.3
2000 TFU	0.3	6.6	7.8	7.3	34.2	1.9	113.8	46.1	17.0	7.4	242.5
% diff. 20/20TFU	0.0	-2.4	-10.6	-0.0	0.0	0.0	-0.1	0.8	-0.0	0.0	-0.3
Transportation											
2000	---	---	---	---	---	---	---	---	--	---	4421.7
2000 TFU	---	---	---	---	---	---	---	---	---	---	4416.0
% diff. 20/20TFU	---	---	---	---	---	---	---	---	---	---	-0.12

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

crop production costs are nearly unchanged. The national estimate for total transportation cost is lower for the scenario by less than 1 percent, indicating minor shifts in the pattern of commodity production relative to fixed demands.

Marginal values estimates for corn, wheat, soybeans, and cotton (given in Table 31) indicate little change from baseline estimates both at the regional and national levels. Estimates of marginal value for legume hay and nonlegume hay, however, suggest higher costs per unit of those commodities because of expanding acres and because fewer productive land resources were allocated to production. Increases of 23 to 50 percent in the marginal value of production for legume hay in the Northeast and Central regions are significant.

Impacts of the scenario on fertilizer, pesticide, machinery, and labor inputs, given in Tables 32 and 33, reflect changes in total cropland use in regions and shifts in the crop mix relative to the baseline estimate.

Since the 37-million-acre scenario used the 2000 baseline, which included the conservation compliance restriction, the estimates of cropland employing conservation tillage practices given in Tables 34 and 35 indicate that any new HEL coming into production must receive conservation treatment. Likewise, if cropland use was lower due to the scenario, the land not allocated for crop production was probably environmentally sensitive land not adequately treated. Estimates for the use of fall plowing on cropland fell significantly in Eastern regions, most notably the Delta region, with a reduction of more than 50 percent. Estimates for the use of strip cropping also reflect shifts in the crop

Table 31. Interregional comparison of marginal value (cost) estimates for selected crops in the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					Dollars per Unit						
Corn (bu.)											
2000	1.31	1.36	1.46	1.38	1.09	1.08	1.04	1.37	1.26	1.79	1.16
2000TFU	1.31	1.37	1.48	1.38	1.11	1.09	1.05	1.37	1.27	1.80	1.17
% diff 20TFU/20	0.60	0.90	1.00	0.10	1.00	0.90	1.10	0.50	0.90	0.60	1.00
Wheat (bu.)											
2000	2.18	2.19	2.29	2.17	1.99	1.83	1.79	2.03	1.90	2.36	1.95
2000TFU	2.18	2.17	2.29	2.18	1.99	1.83	1.78	2.01	1.89	2.35	1.94
% diff 20TFU/20	0.10	-0.80	0.10	0.20	0.10	0.20	-0.40	-0.60	-0.60	-0.60	-0.50
Soybeans (bu.)											
2000	2.81	2.83	2.95	2.83	2.57	2.56	2.50	2.76	2.50	0.00	2.61
2000TFU	2.82	2.84	2.96	2.83	2.58	2.57	2.51	2.77	2.51	0.00	2.62
% diff 20TFU/20	0.30	0.20	0.20	0.10	0.20	0.30	0.30	0.20	0.30	0.00	0.20
Cotton (bale)											
2000	0.00	148.74	148.74	148.74	148.74	0.00	0.00	148.74	148.74	148.74	148.74
2000TFU	0.00	148.74	148.74	148.74	148.74	0.00	0.00	148.74	148.74	148.74	148.74
% diff 20TFU/20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Legume Hay (ton)											
2000	2.14	11.19	11.24	14.06	6.82	0.41	2.60	2.84	3.22	9.41	6.39
2000TFU	3.08	12.26	12.11	14.64	8.41	0.62	3.27	3.80	3.75	10.12	7.40
% diff 20TFU/20	44.20	9.60	7.80	4.10	23.20	50.80	25.80	33.80	16.30	7.60	15.80
Nonlegume Hay (ton)											
2000	1.21	7.66	1.96	9.57	1.94	0.88	0.75	4.17	0.91	9.28	2.35
2000TFU	4.75	7.51	2.24	10.20	1.89	1.01	0.84	4.53	1.25	9.87	2.65
% diff 20TFU/20	292.30	-1.90	14.00	6.60	-2.90	15.10	11.90	8.70	37.50	6.40	12.60

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 32. Interregional comparison of estimates for fertilizer cost and use in the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Thousand Dollars -----						
Fertilizer Cost											
2000	308.8	438.6	178.3	397.3	1853.5	565.9	994.9	522.0	382.1	216.7	5858.1
2000 TFU	305.7	429.4	180.0	430.5	1855.9	564.8	990.1	537.7	379.7	222.0	5895.8
% diff. 20TFU/20	-1.01	-2.08	0.92	8.34	0.13	-0.19	-0.48	3.01	-0.63	2.44	0.64
					----- Thousand Tons -----						
Total Nitrogen Use											
2000	276.9	621.6	341.7	734.4	2325.3	866.2	1997.5	1167.6	718.0	746.3	9795.5
2000 TFU	265.1	609.9	347.5	773.5	2292.8	864.8	2006.5	1199.2	717.8	746.3	9823.5
% diff. 20TFU/20	-4.3	-1.9	1.7	5.3	-1.4	-0.2	0.4	2.7	0.0	0.0	0.3
Total Phos. Used											
2000	195.6	252.0	125.3	231.8	1248.7	339.2	570.7	262.7	260.7	115.3	3602.0
2000 TFU	194.1	247.5	119.5	246.3	1254.0	339.1	572.0	271.3	260.8	115.3	3619.9
% diff. 20TFU/20	-0.8	-1.8	-4.6	6.3	0.4	0.0	0.2	3.3	0.0	0.0	0.5
Total Potash Used											
2000	613.0	573.0	246.2	355.6	2384.8	579.2	354.0	141.1	74.7	87.8	5409.4
2000 TFU	619.5	567.0	243.2	389.8	2417.7	580.6	351.0	142.5	74.8	87.8	5473.9
% diff. 20TFU/20	1.1	-1.0	-1.2	9.6	1.4	0.2	-0.9	1.0	0.2	0.0	1.2

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 33. Interregional comparison of pesticide, machinery, and labor cost estimates for the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Million Dollars -----						
Pesticide Cost											
2000	182.0	374.9	213.5	235.5	1392.2	477.0	544.0	459.2	155.5	188.9	4222.6
2000 TFU	175.9	362.9	216.7	245.2	1380.8	476.8	541.6	464.2	155.6	188.9	4208.5
% diff 20TFU/20	-3.4	-3.2	1.5	4.1	-0.8	0.0	-0.4	1.1	0.1	0.0	-0.3
Machinery Cost											
2000	261.4	394.5	174.1	318.6	1615.5	600.2	1087.2	685.5	450.5	328.9	5916.6
2000 TFU	259.7	389.2	172.9	335.3	1614.1	601.5	1082.8	695.4	450.2	328.9	5930.1
% diff 20TFU/20	-0.6	-1.3	-0.7	5.2	-0.1	0.2	-0.4	1.4	-0.1	0.0	0.2
Labor Cost											
2000	136.0	172.7	80.9	149.1	687.8	256.5	467.0	300.7	158.8	140.8	2550.1
2000 TFU	135.6	171.2	80.9	157.5	690.2	257.1	465.0	304.9	158.8	140.8	2562.1
% diff 20TFU/20	-0.3	-0.8	0.1	5.7	0.4	0.2	-0.4	1.4	0.0	0.0	0.5
Water Cost											
2000	0.6	55.8	19.3	105.8	20.9	8.8	564.4	484.0	596.1	607.4	2463.1
2000 TFU	0.6	55.8	21.0	105.8	20.9	8.8	573.9	500.7	596.1	607.5	2491.0
% diff 20TFU/20	0.0	0.0	8.9	0.0	0.0	0.0	1.7	3.5	0.0	0.0	1.1

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 34. Interregional comparison of tillage practices used for cropping in the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Thousand Acres -----						
Fall Plowing											
2000	2424	651	1270	21	1070	4344	10193	3588	12030	4501	40091
2000 TFU	1835	757	713	10	1094	4297	10068	3707	11993	4501	38976
% diff 20TFU/20	-24.30	16.28	-43.86	-52.38	2.24	-1.08	-1.23	3.32	-0.31	0.00	-2.78
Spring Plowing											
2000	7112	8743	2247	9692	11548	10285	18671	14495	2831	6568	92190
2000 TFU	7560	8757	2707	10447	11881	10331	18678	14842	2831	6569	94601
% diff 20TFU/20	6.30	0.16	20.47	7.79	2.88	0.45	0.04	2.39	0.00	0.02	2.62
Cons. Tillage											
2000	2740	5296	1868	3450	59120	14702	46978	13619	13347	3820	164939
2000 TFU	2714	5096	1764	3394	59076	14745	46800	13520	13343	3820	164273
% diff 20TFU/20	-0.95	-3.78	-5.57	-1.62	-0.07	0.29	-0.38	-0.73	-0.03	0.00	-0.40
Zero Tillage											
2000	2335	3863	2439	863	6896	1539	3161	760	737	292	22884
2000 TFU	2331	3584	2568	894	6792	1514	3167	755	748	292	22646
% diff 20TFU/20	-0.17	-7.22	5.29	3.59	-1.51	-1.62	0.19	-0.66	1.49	0.00	-1.04

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

Table 35. Interregional comparison of conservation practices used for cropping in the 2000 baseline and the conversion to trees scenario

Variable/ Run	NE	Appl	SE	Delta	Cn Blt	LS	N.Plns	S.Plns	Mntn	Pcfc	Natnl
					----- Thousand Acres -----						
Straight Row											
2000	12273	14802	6141	13430	67396	29853	66893	24343	20242	13064	268437
2000 TFU	12036	14982	6099	14153	67998	29879	66707	24775	20192	13057	269877
% diff 20TFU/20	-1.9	1.2	-0.7	5.4	0.9	0.1	-0.3	1.8	-0.2	-0.1	0.5
Contour Row											
2000	2123	2887	162	367	6297	680	506	129	1081	394	14626
2000 TFU	2171	2510	72	372	6155	679	479	63	1141	405	14047
% diff 20TFU/20	2.3	-13.0	-55.5	1.2	-2.3	-0.2	-5.4	-50.9	5.5	2.9	-4.0
Strip Cropping											
2000	196	282	0	25	801	146	526	72	6904	1473	10425
2000 TFU	215	169	12	18	551	139	450	68	6865	1469	9956
% diff 20TFU/20	9.7	-39.9	--	-27.7	-31.1	-5.3	-14.5	-6.1	-0.6	-0.3	-4.5
Terracing											
2000	18	582	1521	203	4140	191	11077	7917	718	251	26617
2000 TFU	18	534	1568	203	4139	191	11077	7917	718	251	26617
% diff 20TFU/20											

SOURCE: Agricultural Resources Interregional Modeling System (ARIMS).

mix in the Corn Belt, Lake States, and Northern Plains, where legume hay and wheat increased relative to others. In the Delta region, however, where cropland increased, estimates indicated less strip cropping and more straight row methods with no-till production employed for conservation compliance.

APPENDIX A
Acronyms Used in This Report

Second RCA	Second Resource Conservation Act Appraisal (1985)
82NRI	1982 National Resources Inventory
85FSA	1985 Food Security Act
ACS	Alternative Conservation System
ARIMS	Agricultural Resources Interregional Modeling System
BEA	Bureau of Economic Analysis
CARD	Center for Agricultural and Rural Development
CC	Conservation Compliance
CRP	Conservation Reserve Program
CTIC	Conservation Technology Information Center
EI	Erosion Index
EPA	U.S. Environmental Protection Agency
EPIC	Erosion Productivity Impact Calculator
FAPRI	Food and Agricultural Policy Research Institute
FBCW	1990 Farm Bill Conservation Initiatives Work Group
HEL	Highly Erodible Land
MR	Market Region
NASS	National Agricultural Statistical Service
nHEL	non-Highly Erodible Land
NIRAP	National Interregional Agricultural Projection System
PA	Producing Area
SCS	Soil Conservation Service
USDA	U.S. Department of Agriculture
USLE	Universal Soil Loss Equation

APPENDIX B
ARIMS Specification Update from the 1985 RCA Version

1. Irrigated yields are now the same for surface and groundwater source cropping activities for years beyond 1990.

2. Strip-cropping activities now contain a minimum specified proportion of both close grown and row crops as was intended for the Second RCA.

3. Cotton demands now include both domestic and export quantities, consistent with the level of the minimum cotton acreage restrictions.

4. The barge transportation route activities prepared for the Second RCA but inadvertently left out are now included.

5. All crop minimum acreage constraints are "G" type, rather than some having been "N" such that RHS changes had no effect.

6. Fixed costs associated with terracing and irrigation have been removed for consistency with shorter-run policy analysis.

7. Minimum terraced acreage lower bounds have been changed from Market Region (MR) to Producing Area (PA) to prevent terrace locations from shifting so drastically among PAs of an MR between solutions. MR-level terrace costs are used for all PAs for each MR.

8. Land conversion activities both ways between dry and irrigated have been changed from one per PA (with land group proportions) to one for each land group in each PA to correct the "land creating" tendency and many of the infeasible solution problems previously existing in ARIMS.

9. The land conversion activities from High and Medium potential range and forestland to cropland that were created for RCA are now included.

10. In appropriate PAs (comparison of wind and water erosion problem dominance according to 82NRI) strip-cropping has been designated as being for wind erosion control with the assumption of control to the level of 5 tons per acre per year.

11. Minimum crop acreage flexibility constraints have been changed from 60 percent of 82NRI to 80 percent of NASS historical acreages.

12. All land must be used for cropping, CRP enrollment, or idled with a green cover crop (which has establishment and maintenance costs).

13. Green cover crops are assumed possible without irrigation in all PAs.

14. Upper bounds on tillage for the zero and conservation practices by PA have been set at 120 percent of the 1987 CTIC survey for 1990.

15. National feed consumption correction rows with RHSs are put in the model to explain additional exogenous feed use and other unaccounted excess disappearance for corn, wheat, soybeans, oats and sorghum; these are based on model comparison to published statistics.

16. Potassium and phosphorous coefficients that were switched in the Second RCA have been corrected.

17. Drying costs for irrigated double crops that were too high by a factor of 100 are now correct.

18. Sunflower crop production activities have interaction with minimum sunflower acreage rows rather than soybean rows.

19. Yield changes over time have been scaled back to the levels of the FAPRI projections (1989 version and onward).

20. Minimum acreage constraint RHS for corn and sorghum have been split to separate grain and silage rows (1989 versions and onward).

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