The Environmental Effects of Freedom to Farm

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by

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Abstract

The Federal Agriculture Improvement and Reform Act (FAIR) of 1996 ended commodity specific subsidies and resulted in a significant shifts in corn and soybean production in 1997. While conservation compliance improved the environmental health of the Central U.S., changes in production due to the FAIR act have tempered these improvements.

1. INTRODUCTION

The Federal Agriculture Improvement and Reform Act (FAIR) of 1996 ended more than 60 years of planting restrictions and commodity subsidies tied to market prices, while maintaining Conservation Compliance provisions on highly erodible land and a revamped Conservation Reserve Program (CRP). The act allows farmers to plant almost any crop while remaining eligible for fixed government payments provided they comply with applicable conservation and wetland protection requirements. Eligible farmers include those who planted barley, corn, upland cotton, oats, rice, sorghum, and/or wheat and who participated in the corresponding government commodity programs at least once during the period from 1991 to 1995.

Farmers benefit from the new legislation by gaining increased planting flexibility with continued government subsidies. But the environmental effect of the 1996 Act is uncertain. Continuation of CRP, Conservation Compliance, and swampbuster, along with new initiatives such as the Environmental Quality Incentives Program and whole-farm conservation plans, will yield important benefits. In addition, the focus on obtaining the greatest environmental benefits per dollar and geographic targeting emphasized in the Farm Bill has created opportunities to improve the environmental performance of farm programs (Kuch and Ogg 1996). But the elimination of acreage set-asides and the change in economic conditions that have induced farmers to take land out of the CRP means increased production levels and increased chemical use. In addition, high commodity prices pressure the natural resource base, which increases the incentive for farmers to plant on marginal land that, provides important wildlife habitat and other environmental benefits.

The purpose of this paper is to explore the environmental consequences of changes in crop production in the central United States between 1992 to 1997. These changes include the effects of the FAIR Act's elimination of commodity-based subsidies, higher commodity prices, and the implementation of Conservation Compliance. The analysis integrates an econometric model used to predict changes in crop production with physical process models used to estimate the effect of crop production on atrazine leaching, runoff, and volatilization; carbon sequestration; nitrogen leaching and runoff; and soil erosion.

Greater planting flexibility and high commodity prices increased soybean production by 22.9 percent in the central United States between 1992 and 1997. While corn acreage showed a slight increase for the region, as a whole, traditional corn growing states tended to decrease corn acreage. Wheat acreage decreased by 7 percent, sorghum acreage by 15.6 percent, hay acreage by 5.5 percent, and CRP acreage by 4.7 percent. While farmers planted additional marginal land and shifted to more erosive crops with a higher potential for chemical leaching and runoff, they also increased conservation practices to fulfill Conservation Compliance requirements and remain eligible for federal subsidies. Increased conservation led to a 14.8 percent increase in land cultivated using conservation tillage, which had significant positive environmental consequences that alleviated much of the negative impacts of increased farming intensity.

The environmental impact of agricultural production generally declined between 1992 and 1997 even though farming intensity increased. Soil erosion declined by 3.7 percent. The rate of loss of soil organic carbon from fertile cropland decreased by 2.9 percent, and atrazine lost from cropland decreased 12.4 percent. The only exception was nitrogen lost from cropland, which increased by 1.6 percent.

2. DATA AND ANALYSIS

The environmental consequences of changes in crop production between 1992 and 1997 were estimated by integrating two separate modeling components.[1] First, the Acreage Response Modeling System (ARMS) projects crop choices, crop rotation, and conservation practices given the natural resource base, climatic conditions, commodity prices, and government policy at more than 160,000 National Resource Inventory (NRI) points in the central United States. The Site-Specific Pollution Production modeling system (SIPP) then estimates the environmental effects of the projected management practices. The results show the effect of agricultural production on the environment in 1997 and how the environmental health of the central U.S. has changed since 1992 due to changes in agricultural policy and economic conditions faced by farmers.

The primary determinant of an individual farm's effect on the environment is the interaction among the type of crop grown on the farm, the management practices used to grow the crop, and location-specific resource factors, such as soil type, and proximity to water. Most farmers base their choice of which crop to grow on profit considerations. Profits from growing a particular crop depend on crop prices, crop yield, and the cost of production. Farmers are more likely to grow a crop that has a higher price, a higher yield, and/or a lower production cost than an alternative crop.

ARMS consists of two "discrete choice" models that predict farmers' choices of crops and tillage system. The models are discrete choice because farmers grow only one crop and use only one tillage system on a field during the growing season. Because nobody can predict farmers' choices with certainty, ARMS estimates the probabilities that

[1] An additional discussion of our methods and results can be found in *RAPS 1997: Agricultural and*

a particular site is planted to corn, soybeans, wheat, sorghum, hay, or some other crop. In addition, ARMS estimates the probability that a particular site is planted under a no-till, reduced-till, or conventional tillage system. These crop and tillage probabilities were estimated using the site-specific data on cropping history, tillage practices, and resource settings reported in the NRI, as well as climatic information from the National Climate Data Center, input prices from the USDA, and output prices from the Bridge data set.

After ARMS predicts probabilities for each NRI point, points are assigned to one of the six crops or the CRP, and to a tillage system. First, points are assigned to CRP using the 1992 NRI CRP designations as a baseline. ARMS uses Economic Research Service (ERS) state-level CRP acreage reports to determine whether to add or remove NRI points from the 1992 baseline on the basis of predicted probabilities for crop choice. Once state-level CRP acreage assignments agree with the ERS summary reports, ARMS assigns the remaining points to one of the six crop choices using the predicted probabilities and state-level acreage estimates from National Agricultural Statistics Service (NASS) Crops County Data. ARMS assigns each point to one of 15 possible rotations using its own crop assignment and the crop history from the 1992 NRI. ARMS assigns each NRI point to one of the three tillage systems using the tillage probabilities and crop acreage estimates for conservation tillage in each state from the Conservation Tillage Information Center (CTIC). Finally, ARMS maintains the 1992 NRI assignments for irrigation and conservation practices (contouring, strip cropping, and terracing).

SIPP uses eight environmental production functions to predict the local generation of atrazine runoff, leaching, and volatilization; changes in soil organic carbon; nitrogen

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Environmental Outlook (1997).

runoff and leaching; and water and wind erosion. Levels of these pollutants serve as environmental indicators, measures of the site-specific environmental effects of crop production. When crop production and management practices change, the local environmental impacts change as well. These indicators quantify the environmental consequences of these changes.

SIPP uses the Erosion Productivity Impact Calculator (EPIC) version 5300 (Sharpley and Williams 1988) and the Pesticide Root Zone Model (PRZM) 2.0 (Mullins et al. 1993) to develop its environmental production functions. Since running EPIC and PRZM simulations for every NRI point and all possible management practices is prohibitive, SIPP makes regional coverage possible by using a sample of 11,000 NRI points to estimate environmental production functions. EPIC and PRZM simulate the environmental effects of crop management practices for this NRI sample, using resource and management data from the NRI, climatic data from the NCDC, and fertilizer and atrazine application rates from the USDA's Cropping Practices Survey. The resulting environmental production functions predict site-specific pollution generation given local soil characteristics, climatic factors, and crop management practices (for example, see Mitchell et al., 1997).

To apply SIPP, the NRI provides soil and climatic data and ARMS assigns the crop management practices (crop rotation, tillage system, conservation practices, and irrigation system) used at each NRI point. SIPP then uses this information to calculate the potential environmental impacts of crop production at each NRI point and points are aggregated using the NRI expansion factors

3. The Environmental Consequences of Changes in Production

The FAIR Act gives U.S. farmers freedom to choose which crops to grow. Therefore, the relative profitability of crops is what now drives cropping patterns. In the past, government payments played a large role in driving cropping patterns because farmers who wanted to plant fewer program crops risked losing federal subsidies. The loss of subsidies created an incentive for farmers to maintain production levels of these program crops, while artificially holding down production levels of nonprogram crops.

The first year when farmers had sufficient knowledge of the new program rules to adjust their planting decisions was 1997. The extent to which farmers devoted fewer acres to program crops and more acres to nonprogram crops under the new rules is shown in Table 1. This table shows 1992 and 1997 crop acres by state, USDA production region (Lake States, Corn Belt, and Northern Plains), and for the entire study region.

Over the study region, corn acreage increased by a scant 0.3 percent, wheat acreage dropped by 7.0 percent, and sorghum acreage dropped by almost 16.0 percent. Soybean acreage increased by almost 23 percent. Thus, at least for wheat, sorghum, and soybeans, the FAIR Act seems to have had the predicted effect of increasing nonprogram crops in favor of program crops. The small aggregate increase of corn acreage from 65.6 to 65.8 million acres hides large changes in the distribution of acreage across the study region. In Iowa, corn acreage dropped 7.6 percent whereas in Missouri, acreage increased by 17.8 percent. Kansas corn acreage increased by 56.6 percent, but in North Dakota, corn acreage dropped by 21 percent.

What occurred was that farmers in Missouri and Kansas planted more corn because they found that their farm resources, combined with crop prices, made corn relatively more attractive. In Iowa and North Dakota, corn was relatively less attractive, so acreage decreased. The FAIR Act gave farmers the ability to adjust crop acreage in this manner. It just happened that the optimal adjustment across the study region resulted in little net change in corn acreage.

Why did soybean acreage increase so dramatically? First, soybean acreage had been artificially held down because, under the old farm program, soybeans did not receive subsidies. So putting soybeans on a “level playing field” with corn and wheat naturally resulted in relatively more soybean acres. Nationally, the ratio of corn to soybean acres fell from 1.44 in 1992 to 1.18 in 1997. In the Corn Belt, where most of the nation’s corn and soybeans are grown, this ratio fell from 1.22 to 1.02. So even though total corn acreage did not fall in absolute terms, it fell dramatically relative to soybean acreage. The second reason soybean acreage increased so dramatically is that the price of soybeans is high relative to other crops. The new farm policy allows farmers to plant crops for the market rather than for the government, which in recent years increased soybean acreage.

Where did farmers find the 10.3 million acres of land to devote to soybean production? The first source was acreage previously devoted to other crops. Aggregate wheat acreage decreased by 3 million acres. Grain sorghum decreased by 1 million acres while hay decreased by 1.5 million acres. Another source was land brought out of CRP. Many CRP contracts expired in 1996 and a large proportion of CRP land brought into production was planted to soybeans. As shown in Table 3.2, about 800,000 acres of CRP was brought back into production in the Corn Belt. In Iowa alone, 300,000 acres of CRP land from 1992 was put into production in 1997. Finally, more marginal cropland was brought into production.

The increased flexibility provided by the FAIR Act and higher commodity prices increased soybean acreage, while reducing the amount of land devoted to CRP and other less intensively cultivated crops. This increased farming intensity is likely to result in adverse environmental consequences; however, they will be mitigated by retaining Conservation Compliance, which requires farmers to develop and implement conservation plans to remain eligible for federal farm programs. Partly as a result of Conservation Compliance, farmers have drastically increased the percentage of acreage farmed using conservation tillage (Table 2). Between 1992 and 1997, conservation tillage acreage increased by nearly 15 percent over the study region. With the exception of Illinois where conservation tillage decreased, all other state showed increases.

Understanding the effects of the FAIR Act and high commodity prices on the environment is confounded by Conservation Compliance. While the environmental effects of increased soybean production are determined by a number of climatic and land resource characteristics, a few generalizations are possible. Converting CRP to soybean production increases soil erosion and chemical runoff and leaching. Planting soybeans instead of wheat and other less intensively farmed crops also increases soil erosion and chemical runoff and leaching. The environmental impact of retaining Conservation Compliance can either complement or counteract the effect of increased soybean production. Conservation tillage slows erosion by reducing runoff, but also allows more water to leach dissolved chemicals below the root zone. RAPS is designed to decompose the environmental changes into a cropping effect that shows the impact of the FAIR Act combined with higher commodity prices, and a tillage effect that shows the impact of

Conservation Compliance and other extraneous factors that have influenced farm management practices.

The FAIR Act's elimination of price supports increased soil erosion; however, maintaining Conservation Compliance mitigated this increase so that soil erosion actually fell between 1992 and 1997. In 1992, 14.2 billion tons of soil was lost to erosion in the study region (Table 3). This total declined by almost 4 percent, falling to 13.7 billion tons. Increased planting flexibility and higher commodity prices tended to increase soil erosion, with the exception of Ohio's small decrease, because farmers moved to more erosive corn and soybean rotations. With the exception of Illinois where conservation tillage generally increased, Conservation Compliance and changes in cultivation decreased soil erosion. For all the Corn Belt states except Illinois, Michigan, and all the Northern Plains states except North Dakota, increases in soil erosion due to increased planting flexibility and higher commodity prices were more than offset by Conservation Compliance and less erosive cultivation.

Cropping flexibility and increased commodity prices have had a negative effect on the rate of loss of soil organic carbon, but this effect has generally been offset by Conservation Compliance and improved soil management. The rate of loss of soil organic carbon fell nearly 3 percent between 1992 and 1997 (Table 4). The decrease in the rate of loss of soil organic carbon due to Conservation Compliance and changes in cultivation were substantially larger than the increase in the rate of loss caused by planting flexibility and higher commodity prices. Illinois and North Dakota are the only states that show a net increase. Illinois's net increase is attributable to its decline in the use of conservation tillage, while North Dakota's net increase is attributable to soybean acres replacing hay, sorghum, and wheat acres.

The FAIR Act exacerbated already increasing nitrogen losses from Conservation Compliance increasing leaching. Nitrogen losses increased 1.6 percent between 1992 and 1997 (Table 5). This increase is due to cropping flexibility, higher commodity prices, conservation compliance, and other changes in cultivation practices. The increase in nitrogen losses due to cropping flexibility and higher commodity prices is attributable to an increase in corn and soybean rotations, and a movement of cropland out of hay, sorghum, wheat, and CRP. With the exception of Illinois, Conservation Compliance increased the amount of land cultivated using conservation tillage, which generally increases nitrogen leaching. The Corn Belt and Lake States led this trend because leaching is a more significant source of nitrogen losses in these states. With the exception of North Dakota where the increase in soybean production was particularly pronounced, the Northern Plains experienced decreasing nitrogen losses because climactic and land resource characteristics are not as prone to leaching.

Atrazine losses decreased 12.4 percent between 1992 and 1997 (Table 6). Increases in atrazine losses due to cropping flexibility and higher commodity prices were more than offset by a general decrease in application rates, the percentage of acres receiving atrazine applications, and Conservation Compliance. The most significant increases in atrazine losses due to the FAIR Act were in Kansas and Illinois. The increase in Kansas is attributable to a large increase in corn acres in general. While there was almost no change in corn acres in Illinois, a significant increase in continuous corn and corn and soybean rotations increased in atrazine losses. Conservation Compliance and changes in farming practices generally decreased atrazine losses as farmers generally reduced atrazine application rates and the percentage of acres receiving atrazine applications. Nebraska is a notable exception because atrazine application rates and the percentage of acres receiving atrazine increased.

4. CONCLUSIONS

Agricultural production in the central United States underwent significant changes between 1992 and 1997 due to the FAIR Act of 1996 and the continued implementation of Conservation Compliance. The FAIR Act brought to an end more than 60 years of crop subsidies that artificially increased the production of program crops, barley, corn, upland cotton, oats, rice, sorghum, and wheat, while lowering the production of oil seed crops such as soybeans. Conservation Compliance required farmers to develop and implement conservation plans in order to maintain their eligibility for federal subsidies. As a result, soybean production increased by 22.9 percent replacing program crops and land coming out of CRP. While corn acreage showed a slight increase for the region, as a whole, traditional corn growing states tended to decrease corn acreage. Wheat acreage decreased by 7.0 percent, sorghum acreage by 15.6 percent, hay acreage by 5.5 percent, and CRP acreage by 4.7 percent. Finally, Conservation Compliance helped produce a 14.8 percent increase in land cultivated with conservation tillage.

The changes in agricultural production between 1992 and 1997 have generally resulted in an improvement in the environmental health of the central United States. While replacing less intensively farmed program crops and CRP with soybeans generally increased soil erosion, and the amount of organic carbon, nitrogen, and atrazine lost to the environment, increased conservation tillage decreased erosion, and the loss of organic carbon and atrazine. Unfortunately, increasing conservation tillage also increased nitrogen lost to the environment. The net effect was a 3.7 percent decline in soil erosion; a 2.9 percent decrease in the rate of loss of soil organic carbon; a 1.6 percent increase in nitrogen losses; and a 12.4 percent decrease in the loss of atrazine.

The political decision has been made to free farmers from the guiding hand of Washington when it comes to planting and production decisions. This study has investigated the environmental implications of this freedom. Two important findings emerge. First, the overall effect of agriculture on environmental quality has modestly declined since 1992 in the 12 states studied. Soil erosion rates are down, carbon sequestration rates are up, and losses of atrazine from farm fields are down. The second finding is that these beneficial changes have emerged not because farmers' planting freedom has resulted in less environmental damage, but rather because farmers have implemented their Conservation Compliance plans. Where adoption rates of conservation tillage are up, environmental damage is down. The importance of Conservation Compliance in lessening agriculture's effect on the environment raises an important policy question that Congress will be forced to address in the next few years. If the public interest is being served by Conservation Compliance, how will farmers be induced to maintain their conservation plans after current government payments end in 2002?

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Table 1. ARMS crop acres

Region	Corn Acres			Soybean Acres			Wheat Acres			Sorghum Acres			Hay Acres		
	1992	1997	Change	1992	1997	Change	1992	1997	Change	1992	1997	Change	1992	1997	Change
	1,000 acres		percent	1,000 acres		percent	1,000 acres		percent	1,000 acres		percent	1,000 acres		percent
Corn Belt															
Illinois	11,207	11,201	-0.1	9,514	10,004	5.1	1,450	1,202	-17.1	258	151	-41.6	1,071	1,021	-4.7
Indiana	6,102	6,002	-1.6	4,551	5,452	19.8	801	697	-13.0	0	0		631	750	19.0
Iowa	13,203	12,202	-7.6	8,153	10,501	28.8	69	25	-64.0	2	0	-100.0	1,951	1,700	-12.8
Missouri	2,504	2,951	17.8	4,309	4,901	13.7	1,498	1,101	-26.5	743	445	-40.1	3,600	3,481	-3.3
Ohio	3,801	3,601	-5.3	3,695	4,500	21.8	1,220	1,202	-1.5	1	0	-100.0	1,402	1,251	-10.8
Region	36,81	35,95	-2.3	30,22	35,35	17.0	5,038	4,227	-16.1	1,003	595	-40.7	8,654	8,203	-5.2
Lake States															
Michigan	2,698	2,602	-3.6	1,450	1,900	31.1	651	542	-16.6	0	0		1,369	1,251	-8.7
Minnesota	7,227	7,001	-3.1	5,507	6,802	23.5	2,850	2,458	-13.7	1	0	-100.0	2,185	2,451	12.2
Wisconsin	3,906	3,803	-2.6	751	1,001	33.3	163	145	-11.2	2	0	-100.0	2,818	2,402	-14.7
Region	13,83	13,40	-3.1	7,708	9,703	25.9	3,663	3,145	-14.2	2	0	-100.0	6,372	6,104	-4.2
Northern															
Kansas	1,852	2,900	56.6	1,911	2,350	23.0	12,020	11,400	-5.2	3,312	3,750	13.3	2,400	2,601	8.3
Nebraska	8,300	9,002	8.5	2,500	3,501	40.0	2,363	2,001	-15.3	1,702	950	-44.2	3,650	3,146	-13.8
North	1,011	799	-21.0	703	1,300	85.0	11,703	11,582	-1.0	1	0	-100.0	2,902	2,401	-17.3
South	3,817	3,754	-1.6	2,303	3,501	52.0	4,482	4,174	-6.9	581	272	-53.1	4,117	4,094	-0.5
Region	14,98	16,45	9.9	7,416	10,65	43.6	30,56	29,15	-4.6	5,596	4,973	-11.1	13,06	12,24	-6.3
Total	**65,627**	**65,817**	**0.3**	**45,347**	**55,712**	**0.2**	**39,268**	**36,530**	**-7.0**	**6,601**	**5,569**	**-15.6**	**28,095**	**26,548**	**-5.5**

Table 2. ARMS conservation reserve and tillage acres

	Conservation Reserve Program			Conservation Tillage		
Region	**1992**	**1997**	**Change**	**1992**	**1997**	**Change**
	1,000 acres		percent	1,000 acres		percent
Corn Belt						
Illinois	711	732	2.9	10,862	8,615	-20.7
Indiana	415	380	-8.5	4,270	5,735	34.3
Iowa	2,097	1,745	-16.8	10,238	12,642	23.5
Missouri	1,604	1,626	1.4	5,672	6,389	12.7
Ohio	316	325	2.9	3,878	4,714	21.6
Region	5,143	4,806	-6.5	34,919	38,095	9.1
Lake States						
Michigan	255	326	28.1	2,017	2,751	36.4
Minnesota	1,812	1,560	-13.9	4,057	4,545	12.0
Wisconsin	665	666	0.2	1,757	2,070	17.8
Region	2,731	2,552	-6.6	7,830	9,366	19.6
Northern Plains						
Kansas	2,864	2,851	-0.4	5,447	6,665	22.4
Nebraska	1,363	1,249	-8.3	8,429	9,965	18.2
North	2,902	2,827	-2.6	4,288	4,858	13.3
South	1,762	1,695	-3.8	3,927	5,469	39.3
Region	8,890	8,622	-3.0	22,091	26,957	22.0
Total	**16,764**	**15,981**	**-4.7**	**64,840**	**74,418**	**14.8**

Table 3. Soil erosion

Region	1992	1997	Crop Change	Tillage Change	Net Change	
			million tons			percent
Corn Belt						
Illinois	166.61	187.28	5.34	15.32	20.66	12.4
Indiana	71.02	61.95	3.03	-12.11	-9.08	-12.8
Iowa	252.13	223.89	5.44	-33.68	-28.24	-11.2
Missouri	85.37	78.08	0.82	-8.12	-7.30	-8.5
Ohio	55.54	50.37	-1.37	-3.80	-5.17	-9.3
Region	630.69	601.56	13.26	-42.39	-29.12	-4.6
Lake States						
Michigan	31.37	28.51	1.60	-4.46	-2.86	-9.1
Minnesota	102.59	103.12	3.13	-2.61	0.53	0.5
Wisconsin	59.09	62.46	4.03	-0.66	3.37	5.7
Region	193.05	194.09	8.77	-7.73	1.04	0.5
Northern Plains						
Kansas	242.02	236.56	5.74	-11.20	-5.46	-2.3
Nebraska	174.34	156.87	3.68	-21.15	-17.47	-10.0
North	97.71	98.55	3.31	-2.47	0.84	0.9
South	82.85	80.68	6.50	-8.68	-2.17	-2.6
Region	596.93	572.66	19.22	-43.49	-24.26	-4.1
Total	**1,420.67**	**1,368.32**	**41.26**	**-93.61**	**-52.35**	**-3.7**

Table 4. Soil organic carbon gained by cropland

Region	1992	1997	Crop Change	Tillage Change	Net Change	
		1,000 tons				percent
Corn Belt						
Illinois	-3,409.87	-3,728.07	-46.37	-271.84	-318.21	-9.3
Indiana	-1,244.78	-1,055.64	43.14	146.00	189.14	15.2
Iowa	-5,418.22	-4,984.52	-26.61	460.31	433.71	8.0
Missouri	-1,575.61	-1,481.47	7.69	86.45	94.14	6.0
Ohio	-2,158.24	-2,055.79	39.06	63.39	102.45	4.7
Region	-13,806.72	-13,305.49	16.92	484.31	501.23	3.6
Lake States						
Michigan	-225.48	-97.50	65.47	62.51	127.98	56.8
Minnesota	-3,805.85	-3,747.52	-2.44	60.76	58.32	1.5
Wisconsin	-94.80	-93.47	-13.69	15.02	1.33	1.4
Region	-4,126.13	-3,938.49	49.34	138.30	187.64	4.5
Northern Plains						
Kansas	-6,094.27	-6,028.87	-51.98	117.38	65.40	1.1
Nebraska	-3,558.76	-3,350.96	-27.04	234.84	207.80	5.8
North	-5,699.38	-5,744.83	-103.02	57.58	-45.44	-0.8
South	-2,927.40	-2,793.81	-5.31	138.90	133.59	4.6
Region	-18,279.82	-17,918.48	-187.35	548.69	361.34	2.0
Total	**-36,212.67**	**-35,162.46**	**-121.09**	**1,171.30**	**1,050.21**	**2.9**

Table 5. Nitrogen lost from cropland

Region	1992	1997	Crop Change	Tillage Change	Net Change	
		1,000 tons				percent
Corn Belt						
Illinois	188.68	192.52	5.70	-1.87	3.83	2.0
Indiana	151.71	153.53	0.28	1.55	1.83	1.2
Iowa	152.23	154.68	2.16	0.29	2.45	1.6
Missouri	98.24	101.34	2.43	0.67	3.10	3.2
Ohio	127.87	132.45	3.77	0.81	4.58	3.6
Region	718.72	734.51	14.33	1.45	15.79	2.2
Lake States						
Michigan	86.08	90.83	4.12	0.62	4.75	5.5
Minnesota	172.85	175.44	2.39	0.20	2.59	1.5
Wisconsin	67.86	70.65	2.62	0.16	2.79	4.1
Region	326.79	336.92	9.14	0.99	10.13	3.1
Northern Plains						
Kansas	142.99	141.46	-1.50	-0.02	-1.53	-1.1
Nebraska	111.66	108.47	-2.77	-0.42	-3.20	-2.9
North	78.69	81.45	2.34	0.42	2.76	3.5
South	35.69	34.72	-0.46	-0.51	-0.97	-2.7
Region	369.04	366.10	-2.40	-0.53	-2.93	-0.8
Total	**1,414.55**	**1,437.53**	**21.08**	**1.90**	**22.98**	**1.6**

Table 6. Atrazine lost from cropland

Region	1992	1997	Crop Change	Tillage Change	Net Change	
		1,000 tons				percent
Corn Belt						
Illinois	32.42	28.51	4.37	-8.27	-3.91	-12.1
Indiana	26.89	26.80	-0.20	0.12	-0.08	-0.3
Iowa	9.55	7.70	-0.83	-1.02	-1.85	-19.4
Missouri	18.23	17.43	0.55	-1.35	-0.79	-4.4
Ohio	7.72	6.47	-0.26	-0.99	-1.25	-16.2
Region	94.80	86.92	3.63	-11.51	-7.88	-8.3
Lake States						
Michigan	8.01	6.74	0.68	-1.94	-1.26	-15.8
Minnesota	2.43	2.45	0.15	-0.13	0.02	0.9
Wisconsin	4.98	4.81	0.01	-0.18	-0.17	-3.3
Region	15.41	14.00	0.84	-2.25	-1.41	-9.2
Northern Plains						
Kansas	55.02	36.64	4.79	-23.17	-18.38	-33.4
Nebraska	32.47	35.66	1.82	1.38	3.20	9.8
North	0.07	0.06	0.00	-0.01	-0.01	-15.1
South	0.78	0.56	0.03	-0.25	-0.22	-27.9
Region	88.33	72.92	6.64	-22.05	-15.41	-17.4
Total	**198.54**	**173.83**	**11.11**	**-35.81**	**-24.70**	**-12.4**