

Adjustment of CEAP Cropland Survey Nutrient Application Rates for APEX Modeling

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Introduction

In the NRI-CEAP Cropland Survey, farm operators were asked to provide information on nitrogen and phosphorus application rates for all crops grown on the sample field for the previous three years. Preliminary APEX model runs revealed, however, that the reported fertilizer levels were often insufficient to meet agronomic needs over the 47 years of the model simulation. This not only resulted in crop yields significantly below those reported in the survey (and by other sources on a regional basis), but also produced inflated estimates of soil erosion and sediment loss because of the lack of crop growth and canopy cover that normally protects the soil from the forces of wind and water during the crop growing period. Some sample points without sufficient nitrogen or phosphorus applications as reported in the survey also had high occurrences of crop failures over the 47-year simulation.

Some of the cases were determined to be data entry errors, including errant unit conversions. These were corrected when the intended response was clear. In most cases, however, this was not possible. In a few cases, the explanation could be that residual soil fertility levels had been built up in years prior to the survey period and only modest amounts of nitrogen or phosphorus were needed during the years reported in the survey. Reported applications during drought years or other conditions indicative of impending crop failures would also be expected to be less than agronomic requirements. In the case of phosphorus, the 3-year data period for which information was reported was too short to pick up phosphorus applications made at 4- and 5-year intervals between applications, which is a common practice for producers adhering to sound phosphorus management techniques. In all three of these cases, the model is unable to produce reasonable yields over the 47-year simulation without adjusting the nutrient application rates prior to model simulations.

In many cases, however, it appeared that key application rate data were simply missing from the survey responses. Corn grown with a reasonable yield but without any nitrogen applied, for example, strongly suggests that the nutrient inputs were not completely reported in the survey.

To obtain appropriate estimates of the effects of conservation practices, it was necessary to add additional nitrogen and phosphorus when the reported levels were insufficient to support reasonable crop yields throughout the 47 years in the model simulation. The approach taken was to first identify crop samples that have nitrogen or phosphorus application rates recorded erroneously or were under-reported in the survey. The set of crop samples identified were treated as if they had missing data. Additional nitrogen or phosphorus was added to these crop samples so that the total nitrogen or phosphorus use was similar to that for the unadjusted set of crop samples.

The methods used to estimate which sample points required additional nitrogen or phosphorus application and how much additional nitrogen or phosphorus was added is addressed in this documentation report.

Determination of crops that need nitrogen and/or phosphorus adjustment

The following steps were taken to determine the crops that most likely have nitrogen or phosphorus application rates recorded erroneously or under-reported in the survey.

1. Obtain the 47-year average annual crop yield using the nitrogen and phosphorus application rates as reported in the survey for each crop at each sample point—original yields.
2. Obtain the 47-year average annual optimal yield for each crop at each sample point using an APEX procedure called auto-fertilization, which supplies sufficient nitrogen and phosphorus to the crop to avoid plant stress.¹
3. For nitrogen,
 - identify a set of crops that are clearly receiving sufficient nitrogen when modeled using the nitrogen application rates as reported in the survey;
 - using this set of crop samples, develop criteria to identify crops where nitrogen was under-reported by comparing the original yields to the optimal yields; and
 - apply the criteria to each crop at each sample point to determine which crops require additional nitrogen.
4. For phosphorus,
 - identify a set of crops that are clearly receiving sufficient phosphorus when modeled using the phosphorus application rates as reported in the survey;
 - using this set of crop samples, develop criteria to identify crops where phosphorus was under-reported by comparing the original yields to the optimal yields; and
 - apply the criteria to each crop at each sample point to determine which crops require additional phosphorus.

The auto-fertilization routine produces the 47-year average annual optimal yield and optimal nitrogen and phosphorus application rates for the crop grown in the reported rotation under the conditions specific to management activities and conservation practices as reported in the survey, as well as weather and soil properties at each sample point. It accounts for all sources of plant-available nitrogen and phosphorus associated with the specific crop at the specific sample point—the reported amount of fertilizer or manure applied, the time of application, the method of application, atmospheric deposition of plant available nitrogen, and soil nitrogen or phosphorus, which includes nitrogen from previously planted legume crops and any plant-available nitrogen or phosphorus from decomposition of organic material and crop residue. The optimal yield and the optimal nitrogen or phosphorus application rate determined using APEX in this manner also accounts for nitrogen or phosphorus applied that is unavailable for plant growth because of field-level losses through the various loss pathways.

Potential crop yields reported for each soil in the soil survey database were used to identify the set of crops that appeared to have sufficient nitrogen or phosphorus applied when modeled using the nitrogen and phosphorus application rates reported in the survey. If the modeled crop yield obtained using the nitrogen and phosphorus application rates as reported in the survey (original yield) was greater than 90 percent of the soil survey yield for that area, it was judged to have had adequate nitrogen and phosphorus applied *for the purpose of developing the criteria*.

Nitrogen application rate adjustments were not made to legume crops (soybeans, beans and peas, and peanuts), but phosphorus adjustments were made to these legume crops where needed.

Crops were grouped into major crop groups for development of the criteria. These crop groups varied from region to region. For the Upper Mississippi River Basin, for example, criteria were developed separately for three crop groups: 1) all corn crops, 2) all wheat crops, and 3) all other crops. For each crop group, the distribution was created of the percent differences between the original yield and the optimal yield. The distribution represented only the subset of crop samples that appeared to have adequate nitrogen or phosphorus applied when modeled using rates reported in the survey.

The 90th percentile difference was selected as the threshold criteria for identifying crop samples that needed an adjustment in the nitrogen or phosphorus application rate. These thresholds varied for each region and crop group.

¹ For nitrogen, the auto-fertilization procedure was set to add 17.8 pounds per acre (20 kg/ha) of nitrogen when nitrogen available to the plant fell below 95 percent of nitrogen requirements, limiting the frequency of application to a minimum of 5 days between applications and limiting the total amount applied during the growing season to 713 pounds/acre (800 kg/ha). A similar procedure was used for phosphorus to obtain the optimal yield.

For the Upper Mississippi River Basin, the threshold for corn was determined to be an 8 percent difference between the original yield and the optimal yield. The threshold for wheat was a 26 percent difference and the threshold for “other crops” was a 3 percent difference.

Thus, crop samples with a percent difference between the original yield and the optimal yield that was greater than the threshold percent difference were defined to be crop samples with “missing or inadequate” nitrogen or phosphorus use data and for which additional nitrogen or phosphorus was added for the model simulation. This set of sample crops is referred to as the “adjusted” set, whereas the remaining sample crops are referred to as the “unadjusted” set.

Determination of the amount of nitrogen or phosphorus added

The procedure for determining the additional amount added was used for both nitrogen and phosphorus. The procedure is presented here using nitrogen as the example.

The goal for adding nitrogen was to achieve a distribution of nitrogen use for the adjusted set that was similar to the distribution of nitrogen use in the unadjusted set. The following steps were taken to determine how much additional nitrogen should be added to each crop sample in the adjusted set.

1. For the *unadjusted set*, the difference in application rate between the optimal rate (derived using autofert for each crop sample) and the nitrogen rate reported in the survey was determined for each crop sample. The average percent difference was then calculated for each of the three crop groups. For the Upper Mississippi River Basin, the average percent difference between the optimal rate and the nitrogen rate reported in the survey for corn was 18 percent, the average percent difference for wheat was 33 percent, and the average percent difference for other crops was 24 percent.
2. The desired nitrogen application rate for the adjusted set was based on the optimal rate, adjusting for the percent difference determined in step 1. For corn in the Upper Mississippi River Basin, for example, the desired rate for each crop sample was calculated as: $[1 - 0.18] * \text{optimal application rate}$.
3. The amount of nitrogen added to each crop sample in the adjusted set was equal to the desired rate less the amount reported in the survey.

Nitrogen and phosphorus were added by increasing the existing applications (thus preserving the reported timing and methods), when present, or were applied at plant.

The amount of nitrogen and phosphorus added thus varies from crop to crop and region to region. The specific results are reported in the following sections for each of the 12 CEAP regions.

Upper Mississippi River Basin

There were 3,703 sample points for cropped acres in the Upper Mississippi River Basin. Survey results provided data for a total of 8,992 crops grown at these sample points during the 3-year period—an average of 2.4 crops per sample point. Of these 8,922 crops, 974 had nitrogen application rate adjustments and 3,125 had phosphorus application rate adjustments. The number of crops with phosphorous application rate adjustments is higher largely because nitrogen application rate adjustments were not made for soybeans, a dominant crop in this region.

On a sample-point basis, no crops had nitrogen application rate adjustments for a total of 2,959 sample points, representing 46.4 million cropped acres—80 percent of cropped acres in the region. A total of 744 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 11.8 million cropped acres—20 percent of cropped acres in the region. For phosphorus, a total of 1,787 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 29.1 million cropped acres—50 percent of cropped acres in the region.

Nitrogen. Table 1 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Upper Mississippi River Basin. The cropping system “corn and soybean only” had the most crops—6,262, of which 3,256 were corn. Of these corn crops, 493 had nitrogen added for the model simulation (table 1). The average commercial nitrogen fertilizer application per year as reported was only 40 pounds per acre for the adjusted set, compared to an average of 148 pounds per acre for corn crops in the unadjusted set. The average amount of nitrogen added to these 493 corn crops was 68 pounds per acre per year, increasing the total amount applied to 111 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the crops in the unadjusted set was much higher, averaging 157 pounds per acre per year.

Table 1 shows that the average amount of total nitrogen applied per year was less for the adjusted set than the unadjusted set for all crops except small grains in the “corn and close grown crops” cropping system and hay and small grains in the “hay-crop mix” cropping system. For example—

- in the “corn only” cropping system, the 87 corn crops in the adjusted set had an average of 64 pounds per acre of nitrogen added, increasing the total amount applied to 108 pounds per acre per year compared to 168 pounds per acre per year for the unadjusted set;
- in the “corn and close-grown crops” cropping system, the 13 corn crops in the adjusted set had an average of 70 pounds per acre of nitrogen added, increasing the total amount applied to 104 pounds per acre per year compared to 138 pounds per acre per year for the unadjusted set;
- in the “corn-soybean with close-grown crops” cropping system, the 5 corn crops in the adjusted set had an average of 72 pounds per acre of nitrogen added, increasing the total amount applied to 109 pounds per acre per year compared to 138 pounds per acre per year for the unadjusted set;
- in the “hay-crop mix” cropping system, the 67 corn crops in the adjusted set had an average of 60 pounds per acre of nitrogen added, increasing the total amount applied to 103 pounds per acre per year compared to 164 pounds per acre per year for the unadjusted set; and
- in the “remaining mix of crops” cropping system, the 4 corn crops in the adjusted set had an average of 56 pounds per acre of nitrogen added, increasing the total amount applied to 93 pounds per acre per year compared to 151 pounds per acre per year for the unadjusted set.

In the “corn and close grown crops” cropping system, the 15 small grain crops in the adjusted set had an average of 49 pounds per acre of nitrogen added, increasing the total amount applied to 54 pounds per acre per year compared to 30 pounds per acre per year for the unadjusted set. In the “hay-crop mix” cropping system, the 66 hay crops in the adjusted set had an average of 128 pounds per acre of nitrogen added, increasing the total amount applied to 137 pounds per acre per year compared to 10 pounds per acre per year for the unadjusted set.

The results shown in table 1 are converted to a sample-point basis by averaging application rates over the years reported in the survey for each sample point. Table 2 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates in table 2 are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 2 shows that, for all but the “hay-crop mix” cropping system, the average amount of total nitrogen applied for sample points with all crops in the unadjusted set is more than the average for sample points with one or more crops in the adjusted set. For example, the amount of nitrogen applied per year for the 262 sample points in the “corn

only” cropping system with all crops in the unadjusted set averaged 172 pounds per acre per year, compared to 108 pounds per acre per year for the 54 sample points with one or more crops in the adjusted set.

For the “hay-crop mix” cropping system, the amount of total nitrogen applied per year for the 106 sample points with all crops in the unadjusted set averaged 63 pounds per acre per year, which was slightly less than the 73 pounds per acre per year for the 131 sample points with one or more crops in the adjusted set.

The “corn-soybean only” cropping system consists of 2,694 sample points in this region. A total of 408 of these sample points have one or more crops with nitrogen added, representing 16 percent of the acres in the cropping system (table 2). For other cropping systems—

- 54 sample points have one or more crops with nitrogen added for the “corn only” cropping system, representing 18 percent of the acres in the cropping system;
- 28 sample points have one or more crops with nitrogen added for the “soybean-wheat only” cropping system, representing 37 percent of the acres in the cropping system;
- 22 sample points have one or more crops with nitrogen added for the “corn and close-grown crops” cropping system, representing 48 percent of the acres in the cropping system;
- 75 sample points have one or more crops with nitrogen added for the “corn-soybean with close-grown crops” cropping system, representing 50 percent of the acres in the cropping system;
- 131 sample points have one or more crops with nitrogen added for the “hay-crop mix” cropping system, representing 56 percent of the acres in the cropping system; and
- 26 sample points have one or more crops with nitrogen added for the “remaining mix of crops” cropping system, representing 32 percent of the acres in the cropping system.

Overall, a total of 744 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 11.8 million cropped acres—20 percent of cropped acres in the region. As shown in the cumulative distribution in figure 1—

- 80 percent of cropped acres had no nitrogen added,
- 2 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 6 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Figure 1. Cumulative distribution of amount of nitrogen added to sample points in the Upper Mississippi River Basin

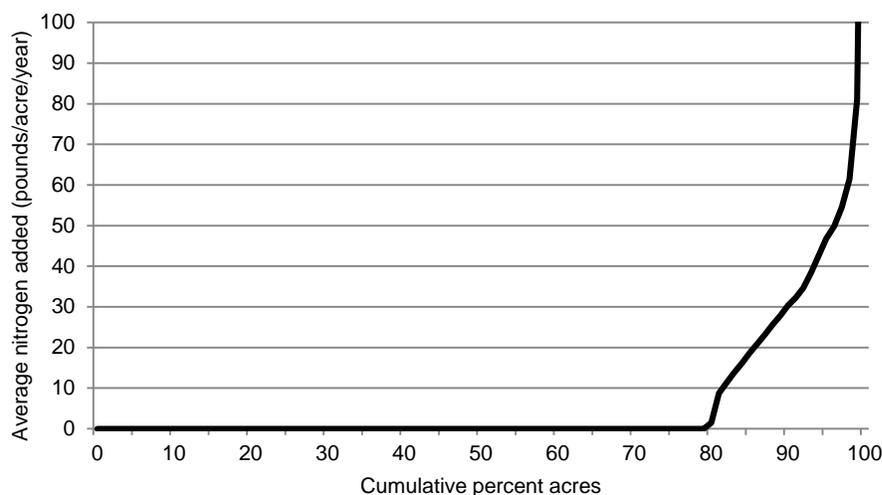


Table 1. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Upper Mississippi River Basin*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	2,763	148	0	157
CN, adjusted set	493	40	68	111
Corn only				
CN, unadjusted set	401	134	0	168
CN, adjusted set	87	41	64	108
SB-WT only				
WH, unadjusted set	42	106	0	111
WH, adjusted set	31	35	49	84
CN and close grown crops				
CN, unadjusted set	60	91	0	138
CN, adjusted set	13	20	70	104
SM, unadjusted set	14	8	0	30
SM, adjusted set	15	5	49	54
CN-SB with close grown crops				
CN, unadjusted set	164	130	0	138
CN, adjusted set	5	37	72	109
SM, unadjusted set	6	34	0	130
SM, adjusted set	16	10	45	54
WH, unadjusted set	86	107	0	107
WH, adjusted set	56	32	48	82
Hay-crop mix				
CN, unadjusted set	188	83	0	164
CN, adjusted set	67	25	60	103
HY, unadjusted set	399	2	0	10
HY, adjusted set	66	7	128	137
SM, unadjusted set	27	4	0	42
SM, adjusted set	65	4	58	64
Remaining mix of crops				
CN, unadjusted set	30	140	0	151
CN, adjusted set	4	37	56	93
SG, unadjusted set	28	101	0	102
SG, adjusted set	6	38	49	87

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 2. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Upper Mississippi River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	2,286	36,304,661	78	0	83
Sample points with one or more crops in the adjusted set	408	6,676,027	22	36	60
Corn only					
Sample points with all crops in the unadjusted set	262	4,128,388	142	0	172
Sample points with one or more crops in the adjusted set	54	908,645	48	55	108
Soybean only					
Sample points with all crops in the unadjusted set	105	1,507,404	3	0	6
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
SB-WT only					
Sample points with all crops in the unadjusted set	35	491,054	50	0	53
Sample points with one or more crops in the adjusted set	28	292,410	18	22	41
CN and close grown crops					
Sample points with all crops in the unadjusted set	19	393,937	72	0	150
Sample points with one or more crops in the adjusted set	22	358,357	36	34	80
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	89	1,073,282	84	0	92
Sample points with one or more crops in the adjusted set	75	1,070,763	46	16	66
Hay-crop mix					
Sample points with all crops in the unadjusted set	106	1,611,517	24	0	63
Sample points with one or more crops in the adjusted set	131	2,041,514	21	40	73
Remaining mix of crops					
Sample points with all crops in the unadjusted set	57	884,998	77	0	78
Sample points with one or more crops in the adjusted set	26	410,543	39	16	55
All cropping systems					
Sample points with all crops in the unadjusted set	2,959	46,395,241	--	--	--
Sample points with one or more crops in the adjusted set	744	11,758,259	--	--	--
Total	3,703	58,153,500	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Phosphorus. Table 3 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Upper Mississippi River Basin. The cropping system “corn and soybean only” had 6,262 crops, of which 3,256 were corn and 3,006 were soybeans. Of the corn crops, 827 had phosphorus added for the model simulation (table 3). The average commercial phosphorus fertilizer application per year as reported was 4.9 pounds per acre for the adjusted set, compared to an average of 27.9 pounds per acre for corn crops in the unadjusted set. The average amount of phosphorus added to these 827 corn crops was 18.6 pounds per acre per year, increasing the total amount applied to 23.9 pounds per acre per year in the model simulations (including manure applications). The amount of total phosphorus applied to the crops in the unadjusted set was higher, averaging 33.4 pounds per acre per year.

Of the soybean crops in the “corn and soybean only” cropping system, 1,596 had phosphorus added for the model simulation (table 3). The average phosphorus application per year as reported was only 0.2 pound per acre for the adjusted set, compared to an average of 7.1 pounds per acre for soybean crops in the unadjusted set. The average amount of phosphorus added to these 1,596 soybean crops was 11.8 pounds per acre per year, increasing the total amount applied to 12.1 pounds per acre per year. The amount of total phosphorus applied to the crops in the unadjusted set was slightly lower, averaging 8.9 pounds per acre per year.

For crops in other cropping systems, table 3 shows that the average amount of total phosphorus applied per year was less for the adjusted set than the unadjusted set for all but soybeans in three separate cropping systems, and those amounts were only slightly higher for the unadjusted crop sets. The average amount of phosphorus applied per year was slightly higher for the adjusted set than the unadjusted set for—

- soybeans in the “corn-soybean with close grown crops” cropping system,
- soybeans in the “hay-crop mix” cropping system, and
- soybeans in the “remaining mix of crops” cropping system.

The results shown in table 3 are converted to a sample-point basis in table 4 by averaging application rates over the years reported in the survey for each sample point, as described previously for nitrogen. Table 4 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is more than the average for sample points with one or more crops in the adjusted set for all cropping systems.

A total of 1,535 of the sample points in the “corn-soybean only” cropping system have one or more crops with phosphorus added, representing 55 percent of the acres in the cropping system (table 4). For other cropping systems—

- 91 sample points have one or more crops with phosphorus added for the “corn only” cropping system, representing 27 percent of the acres in the cropping system;
- 82 sample points have one or more crops with phosphorus added for the “soybean only” cropping system, representing 80 percent of the acres in the cropping system;
- 18 sample points have one or more crops with phosphorus added for the “soybean-wheat only” cropping system, representing 21 percent of the acres in the cropping system;
- 10 sample points have one or more crops with phosphorus added for the “corn and close-grown crops” cropping system, representing 25 percent of the acres in the cropping system;
- 58 sample points have one or more crops with phosphorus added for the “corn-soybean with close-grown crops” cropping system, representing 36 percent of the acres in the cropping system;
- 99 sample points have one or more crops with phosphorus added for the “hay-crop mix” cropping system, representing 38 percent of the acres in the cropping system; and
- 23 sample points have one or more crops with phosphorus added for the “remaining mix of crops” cropping system, representing 27 percent of the acres in the cropping system.

Overall, a total of 1,916 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 29.1 million cropped acres—50 percent of cropped acres in the region. As shown in the cumulative distribution in figure 2—

- 50 percent of cropped acres had no phosphorus added,
- 10 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 10 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 18 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 12 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 2. Cumulative distribution of amount of phosphorus added to sample points in the Upper Mississippi River Basin

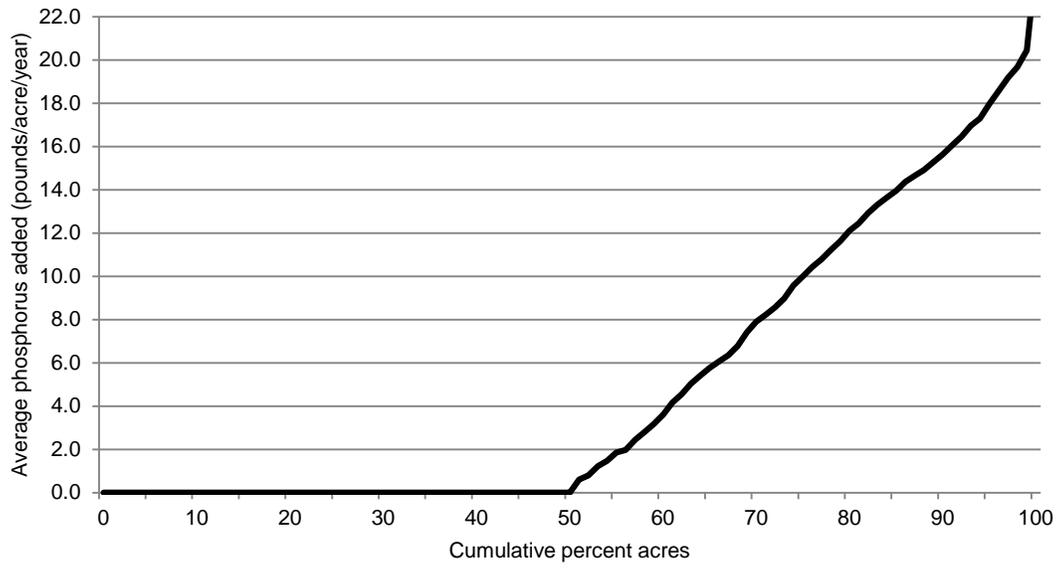


Table 3. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Upper Mississippi River Basin

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	2,429	27.9	0.0	33.4
CN, adjusted set	827	4.9	18.6	23.9
SB, unadjusted set	1,410	7.1	0.0	8.9
SB, adjusted set	1,596	0.2	11.8	12.1
Corn only				
CN, unadjusted set	362	20.2	0.0	42.5
CN, adjusted set	126	3.8	15.6	20.9
Soybean only				
SB, unadjusted set	33	18.0	0.0	28.6
SB, adjusted set	106	0.4	14.0	14.5
SB-WT only				
SB, unadjusted set	67	12.0	0.0	12.3
SB, adjusted set	31	0.7	11.0	11.6
WH, unadjusted set	62	25.1	0.0	27.8
WH, adjusted set	11	0.0	10.8	10.8
CN and close grown crops				
CN, unadjusted set	64	14.1	0.0	34.9
CN, adjusted set	9	3.2	12.8	16.0
SM, unadjusted set	26	1.9	0.0	11.3
SM, adjusted set	3	0.0	8.3	8.3
CN-SB with close grown crops				
CN, unadjusted set	146	27.6	0.0	32.3
CN, adjusted set	23	2.4	23.0	25.8
SB, unadjusted set	171	5.0	0.0	5.4
SB, adjusted set	51	0.5	7.8	8.3
SM, unadjusted set	19	8.9	0.0	24.7
SM, adjusted set	3	0.0	10.2	10.2
WH, unadjusted set	118	22.8	0.0	23.4
WH, adjusted set	24	0.0	12.6	12.6
Hay-crop mix				
CN, unadjusted set	207	12.7	0.0	58.7
CN, adjusted set	48	3.9	13.8	19.2
HY, unadjusted set	290	4.0	0.0	9.7
HY, adjusted set	175	0.2	9.2	9.5
SB, unadjusted set	39	8.1	0.0	12.0
SB, adjusted set	18	0.2	11.9	12.1
SM, unadjusted set	72	3.3	0.0	11.3
SM, adjusted set	20	0.0	9.9	9.9
Remaining mix of crops				
CN, unadjusted set	30	25.4	0.0	29.7
CN, adjusted set	4	1.8	28.6	30.4
SB, unadjusted set	58	7.5	0.0	7.9
SB, adjusted set	24	0.0	9.5	9.5

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 4. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Upper Mississippi River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	1,159	19,358,800	20.1	0.0	25.0
Sample points with one or more crops in the adjusted set	1,535	23,621,888	8.3	9.7	18.6
Corn only					
Sample points with all crops in the unadjusted set	225	3,664,868	21.4	0.0	41.7
Sample points with one or more crops in the adjusted set	91	1,372,165	3.8	15.2	20.3
Soybean only					
Sample points with all crops in the unadjusted set	23	307,299	16.1	0.0	32.3
Sample points with one or more crops in the adjusted set	82	1,200,105	0.3	14.0	14.3
SB-WT only					
Sample points with all crops in the unadjusted set	45	619,055	18.2	0.0	19.8
Sample points with one or more crops in the adjusted set	18	164,409	5.0	9.8	14.8
CN and close grown crops					
Sample points with all crops in the unadjusted set	31	564,885	10.4	0.0	40.7
Sample points with one or more crops in the adjusted set	10	187,408	2.7	5.7	11.3
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	106	1,366,961	19.4	0.0	23.5
Sample points with one or more crops in the adjusted set	58	777,085	6.6	7.0	14.8
Hay-crop mix					
Sample points with all crops in the unadjusted set	138	2,269,012	7.7	0.0	28.6
Sample points with one or more crops in the adjusted set	99	1,384,019	2.5	8.7	12.2
Remaining mix of crops					
Sample points with all crops in the unadjusted set	60	951,663	18.7	0.0	19.1
Sample points with one or more crops in the adjusted set	23	343,877	4.2	7.9	12.1
All cropping systems					
Sample points with all crops in the unadjusted set	1,787	29,102,544	--	--	--
Sample points with one or more crops in the adjusted set	1,916	29,050,956	--	--	--
Total	3,703	58,153,500	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Ohio-Tennessee River Basin

There were 2,124 sample points for cropped acres in the Ohio-Tennessee River Basin. Survey results provided data for a total of 5,264 crops grown at these sample points during the 3-year period—an average of 2.5 crops per sample point. Of these 5,264 crops, 659 had nitrogen application rate adjustments and 1,324 had phosphorus application rate adjustments. The number of crops with phosphorus application rate adjustments is higher largely because nitrogen application rate adjustments were not made for soybeans, a dominant crop in this region.

On a sample-point basis, 504 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 6.0 million cropped acres—24 percent of cropped acres in the region. For phosphorus, a total of 797 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 10.0 million cropped acres—40 percent of cropped acres in the region.

Nitrogen. Table 5 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Ohio-Tennessee River Basin. The cropping system “corn and soybean only” had the most crops—3,349, of which 1,628 were corn. Of these corn crops, 297 had nitrogen added for the model simulation (table 5). The average commercial nitrogen fertilizer application per year as reported was only 36 pounds per acre for the adjusted set, compared to an average of 162 pounds per acre for corn crops in the unadjusted set. The average amount of nitrogen added to these 297 corn crops was 71 pounds per acre per year, increasing the total amount applied to 109 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the crops in the unadjusted set was much higher, averaging 166 pounds per acre per year.

Table 5 further shows that the average amount of total nitrogen applied per year was less for the adjusted set than the unadjusted set for all but 4 of the crop and cropping system combinations. For example—in the “corn only” cropping system, the 35 corn crops in the adjusted set had an average of 66 pounds per acre of nitrogen added, increasing the total amount applied to 111 pounds per acre per year compared to 175 pounds per acre per year for the unadjusted set.

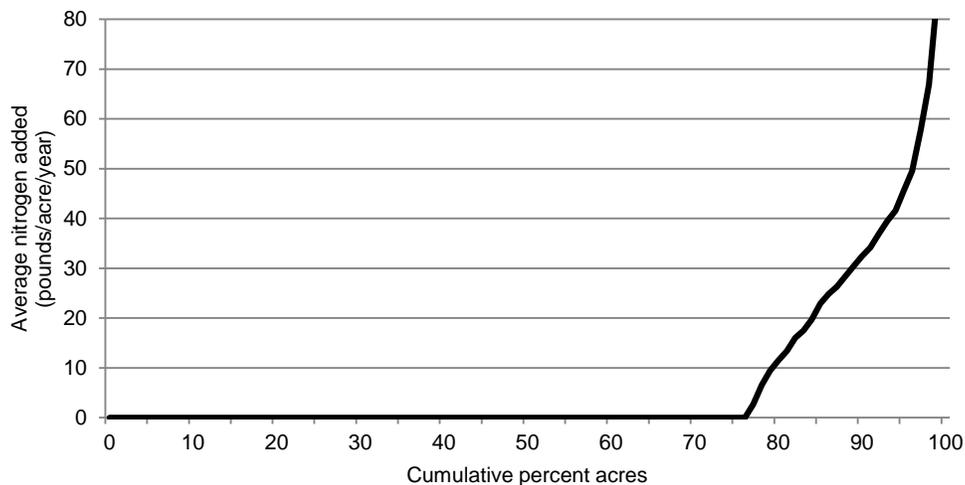
Table 6 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. For all but the “hay-crop mix” cropping system, the average amount of total nitrogen applied for sample points with all crops in the unadjusted set is more than the average for sample points with one or more crops in the adjusted set. For example, a total of 259 of the 1,401 sample points in the “corn-soybean only” cropping system have one or more crops with nitrogen added, representing 19 percent of the acres in the cropping system. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 84 pounds per acre per year, compared to 56 pounds per acre per year for the sample points in the adjusted set.

For the “hay-crop mix” cropping system, the amount of total nitrogen applied per year for the 32 sample points with all crops in the unadjusted set averaged 66 pounds per acre per year, which was less than the 98 pounds per acre per year for the 57 sample points with one or more crops in the adjusted set.

Overall, a total of 504 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 6.0 million cropped acres—24 percent of cropped acres in the region. As shown in the cumulative distribution in figure 3—

- 76 percent of cropped acres had no nitrogen added,
- 3 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 5 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 5 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 7 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Figure 3. Cumulative distribution of amount of nitrogen added to sample points in the Ohio-Tennessee River Basin



Phosphorus. Table 7 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Ohio-Tennessee River Basin. The cropping system “corn and soybean only” had 3,325 crops, of which 1,628 were corn and 1,697 were soybeans. Of the corn crops, 297 had phosphorus added for the model simulation. The average commercial phosphorus fertilizer application per year as reported was 4.1 pounds per acre for the adjusted set, compared to an average of 34.0 pounds per acre for corn crops in the unadjusted set. The average amount of phosphorus added to these 297 corn crops was 19.6 pounds per acre per year, increasing the total amount applied to 24.0 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the crops in the unadjusted set was higher, averaging 36.1 pounds per acre per year.

Of the soybean crops in the “corn and soybean only” cropping system, 676 had phosphorus added for the model simulation (table 7). The average phosphorus fertilizer application per year as reported was only 0.5 pound per acre for the adjusted set, compared to an average of 12.9 pounds per acre for soybean crops in the unadjusted set. The average amount of phosphorus added to these 676 soybean crops was 14.3 pounds per acre per year, increasing the total amount applied to 14.9 pounds per acre per year. The average amount of total phosphorus applied to the crops in the unadjusted set was slightly lower, averaging 14.1 pounds per acre per year.

For crops in other cropping systems, table 7 shows that the average amount of total phosphorus applied per year was less for the adjusted set than the unadjusted set for all but four of the crop and cropping system combinations shown in table 7.

Table 8 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is more than the average for sample points with one or more crops in the adjusted set for all cropping systems.

Overall, a total of 797 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 10.0 million cropped acres—40 percent of cropped acres in the region. As shown in the cumulative distribution in figure 4—

- 60 percent of cropped acres had no phosphorus added,
- 10 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 7 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 10 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 13 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 4. Cumulative distribution of amount of phosphorus added to sample points in the Ohio-Tennessee River Basin

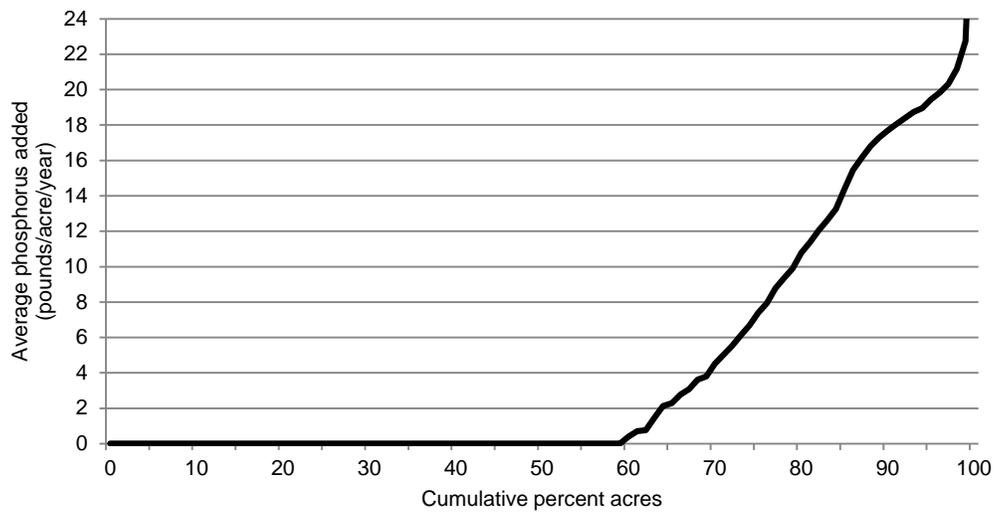


Table 5. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Ohio-Tennessee River Basin*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	1331	162	0	166
CN, adjusted set	297	36	71	109
Corn only				
CN, unadjusted set	142	147	0	175
CN, adjusted set	35	41	66	111
SB-WT only				
WH, unadjusted set	17	109	0	110
WH, adjusted set	26	34	48	81
CN and close grown crops				
CN, unadjusted set	51	98	0	125
CN, adjusted set	13	27	71	102
SM, unadjusted set	3	39	0	66
SM, adjusted set	18	19	56	78
WH, unadjusted set	11	51	0	64
WH, adjusted set	12	17	68	89
CN-SB with close grown crops				
CN, unadjusted set	222	154	0	163
CN, adjusted set	9	7	81	91
WH, unadjusted set	127	106	0	113
WH, adjusted set	89	34	41	75
Hay-crop mix				
CN, unadjusted set	54	133	0	151
CN, adjusted set	47	36	61	101
HY, unadjusted set	91	11	0	20
HY, adjusted set	42	14	118	135
VT, unadjusted set	20	151	0	157
VT, adjusted set	2	38	91	129
WH, unadjusted set	11	22	0	42
WH, adjusted set	14	13	57	71
Remaining mix of crops				
CN, unadjusted set	27	142	0	154
CN, adjusted set	4	12	98	110
CT, unadjusted set	38	96	0	96
CT, adjusted set	3	8	37	45
SG, unadjusted set	8	130	0	130
SG, adjusted set	15	47	44	91
VT, unadjusted set	42	140	0	140
VT, adjusted set	4	24	77	101

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 6. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Ohio-Tennessee River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	1,142	13,965,764	81	0	84
Sample points with one or more crops in the adjusted set	259	3,208,825	21	33	56
Corn only					
Sample points with all crops in the unadjusted set	96	1,094,894	155	0	172
Sample points with one or more crops in the adjusted set	24	234,261	51	62	116
Soybean only					
Sample points with all crops in the unadjusted set	131	1,307,786	7	0	7
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
SB-WT only					
Sample points with all crops in the unadjusted set	16	192,480	47	0	48
Sample points with one or more crops in the adjusted set	26	287,025	21	20	43
CN and close grown crops					
Sample points with all crops in the unadjusted set	11	116,853	106	0	137
Sample points with one or more crops in the adjusted set	27	293,405	48	35	93
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	123	1,320,210	117	0	125
Sample points with one or more crops in the adjusted set	86	1,051,921	58	18	77
Hay-crop mix					
Sample points with all crops in the unadjusted set	32	372,354	50	0	66
Sample points with one or more crops in the adjusted set	57	658,580	44	51	98
Remaining mix of crops					
Sample points with all crops in the unadjusted set	69	690,069	110	0	111
Sample points with one or more crops in the adjusted set	25	244,474	46	32	79
All cropping systems					
Sample points with all crops in the unadjusted set	1,620	19,060,409	--	--	--
Sample points with one or more crops in the adjusted set	504	5,978,491	--	--	--
Total	2,124	25,038,900	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 7. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Ohio-Tennessee River Basin

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	1,331	34.0	0.0	36.1
CN, adjusted set	297	4.1	19.6	24.0
SB, unadjusted set	1,021	12.9	0.0	14.1
SB, adjusted set	676	0.5	14.3	14.9
Corn only				
CN, unadjusted set	145	28.3	0.0	42.7
CN, adjusted set	32	2.8	21.1	25.1
Soybean only				
SB, unadjusted set	94	27.0	0.0	27.0
SB, adjusted set	90	1.6	17.3	19.0
SB-WT only				
SB, unadjusted set	48	18.3	0.0	18.8
SB, adjusted set	21	0.5	15.5	16.1
WH, unadjusted set	38	24.8	0.0	25.1
WH, adjusted set	5	0.0	7.1	7.1
CN and close grown crops				
CN, unadjusted set	52	21.3	0.0	31.8
CN, adjusted set	12	0.5	11.8	13.1
SM, unadjusted set	19	12.1	0.0	16.0
SM, adjusted set	2	0.0	17.1	17.1
WH, unadjusted set	18	4.5	0.0	10.4
WH, adjusted set	5	0.0	11.9	11.9
CN-SB with close grown crops				
CN, unadjusted set	210	30.5	0.0	34.7
CN, adjusted set	21	1.9	25.4	27.5
SB, unadjusted set	249	6.7	0.0	8.1
SB, adjusted set	25	0.4	11.2	11.6
WH, unadjusted set	189	23.8	0.0	26.0
WH, adjusted set	27	0.0	9.7	9.9
Hay-crop mix				
CN, unadjusted set	87	23.4	0.0	32.4
CN, adjusted set	14	0.4	19.7	22.4
HY, unadjusted set	85	10.5	0.0	18.7
HY, adjusted set	48	0.5	15.0	15.6
SB, unadjusted set	19	12.4	0.0	13.8
SB, adjusted set	8	0.8	8.4	12.1
WH, unadjusted set	19	13.5	0.0	20.0
WH, adjusted set	6	1.3	12.8	14.1
Remaining mix of crops				
CN, unadjusted set	28	21.0	0.0	25.3
CN, adjusted set	3	0.0	14.2	14.2
CT, unadjusted set	39	25.0	0.0	25.0
CT, adjusted set	2	0.0	21.7	21.7
SB, unadjusted set	31	11.9	0.0	11.9
SB, adjusted set	13	2.0	12.4	14.4
SG, unadjusted set	18	30.6	0.0	30.6
SG, adjusted set	5	0.0	19.5	19.7
VT, unadjusted set	44	42.2	0.0	42.2
VT, adjusted set	2	0.0	23.7	23.7

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 8. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Ohio-Tennessee River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	806	9,368,990	24.6	0.0	26.2
Sample points with one or more crops in the adjusted set	595	7,805,600	9.1	10.3	19.7
Corn only					
Sample points with all crops in the unadjusted set	96	1,077,601	30.9	0.0	41.1
Sample points with one or more crops in the adjusted set	24	251,554	2.4	19.9	24.0
Soybean only					
Sample points with all crops in the unadjusted set	64	606,090	28.1	0.0	28.1
Sample points with one or more crops in the adjusted set	67	701,696	1.5	17.2	18.7
SB-WT only					
Sample points with all crops in the unadjusted set	27	256,565	21.2	0.0	22.0
Sample points with one or more crops in the adjusted set	15	222,941	5.7	10.7	16.5
CN and close grown crops					
Sample points with all crops in the unadjusted set	29	338,886	16.8	0.0	25.3
Sample points with one or more crops in the adjusted set	9	71,372	5.9	10.5	17.0
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	169	1,879,241	24.9	0.0	27.8
Sample points with one or more crops in the adjusted set	40	492,890	7.9	9.5	18.3
Hay-crop mix					
Sample points with all crops in the unadjusted set	54	672,320	20.2	0.0	27.7
Sample points with one or more crops in the adjusted set	35	358,613	4.0	10.1	15.5
Remaining mix of crops					
Sample points with all crops in the unadjusted set	82	802,565	31.1	0.0	31.4
Sample points with one or more crops in the adjusted set	12	131,977	4.3	11.8	16.1
All cropping systems					
Sample points with all crops in the unadjusted set	1,327	15,002,257	--	--	--
Sample points with one or more crops in the adjusted set	797	10,036,643	--	--	--
Total	2,124	25,038,900	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Missouri River Basin

There were 3,916 sample points for cropped acres in the Missouri River Basin. Survey results provided data for a total of 9,508 crops grown at these sample points during the 3-year period—an average of 2.4 crops per sample point. Of these crops, 1,759 had nitrogen application rate adjustments and 3,350 had phosphorus application rate adjustments. The number of crops with phosphorous application rate adjustments is higher largely because nitrogen application rate adjustments were not made for soybeans, a dominant crop in some parts of this region.

On a sample-point basis, 1,269 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 32.5 million cropped acres—39 percent of cropped acres in the region. For phosphorus, a total of 1,952 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 36.5 million cropped acres—44 percent of cropped acres in the region.

Nitrogen. Table 9 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Missouri River Basin. The cropping system “corn and soybean only” had the most crops—3,924, of which 1,963 were corn. Of these corn crops, 306 had nitrogen added for the model simulation (table 9). The average commercial nitrogen fertilizer application per year as reported was only 46 pounds per acre for the adjusted set, compared to an average of 136 pounds per acre for corn crops in the unadjusted set. The average amount of nitrogen added to these 306 corn crops was 66 pounds per acre per year, increasing the total amount applied to 115 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the crops in the unadjusted set was much higher, averaging 142 pounds per acre per year.

Table 9 further shows that the average amount of total nitrogen applied per year was less for the adjusted set than the unadjusted set for all but 2 of the crop and cropping system combinations. For example—in the “corn only” cropping system, the 72 corn crops in the adjusted set had an average of 73 pounds per acre of nitrogen added, increasing the total amount applied to 108 pounds per acre per year compared to 166 pounds per acre per year for the unadjusted set.

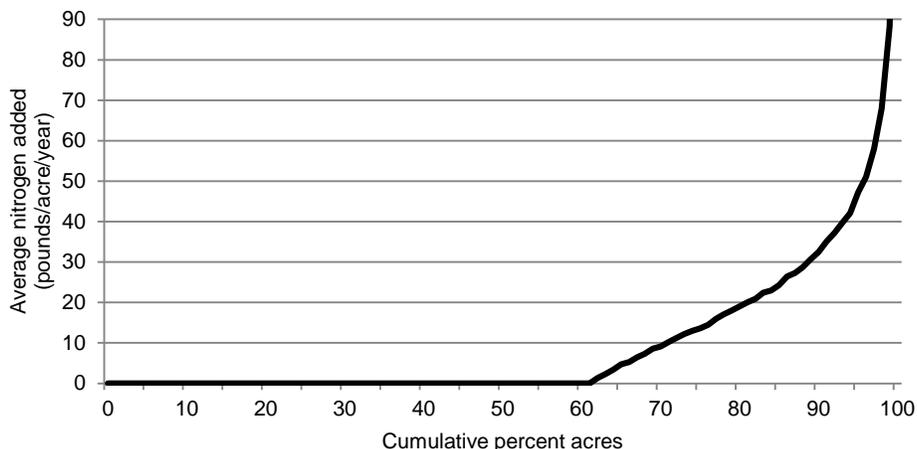
Table 10 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. For all but the “remaining row crops only” and the “remaining close-grown crops only” cropping systems, the average amount of total nitrogen applied for sample points with all crops in the unadjusted set is more than the average for sample points with one or more crops in the adjusted set. For example, a total of 260 of the 1,607 sample points in the “corn-soybean only” cropping system have one or more crops with nitrogen added, representing 17 percent of the acres in the cropping system. The amount of total nitrogen applied per year in the unadjusted set averaged 74 pounds per acre per year, compared to 60 pounds per acre per year for the sample points with one or more crops in the adjusted set.

Overall, a total of 1,269 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 32.5 million cropped acres—39 percent of cropped acres in the region. As shown in the cumulative distribution in figure 5—

- 61 percent of cropped acres had no nitrogen added,
- 9 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 10 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 8 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 5 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 7 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Phosphorus. Table 11 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Missouri River Basin. The cropping system “corn and soybean only” had 3,924 crops, of which 1,963 were corn and 1,948 were soybeans. Of the corn crops, 803 had phosphorus added for the model simulation. The average commercial phosphorus fertilizer application per year as reported was 4.9 pounds per acre for the adjusted set, compared to an average of 22.3 pounds per acre for corn crops in the unadjusted set. The average amount of phosphorus added to these 803 corn crops was 16.6 pounds per acre per year, increasing the total amount applied to 21.7 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the crops in the unadjusted set was higher, averaging 27.0 pounds per acre per year.

Figure 5. Cumulative distribution of amount of nitrogen added to sample points in the Missouri River Basin



Of the 1,948 soybean crops in the “corn and soybean only” cropping system, 1,175 had phosphorus added for the model simulation (table 11). The average phosphorus fertilizer application per year as reported was only 0.8 pound per acre for the adjusted set, compared to an average of 10.8 pounds per acre for soybean crops in the unadjusted set. The average amount of phosphorus added to these 1,175 soybean crops was 14.0 pounds per acre per year, increasing the total amount applied to 14.8 pounds per acre per year. The average amount of total phosphorus applied to the crops in the unadjusted set was about the same. For crops in other cropping systems, table 11 shows that the average amount of total phosphorus applied per year was less for the adjusted set than the unadjusted set for all but five of the crop and cropping system combinations shown in table 11. The difference in total phosphorus applied for these five cases was generally small.

Table 12 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is more than or about the same as the average for sample points with one or more crops in the adjusted set for all cropping systems. Overall, a total of 1,952 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 36.5 million cropped acres—44 percent of cropped acres in the region. As shown in the cumulative distribution in figure 6—

- 56 percent of cropped acres had no phosphorus added,
- 11 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 9 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 13 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 11 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 6. Cumulative distribution of amount of phosphorus added to sample points in the Missouri River Basin

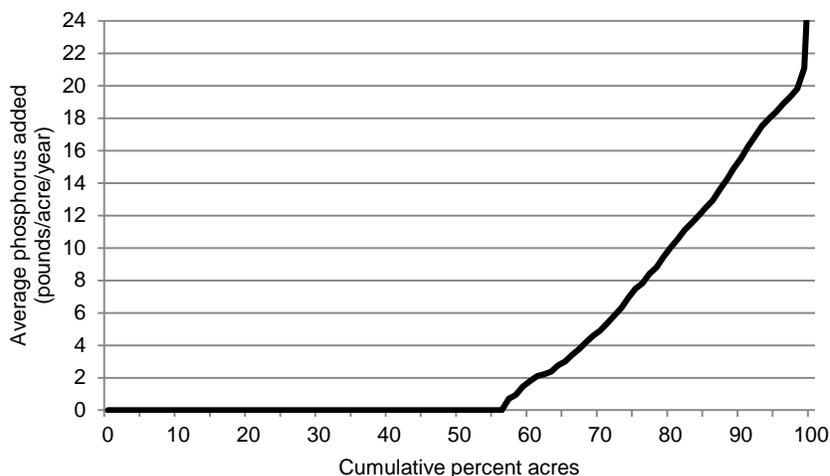


Table 9. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Missouri River Basin*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	1657	136	0	142
CN, adjusted set	306	46	66	115
Corn only				
CN, unadjusted set	319	151	0	166
CN, adjusted set	72	34	73	108
Wheat only				
WH, unadjusted set	423	62	0	64
WH, adjusted set	424	17	38	54
SB-WT only				
WH, unadjusted set	126	90	0	90
WH, adjusted set	41	30	36	66
CN and close grown crops				
CN, unadjusted set	144	94	0	99
CN, adjusted set	56	26	36	62
WH, unadjusted set	78	83	0	86
WH, adjusted set	99	26	40	66
SF and close grown crops				
OS, unadjusted set	36	74	0	74
OS, adjusted set	34	18	36	54
WH, unadjusted set	57	78	0	78
WH, adjusted set	32	20	29	48
Veg/tobacco w/ and w/out other crops				
WH, unadjusted set	61	81	0	81
WH, adjusted set	10	11	28	40
CN-SB with close grown crops				
CN, unadjusted set	122	122	0	129
CN, adjusted set	27	26	58	84
WH, unadjusted set	99	85	0	87
WH, adjusted set	35	24	48	71
Sorghum w/ and w/out wheat				
SG, unadjusted set	83	77	0	79
SG, adjusted set	36	31	35	66
WH, unadjusted set	44	76	0	79
WH, adjusted set	49	34	36	70
Hay-crop mix				
CN, unadjusted set	73	89	0	110
CN, adjusted set	25	21	70	94
HY, unadjusted set	224	14	0	20
HY, adjusted set	33	6	83	89
WH, unadjusted set	55	71	0	77
WH, adjusted set	48	19	64	83
Remaining row crops only				
CN, unadjusted set	33	109	0	117
CN, adjusted set	29	50	50	102
SG, unadjusted set	50	100	0	102
SG, adjusted set	27	55	44	99

Table 9. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Missouri River Basin--**continued**

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
Remaining mix of row and close crops				
BY, unadjusted set	38	84	0	86
BY, adjusted set	34	21	51	72
CG, unadjusted set	77	42	0	42
CG, adjusted set	10	2	33	35
WH, unadjusted set	127	71	0	72
WH, adjusted set	109	18	41	59

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 10. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for Missouri River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	1,397	22,355,378	71	0	74
Sample points with one or more crops in the adjusted set	260	4,701,864	25	33	60
Corn only					
Sample points with all crops in the unadjusted set	208	3,917,691	158	0	169
Sample points with one or more crops in the adjusted set	52	983,198	33	64	99
Soybean only					
Sample points with all crops in the unadjusted set	99	1,521,125	3	0	5
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Wheat only					
Sample points with all crops in the unadjusted set	282	8,616,747	46	0	47
Sample points with one or more crops in the adjusted set	359	10,914,960	12	20	32
SB-WT only					
Sample points with all crops in the unadjusted set	103	2,073,968	46	0	46
Sample points with one or more crops in the adjusted set	31	596,609	20	16	36
CN and close grown crops					
Sample points with all crops in the unadjusted set	65	1,537,284	82	0	89
Sample points with one or more crops in the adjusted set	107	2,786,965	34	22	57
SF and close grown crops					
Sample points with all crops in the unadjusted set	26	749,513	71	0	71
Sample points with one or more crops in the adjusted set	43	1,229,440	33	17	50
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	63	1,515,718	65	0	66
Sample points with one or more crops in the adjusted set	16	453,600	25	14	39
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	94	1,579,787	70	0	74
Sample points with one or more crops in the adjusted set	53	861,688	35	27	63
Hay-crop mix					
Sample points with all crops in the unadjusted set	37	1,138,474	66	0	71
Sample points with one or more crops in the adjusted set	58	2,035,625	29	20	49
Sorghum w/ and w/out other crops					
Sample points with all crops in the unadjusted set	105	2,426,402	44	0	51
Sample points with one or more crops in the adjusted set	77	2,153,473	13	34	48
Remaining row crops only					
Sample points with all crops in the unadjusted set	48	734,405	56	0	58
Sample points with one or more crops in the adjusted set	40	697,771	43	28	72
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	17	569,120	14	0	16
Sample points with one or more crops in the adjusted set	30	1,136,756	11	26	37
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	103	2,345,715	72	0	74
Sample points with one or more crops in the adjusted set	143	3,981,227	27	26	53
All cropping systems					
Sample points with all crops in the unadjusted set	2,647	51,081,324	--	--	--
Sample points with one or more crops in the adjusted set	1,269	32,533,176	--	--	--
Total	3,916	83,614,500	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 11. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Missouri River Basin

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	1,160	22.3	0.0	27.0
CN, adjusted set	803	4.9	16.6	21.7
SB, unadjusted set	773	10.8	0.0	14.8
SB, adjusted set	1,175	0.8	14.0	14.8
Corn only				
CN, unadjusted set	183	17.1	0.0	30.8
CN, adjusted set	208	5.7	16.3	22.9
Soybean only				
SB, unadjusted set	28	18.3	0.0	19.7
SB, adjusted set	95	0.7	17.0	17.8
Wheat only				
WH, unadjusted set	738	8.6	0.0	9.2
WH, adjusted set	109	0.2	5.6	5.8
SB-WT only				
SB, unadjusted set	121	9.7	0.0	9.7
SB, adjusted set	97	0.4	12.9	13.3
WH, unadjusted set	141	17.4	0.0	17.4
WH, adjusted set	26	0.2	7.7	8.3
CN and close grown crops				
CN, unadjusted set	159	12.1	0.0	14.3
CN, adjusted set	41	2.1	6.7	9.1
WH, unadjusted set	122	11.4	0.0	12.1
WH, adjusted set	55	0.7	7.7	8.3
SF and close grown crops				
OS, unadjusted set	55	7.1	0.0	7.1
OS, adjusted set	15	0.0	6.5	6.5
WH, unadjusted set	66	12.2	0.0	12.3
WH, adjusted set	23	0.4	8.0	8.4
Veg/tobacco w/ and w/out other crops				
BP, unadjusted set	65	9.8	0.0	15.4
BP, adjusted set	14	0.5	16.8	17.3
WH, unadjusted set	61	12.0	0.0	12.0
WH, adjusted set	10	0.0	9.8	9.8
CN-SB with close grown crops				
CN, unadjusted set	119	17.4	0.0	21.6
CN, adjusted set	30	4.8	15.6	20.4
SB, unadjusted set	106	6.0	0.0	6.6
SB, adjusted set	56	0.3	15.7	16.0
WH, unadjusted set	105	17.1	0.0	17.7
WH, adjusted set	29	0.5	7.4	7.8
Sorghum w/ and w/out wheat				
SG, unadjusted set	87	7.8	0.0	8.6
SG, adjusted set	32	0.3	8.8	9.1
WH, unadjusted set	78	11.7	0.0	12.6
WH, adjusted set	15	0.0	7.2	7.2

Table 11. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Missouri River Basin--**continued**

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
Hay-crop mix				
CN, unadjusted set	60	11.2	0.0	24.1
CN, adjusted set	38	3.3	12.6	17.3
HY, unadjusted set	160	9.1	0.0	13.7
HY, adjusted set	97	0.6	11.6	12.1
WH, unadjusted set	74	9.0	0.0	11.2
WH, adjusted set	29	0.1	9.8	9.9
Remaining row crops only				
CN, unadjusted set	37	13.9	0.0	19.0
CN, adjusted set	25	4.1	15.4	19.5
SB, unadjusted set	24	7.8	0.0	9.3
SB, adjusted set	44	0.7	11.8	12.5
SG, unadjusted set	44	15.9	0.0	17.3
SG, adjusted set	33	1.2	15.8	17.1
Remaining mix of row AND close crops				
BY, unadjusted set	61	12.7	0.0	12.8
BY, adjusted set	11	0.4	13.2	14.4
CG, unadjusted set	66	5.1	0.0	5.1
CG, adjusted set	21	0.1	6.9	6.9
WH, unadjusted set	185	9.8	0.0	10.3
WH, adjusted set	51	1.3	8.4	9.7

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 12. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for Missouri River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	511	8,574,817	17.6	0.0	22.5
Sample points with one or more crops in the adjusted set	1,146	18,482,424	6.3	11.3	18.0
Corn only					
Sample points with all crops in the unadjusted set	118	2,167,424	18.6	0.0	27.9
Sample points with one or more crops in the adjusted set	142	2,733,465	7.0	14.6	22.5
Soybean only					
Sample points with all crops in the unadjusted set	16	235,986	17.6	0.0	20.0
Sample points with one or more crops in the adjusted set	83	1,285,139	1.4	15.9	17.3
Wheat only					
Sample points with all crops in the unadjusted set	555	16,612,813	5.8	0.0	6.1
Sample points with one or more crops in the adjusted set	86	2,918,893	0.3	3.7	4.1
SB-WT only					
Sample points with all crops in the unadjusted set	74	1,603,564	12.4	0.0	12.4
Sample points with one or more crops in the adjusted set	60	1,067,013	5.5	7.4	12.9
CN and close grown crops					
Sample points with all crops in the unadjusted set	113	2,799,635	9.6	0.0	12.0
Sample points with one or more crops in the adjusted set	59	1,524,614	2.4	5.0	7.5
SF and close grown crops					
Sample points with all crops in the unadjusted set	45	1,189,888	9.5	0.0	9.6
Sample points with one or more crops in the adjusted set	24	789,065	1.3	4.2	5.5
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	60	1,448,235	10.4	0.0	11.1
Sample points with one or more crops in the adjusted set	19	521,082	2.2	8.1	10.3
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	75	1,333,608	15.7	0.0	18.8
Sample points with one or more crops in the adjusted set	72	1,107,867	5.3	7.9	13.2
Hay-crop mix					
Sample points with all crops in the unadjusted set	68	2,284,246	7.1	0.0	8.4
Sample points with one or more crops in the adjusted set	27	889,853	1.4	5.4	6.8
Sorghum w/ and w/out other crops					
Sample points with all crops in the unadjusted set	95	2,664,546	6.6	0.0	10.5
Sample points with one or more crops in the adjusted set	87	1,915,329	3.3	6.8	10.4
Remaining row crops only					
Sample points with all crops in the unadjusted set	31	488,279	12.2	0.0	14.2
Sample points with one or more crops in the adjusted set	57	943,897	3.7	10.4	14.3
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	44	1,556,812	4.5	0.0	4.9
Sample points with one or more crops in the adjusted set	3	149,064	2.6	2.2	4.8
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	159	4,181,798	10.2	0.0	10.7
Sample points with one or more crops in the adjusted set	87	2,145,145	2.0	6.2	8.4
All cropping systems					
Sample points with all crops in the unadjusted set	1,964	47,141,650	--	--	--
Sample points with one or more crops in the adjusted set	1,952	36,472,850	--	--	--
Total	3,916	83,614,500	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Arkansas-White-Red Basin

There were 1,280 sample points for cropped acres in the Arkansas-White-Red Basin. Survey results provided data for a total of 2,891 crops grown at these sample points during the 3-year period—an average of 2.3 crops per sample point. Of these 2,891 crops, 633 had nitrogen application rate adjustments and 598 had phosphorus application rate adjustments.

On a sample-point basis, 407 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 9.9 million cropped acres—33 percent of cropped acres in the region. For phosphorus, a total of 360 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 8.5 million cropped acres—28 percent of cropped acres in the region.

Nitrogen. Table 13 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Arkansas-White-Red Basin. The cropping system “wheat only” had the most crops—881, of which 287 had nitrogen added for the model simulation (table 13). The average commercial nitrogen fertilizer application per year as reported was only 15 pounds per acre for the adjusted set, compared to an average of 61 pounds per acre for wheat crops in the unadjusted set. The average amount of nitrogen added to these 287 crops was 54 pounds per acre per year, increasing the total amount applied to 68 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the crops in the unadjusted set was slightly less, averaging 62 pounds per acre per year.

Table 13 further shows that the average amount of total nitrogen applied per year was about the same or less for the adjusted set than the unadjusted set for all but the crops in two cropping systems—the hay and wheat crops in the “hay-crop mix” cropping system and the wheat crop in the “remaining mix of row and close-grown crops” cropping system.

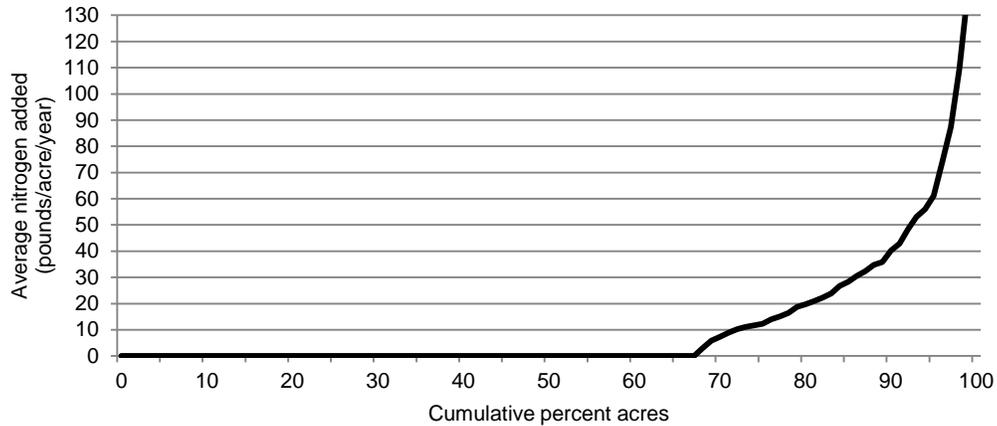
Table 14 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. For all but the “soybean and sorghum with and without other crops” cropping system, the average amount of total nitrogen applied for sample points with all crops in the unadjusted set is about the same or more than the average for sample points with one or more crops in the adjusted set. For example, a total of 207 of the 615 sample points in the “wheat only” cropping system have one or more crops with nitrogen added, representing 34 percent of the acres in the cropping system. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 58 pounds per acre per year, compared to 51 pounds per acre per year for the sample points in the adjusted set.

For the “soybean and sorghum with and without other crops” cropping system, the amount of total nitrogen applied per year for the 26 sample points with all crops in the unadjusted set averaged 55 pounds per acre per year, which was less than the 67 pounds per acre per year for the 11 sample points with one or more crops in the adjusted set.

Overall, a total of 407 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 9.9 million cropped acres—33 percent of cropped acres in the region. As shown in the cumulative distribution in figure 7—

- 67 percent of cropped acres had no nitrogen added,
- 4 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 9 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 5 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 11 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Figure 7. Cumulative distribution of amount of nitrogen added to sample points in the Arkansas-White-Red Basin



Phosphorus. Table 15 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Arkansas-White-Red Basin. The cropping system “wheat only” had 881 crops, of which 174 had phosphorus added for the model simulation. The average commercial phosphorus fertilizer application per year as reported was 0.2 pound per acre for the adjusted set, compared to an average of 8.0 pounds per acre for wheat crops in the unadjusted set. The average amount of phosphorus added to these 174 crops was 7.2 pounds per acre per year, increasing the total amount applied to 7.3 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the crops in the unadjusted set was higher, averaging 8.5 pounds per acre per year. For crops in other cropping systems, table 15 shows that the average amount of total phosphorus applied per year was about the same or less for the adjusted set than the unadjusted set for all but four of the crop and cropping system combinations shown in the table.

Table 16 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is more than the average for sample points with one or more crops in the adjusted set for all but one cropping system—the “soybean only” cropping system, which had only 17 sample points.

Overall, a total of 360 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 8.5 million cropped acres—28 percent of cropped acres in the region. As shown in the cumulative distribution in figure 8—

- 72 percent of cropped acres had no phosphorus added,
- 7 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 9 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 8 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 4 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 8. Cumulative distribution of amount of phosphorus added to sample points in the Arkansas-White-Red Basin

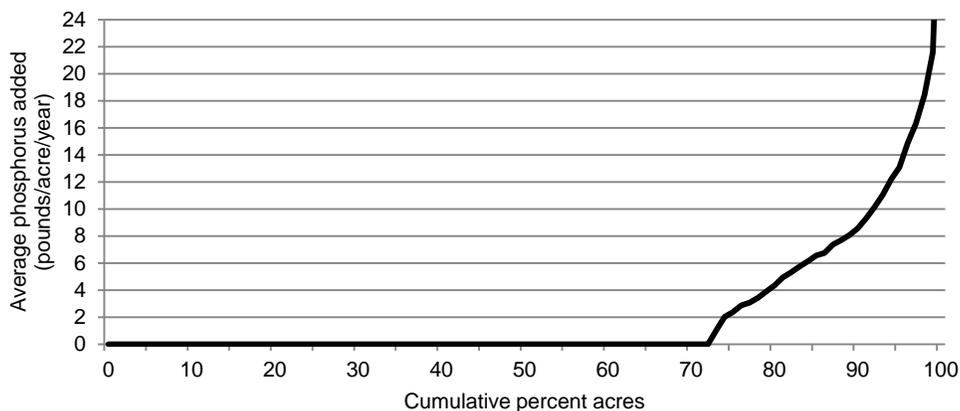


Table 13. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Arkansas-White-Red Basin*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	37	184	0	187
CN	4	12	118	130
Corn only				
CN, unadjusted set	47	209	0	227
CN, adjusted set	9	10	121	132
Cotton only				
CT, unadjusted set	43	54	0	55
CT, adjusted set	3	0	40	40
Wheat only				
WH, unadjusted set	594	61	0	62
WH, adjusted set	287	15	54	68
SB-WT only				
WH, unadjusted set	65	76	0	79
WH, adjusted set	16	22	54	75
CN and close grown crops				
CN, unadjusted set	67	159	0	173
CN, adjusted set	11	22	42	65
WH, unadjusted set	58	84	0	84
WH, adjusted set	20	32	49	81
CN-SB with close grown crops				
CN, unadjusted set	31	173	0	178
CN, adjusted set	8	19	93	112
WH, unadjusted set	31	76	0	79
WH, adjusted set	8	12	56	68
Sorghum w/ and w/out wheat				
SG, unadjusted set	118	62	0	64
SG, adjusted set	53	7	30	38
WH, unadjusted set	105	57	0	59
WH, adjusted set	55	13	41	54
Rice with soybean or other crops				
RI, unadjusted set	30	170	0	174
RI, adjusted set	9	16	84	107
Hay-crop mix				
HY, unadjusted set	70	27	0	28
HY, adjusted set	21	3	85	87
WH, unadjusted set	51	46	0	68
WH, adjusted set	31	14	61	75
SB and SG w/ and w/out other crops				
SG, unadjusted set	35	83	0	88
SG, adjusted set	7	24	55	79
WH, unadjusted set	19	94	0	94
WH, adjusted set	8	11	52	63
Remaining row crops only				
CN, unadjusted set	12	166	0	166
CN, adjusted set	6	20	104	127
Remaining mix of row AND close crops				
WH, unadjusted set	57	62	0	71
WH, adjusted set	34	23	73	96

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 14. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for Arkansas-White-Red Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	30	535,165	104	0	110
Sample points with one or more crops in the adjusted set	4	107,893	28	52	80
Corn only					
Sample points with all crops in the unadjusted set	35	759,344	202	0	223
Sample points with one or more crops in the adjusted set	7	188,100	15	98	113
Soybean only					
Sample points with all crops in the unadjusted set	17	316,169	3	0	3
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Cotton only					
Sample points with all crops in the unadjusted set	27	488,575	65	0	66
Sample points with one or more crops in the adjusted set	3	44,706	0	35	35
Wheat only					
Sample points with all crops in the unadjusted set	408	9,980,115	58	0	58
Sample points with one or more crops in the adjusted set	207	5,208,284	13	38	51
SB-WT only					
Sample points with all crops in the unadjusted set	41	879,419	61	0	61
Sample points with one or more crops in the adjusted set	12	309,944	14	28	41
CN and close grown crops					
Sample points with all crops in the unadjusted set	41	1,220,176	114	0	120
Sample points with one or more crops in the adjusted set	18	391,660	54	31	85
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	25	365,966	106	0	109
Sample points with one or more crops in the adjusted set	10	161,980	38	37	74
Sorghum w/ and w/out other crops					
Sample points with all crops in the unadjusted set	86	2,442,358	53	0	55
Sample points with one or more crops in the adjusted set	58	1,553,604	15	23	38
Rice with soybean or other crop					
Sample points with all crops in the unadjusted set	24	550,809	100	0	102
Sample points with one or more crops in the adjusted set	8	105,148	29	38	69
Hay-crop mix					
Sample points with all crops in the unadjusted set	44	1,030,624	47	0	61
Sample points with one or more crops in the adjusted set	24	610,907	11	50	63
SB and SG w/ and w/out other crops					
Sample points with all crops in the unadjusted set	26	523,148	53	0	55
Sample points with one or more crops in the adjusted set	11	221,794	37	29	67
Remaining row crops only					
Sample points with all crops in the unadjusted set	18	345,536	135	0	135
Sample points with one or more crops in the adjusted set	9	215,215	19	68	88
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	10	166,517	70	0	70
Sample points with one or more crops in the adjusted set	2	19,351	19	51	70
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	41	926,051	69	0	75
Sample points with one or more crops in the adjusted set	34	808,140	40	38	78
All cropping systems					
Sample points with all crops in the unadjusted set	873	20,529,973	--	--	--
Sample points with one or more crops in the adjusted set	407	9,946,727	--	--	--
Total	1,280	30,476,700	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 15. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Arkansas-White-Red Basin

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	24	26.8	0.0	28.5
CN, adjusted set	17	8.1	22.3	30.4
SB, unadjusted set	21	10.0	0.0	14.3
SB, adjusted set	21	1.0	13.7	14.7
Corn only				
CN, unadjusted set	23	23.5	0.0	44.2
CN, adjusted set	33	9.4	20.1	29.5
Soybean only				
SB, unadjusted set	3	10.2	0.0	10.2
SB, adjusted set	19	1.1	13.6	14.7
Cotton only				
CT, unadjusted set	43	7.5	0.0	8.1
CT, adjusted set	3	0.0	6.5	6.5
Wheat only				
WH, unadjusted set	707	8.0	0.0	8.5
WH, adjusted set	174	0.2	7.2	7.3
SB-WT only				
SB, unadjusted set	42	5.7	0.0	5.7
SB, adjusted set	39	1.5	10.1	11.7
WH, unadjusted set	61	16.0	0.0	17.0
WH, adjusted set	20	0.0	7.5	7.5
CN and close grown crops				
CN, unadjusted set	65	15.9	0.0	22.8
CN, adjusted set	13	6.6	11.2	17.8
WH, unadjusted set	55	8.3	0.0	8.3
WH, adjusted set	23	0.3	9.3	9.6
CN-SB with close grown crops				
CN, unadjusted set	29	20.8	0.0	22.9
CN, adjusted set	10	5.0	19.2	24.2
SB, unadjusted set	32	4.1	0.0	4.1
SB, adjusted set	12	0.0	10.2	10.2
WH, unadjusted set	29	16.7	0.0	18.1
WH, adjusted set	10	0.5	9.6	10.1
Sorghum w/ and w/out wheat				
SG, unadjusted set	148	6.4	0.0	7.3
SG, adjusted set	23	0.0	6.3	6.3
WH, unadjusted set	132	6.6	0.0	7.6
WH, adjusted set	28	0.0	6.5	6.8
Rice with soybean or other crop				
RI, unadjusted set	20	17.6	0.0	20.6
RI, adjusted set	19	4.6	17.7	22.4
SB, unadjusted set	22	10.7	0.0	10.7
SB, adjusted set	16	2.5	11.6	14.1
Hay-crop mix				
HY, unadjusted set	78	7.7	0.0	8.6
HY, adjusted set	13	1.7	16.5	18.3
WH, unadjusted set	66	3.6	0.0	10.6
WH, adjusted set	16	0.0	5.3	5.7

Table 15. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Arkansas-White-Red Basin--**continued**

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
SB and SG w/ and w/out other crops				
SB, unadjusted set	35	6.1	0.0	6.1
SB, adjusted set	14	1.7	11.8	13.5
SG, unadjusted set	35	16.0	0.0	17.7
SG, adjusted set	7	0.3	13.1	13.3
WH, unadjusted set	19	16.7	0.0	16.7
WH, adjusted set	8	0.0	5.1	5.5
Remaining row crops only				
CN, unadjusted set	15	14.1	0.0	14.9
CN, adjusted set	3	0.7	12.4	13.2
Remaining mix of row AND close crops				
WH, unadjusted set	73	8.6	0.0	12.1
WH, adjusted set	18	1.5	7.4	8.9

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 16. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for Arkansas-White-Red Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre) *
CN-SB only					
Sample points with all crops in the unadjusted set	11	225,264	23.9	0.0	30.7
Sample points with one or more crops in the adjusted set	23	417,795	7.5	12.0	19.6
Corn only					
Sample points with all crops in the unadjusted set	19	303,767	17.8	0.0	41.9
Sample points with one or more crops in the adjusted set	23	643,677	9.4	19.4	31.2
Soybean only					
Sample points with all crops in the unadjusted set	3	57,535	7.8	0.0	7.8
Sample points with one or more crops in the adjusted set	14	258,634	1.0	13.8	14.7
Cotton only					
Sample points with all crops in the unadjusted set	27	493,015	9.2	0.0	9.6
Sample points with one or more crops in the adjusted set	3	40,265	0.0	6.5	6.5
Wheat only					
Sample points with all crops in the unadjusted set	491	12,227,123	7.5	0.0	7.9
Sample points with one or more crops in the adjusted set	124	2,961,276	0.4	7.0	7.4
SB-WT only					
Sample points with all crops in the unadjusted set	26	507,094	14.0	0.0	14.0
Sample points with one or more crops in the adjusted set	27	682,270	3.7	9.4	13.4
CN and close grown crops					
Sample points with all crops in the unadjusted set	36	874,155	10.5	0.0	14.8
Sample points with one or more crops in the adjusted set	23	737,680	6.7	5.3	12.3
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	20	306,128	22.0	0.0	23.6
Sample points with one or more crops in the adjusted set	15	221,818	3.3	9.5	12.8
Sorghum w/ and w/out other crops					
Sample points with all crops in the unadjusted set	115	3,321,950	6.1	0.0	7.2
Sample points with one or more crops in the adjusted set	29	674,012	0.8	3.9	4.8
Rice with soybean or other crop					
Sample points with all crops in the unadjusted set	14	330,677	16.6	0.0	17.5
Sample points with one or more crops in the adjusted set	18	325,280	5.1	11.8	17.2
Hay-crop mix					
Sample points with all crops in the unadjusted set	53	1,171,281	5.3	0.0	11.4
Sample points with one or more crops in the adjusted set	15	470,251	0.9	8.5	9.6
SB and SG w/ and w/out other crops					
Sample points with all crops in the unadjusted set	25	566,966	13.8	0.0	14.5
Sample points with one or more crops in the adjusted set	12	177,976	3.2	8.1	11.4
Remaining row crops only					
Sample points with all crops in the unadjusted set	17	331,927	15.5	0.0	15.5
Sample points with one or more crops in the adjusted set	10	228,823	3.7	6.2	10.7
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	9	153,881	11.0	0.0	11.0
Sample points with one or more crops in the adjusted set	3	31,988	0.0	12.2	12.2
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	54	1,146,765	9.2	0.0	11.5
Sample points with one or more crops in the adjusted set	21	587,427	5.6	4.8	10.4
All cropping systems					
Sample points with all crops in the unadjusted set	920	22,017,528	--	--	--
Sample points with one or more crops in the adjusted set	360	8,459,172	--	--	--
Total	1,280	30,476,700	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Lower Mississippi River Basin

There were 1,735 sample points for cropped acres in the Lower Mississippi River Basin. Survey results provided data for a total of 3,927 crops grown at these sample points during the 3-year period—an average of 2.3 crops per sample point. Of these 3,927 crops, 232 had nitrogen application rate adjustments and 1,669 had phosphorus application rate adjustments. The number of crops with phosphorous application rate adjustments is higher largely because nitrogen application rate adjustments were not made for soybeans, a dominant crop in this region. On a sample-point basis, 193 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 2.3 million cropped acres—12 percent of cropped acres in the region. For phosphorus, a total of 837 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 9.7 million cropped acres—52 percent of cropped acres in the region.

Nitrogen. Table 17 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Lower Mississippi River Basin. The table shows that the average amount of total nitrogen applied per year was less for the adjusted set than the unadjusted set for all crop and cropping system combinations. For example, in the “cotton only” cropping system, the average commercial nitrogen fertilizer application per year as reported was only 24 pounds per acre for the 29 cotton crops in the adjusted set, compared to an average of 110 pounds per acre for the 327 cotton crops in the unadjusted set. The average amount of nitrogen added to the 29 cotton crops was 43 pounds per acre per year, increasing the total amount applied to 68 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the crops in the unadjusted set was much higher, averaging 110 pounds per acre per year.

Table 18 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. For all cropping systems, the average amount of total nitrogen applied for sample points with all crops in the unadjusted set was about the same or more than the average for sample points with one or more crops in the adjusted set. For example, a total of 54 of the 283 sample points in the “rice with soybean or other crops” cropping system have one or more crops with nitrogen added, representing 24 percent of the acres in the cropping system. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 88 pounds per acre per year, compared to 55 pounds per acre per year for the sample points in the adjusted set.

Overall, a total of 193 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 2.3 million cropped acres—12 percent of cropped acres in the region. As shown in the cumulative distribution in figure 9—

- 88 percent of cropped acres had no nitrogen added,
- 1 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 2 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 2 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 2 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 5 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Phosphorus. Table 19 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Lower Mississippi River Basin. The cropping system “corn and soybean only” had 585 crops, of which 275 were corn and 310 were soybeans. Of the corn crops, 67 had phosphorus added for the model simulation. The average commercial phosphorus fertilizer application per year as reported was 2.8 pounds per acre for the adjusted set, compared to an average of 34.3 pounds per acre for corn crops in the unadjusted set. The average amount of phosphorus added to these 67 corn crops was 17.8 pounds per acre per year, increasing the total amount applied to 20.6 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the crops in the unadjusted set was higher, averaging 35.7 pounds per acre per year.

Of the soybean crops in the “corn and soybean only” cropping system, 108 had phosphorus added for the model simulation (table 19). The average phosphorus fertilizer application per year as reported was only 0.4 pound per acre for the adjusted set, compared to an average of 13.3 pounds per acre for soybean crops in the unadjusted set. The average amount of phosphorus added to these 108 soybean crops was 18.8 pounds per acre per year, increasing the

total amount applied to 19.3 pounds per acre per year. The average amount of total phosphorus applied to the crops in the unadjusted set was slightly lower, averaging 14.1 pounds per acre per year.

For crops in other cropping systems, table 19 shows that the average amount of total phosphorus applied per year was about the same or less for the adjusted set than the unadjusted set for all crop and cropping system combinations shown in the table.

Table 20 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is about the same as or more than the average for sample points with one or more crops in the adjusted set for all cropping systems. Overall, a total of 837 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 9.7 million cropped acres—52 percent of cropped acres in the region. As shown in the cumulative distribution in figure 10—

- 48 percent of cropped acres had no phosphorus added,
- 1 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 4 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 12 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 35 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 9. Cumulative distribution of amount of nitrogen added to sample points in the Lower Mississippi River Basin

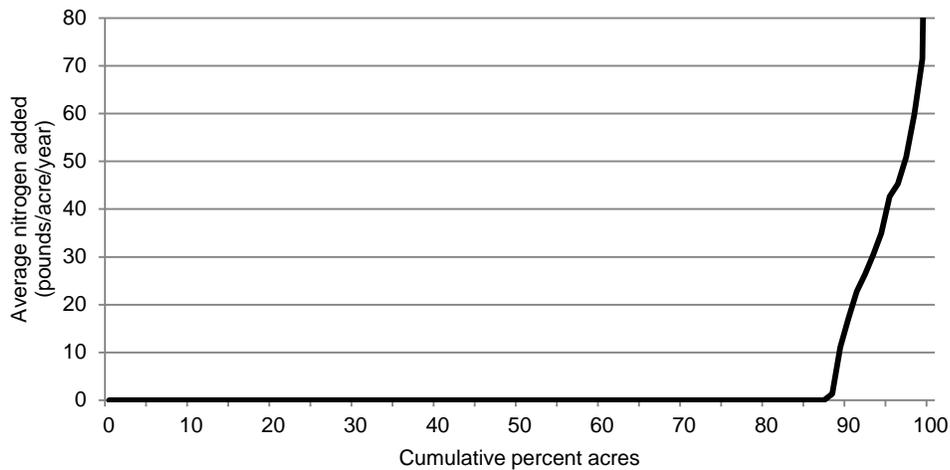


Figure 10. Cumulative distribution of amount of phosphorus added to sample points in the Lower Mississippi River Basin

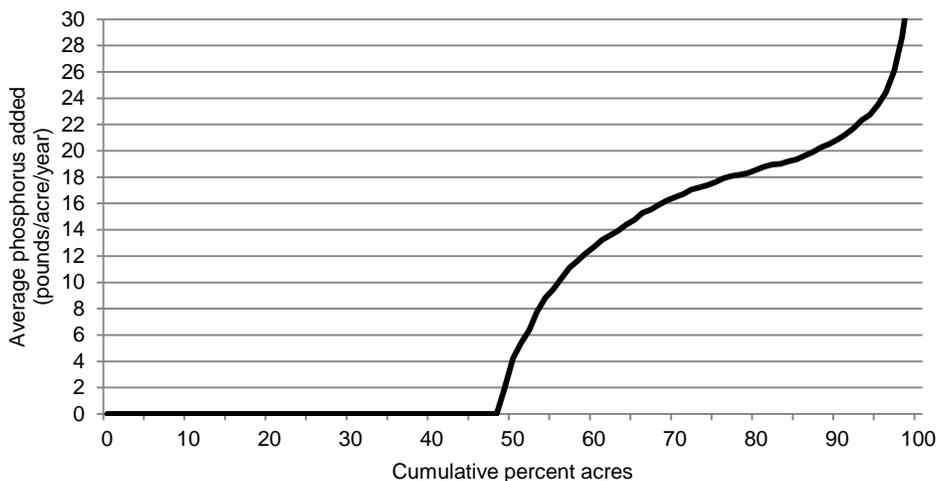


Table 17. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Lower Mississippi River Basin*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	252	182	0	184
CN, adjusted set	23	30	72	102
Cotton only				
CT, unadjusted set	327	110	0	110
CT, adjusted set	29	24	43	68
Rice only				
RI, unadjusted set	122	160	0	160
RI, adjusted set	12	37	60	102
SB-WT only				
WH, unadjusted set	38	127	0	127
WH, adjusted set	16	5	62	67
CN-CT only				
CT, unadjusted set	97	113	0	113
CT, adjusted set	8	46	52	98
SB-SG only				
SG, unadjusted set	24	121	0	121
SG, adjusted set	7	24	56	80
CN-SB with close grown crops				
CN, unadjusted set	94	181	0	181
CN, adjusted set	7	9	60	69
WH, unadjusted set	70	97	0	99
WH, adjusted set	30	5	47	53
Rice with soybean or other crop				
RI, unadjusted set	274	170	0	172
RI, adjusted set	54	28	79	107
CT-SB w/ and w/out other crops				
CT, unadjusted set	105	101	0	101
CT, adjusted set	12	10	77	87
Remaining row crops only				
CN, unadjusted set	18	175	0	207
CN, adjusted set	5	47	92	139
Remaining mix of row AND close crops				
WH, unadjusted set	18	87	0	87
WH, adjusted set	5	25	40	66

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 18. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for Lower Mississippi River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	212	1,355,546	90	0	91
Sample points with one or more crops in the adjusted set	19	235,841	14	43	57
Soybean only					
Sample points with all crops in the unadjusted set	357	4,191,899	1	0	1
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Cotton only					
Sample points with all crops in the unadjusted set	266	3,201,638	111	0	111
Sample points with one or more crops in the adjusted set	25	327,539	31	37	68
Rice only					
Sample points with all crops in the unadjusted set	105	906,080	113	0	113
Sample points with one or more crops in the adjusted set	11	122,012	22	52	77
SB-WT only					
Sample points with all crops in the unadjusted set	31	372,146	85	0	85
Sample points with one or more crops in the adjusted set	14	135,231	7	34	42
CN-CT only					
Sample points with all crops in the unadjusted set	60	685,321	139	0	139
Sample points with one or more crops in the adjusted set	8	129,194	68	19	87
SB-SG only					
Sample points with all crops in the unadjusted set	22	289,382	54	0	54
Sample points with one or more crops in the adjusted set	6	74,441	10	20	29
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	60	589,938	156	0	157
Sample points with one or more crops in the adjusted set	31	160,007	65	25	90
Rice with soybean or other crop					
Sample points with all crops in the unadjusted set	229	2,723,412	87	0	88
Sample points with one or more crops in the adjusted set	54	868,066	13	42	55
Hay-crop mix					
Sample points with all crops in the unadjusted set	5	44,330	65	0	100
Sample points with one or more crops in the adjusted set	3	55,798	1	49	50
CT-SB w/ and w/out other crops					
Sample points with all crops in the unadjusted set	76	750,438	66	0	66
Sample points with one or more crops in the adjusted set	10	84,229	3	37	40
Remaining row crops only					
Sample points with all crops in the unadjusted set	100	1,141,010	99	0	106
Sample points with one or more crops in the adjusted set	8	110,587	25	37	62
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	3	45,941	69	0	69
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	16	212,955	114	0	114
Sample points with one or more crops in the adjusted set	4	22,318	53	30	83
All cropping systems					
Sample points with all crops in the unadjusted set	1,542	16,510,037	--	--	--
Sample points with one or more crops in the adjusted set	193	2,325,263	--	--	--
Total	1,735	18,835,300	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 19. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Lower Mississippi River Basin

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	208	34.3	0.0	35.7
CN, adjusted set	67	2.8	17.8	20.6
SB, unadjusted set	202	13.3	0.0	14.1
SB, adjusted set	108	0.4	18.8	19.3
Soybean only				
SB, unadjusted set	105	19.1	0.0	19.5
SB, adjusted set	354	0.6	18.8	19.5
Cotton only				
CT, unadjusted set	258	17.2	0.0	17.2
CT, adjusted set	98	0.1	12.7	12.9
Rice only				
RI, unadjusted set	113	24.7	0.0	24.9
RI, adjusted set	21	0.0	12.0	12.0
SB-WT only				
SB, unadjusted set	25	16.5	0.0	16.5
SB, adjusted set	62	1.3	17.3	18.6
WH, unadjusted set	29	10.8	0.0	10.8
WH, adjusted set	25	0.0	9.5	9.5
CN-CT only				
CN, unadjusted set	54	16.9	0.0	16.9
CN, adjusted set	27	2.7	15.6	18.3
CT, unadjusted set	66	18.8	0.0	18.8
CT, adjusted set	39	0.2	16.1	16.3
SB-SG only				
SB, unadjusted set	9	13.7	0.0	13.7
SB, adjusted set	36	0.2	15.4	15.6
SG, unadjusted set	17	16.3	0.0	16.3
SG, adjusted set	14	0.0	12.9	12.9
CN-SB with close grown crops				
CN, unadjusted set	80	37.5	0.0	37.5
CN, adjusted set	21	2.3	26.1	28.8
SB, unadjusted set	107	9.0	0.0	9.5
SB, adjusted set	20	0.0	10.2	10.2
WH, unadjusted set	75	17.1	0.0	17.7
WH, adjusted set	25	0.0	7.6	7.6
Rice with soybean or other crop				
RI, unadjusted set	188	21.3	0.0	22.7
RI, adjusted set	140	0.5	22.4	23.0
SB, unadjusted set	205	14.7	0.0	14.8
SB, adjusted set	135	0.3	17.1	17.4
CT-SB w/ and w/out other crops				
CT, unadjusted set	76	22.2	0.0	22.3
CT, adjusted set	41	0.1	18.8	18.9
SB, unadjusted set	55	14.2	0.0	14.2
SB, adjusted set	59	0.0	13.9	13.9
Remaining row crops only				
CN, unadjusted set	13	26.9	0.0	43.8
CN, adjusted set	10	0.0	21.2	21.2
SC, unadjusted set	28	28.6	0.0	28.6
SC, adjusted set	308	7.9	24.7	32.7
Remaining mix of row AND close crops				
WH, unadjusted set	16	5.4	0.0	5.4
WH, adjusted set	7	0.0	7.3	7.3

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 20. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for Lower Mississippi River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	158	890,279	24.3	0.0	25.1
Sample points with one or more crops in the adjusted set	73	701,108	3.2	17.7	20.9
Soybean only					
Sample points with all crops in the unadjusted set	73	811,815	17.7	0.0	18.0
Sample points with one or more crops in the adjusted set	284	3,380,084	0.5	18.6	19.1
Cotton only					
Sample points with all crops in the unadjusted set	213	2,719,961	18.3	0.0	18.3
Sample points with one or more crops in the adjusted set	78	809,215	0.1	11.8	11.9
Rice only					
Sample points with all crops in the unadjusted set	98	823,636	17.1	0.0	17.2
Sample points with one or more crops in the adjusted set	18	204,456	0.0	13.2	13.2
SB-WT only					
Sample points with all crops in the unadjusted set	9	67,486	25.1	0.0	25.1
Sample points with one or more crops in the adjusted set	36	439,891	3.3	16.3	19.6
CN-CT only					
Sample points with all crops in the unadjusted set	41	486,837	18.4	0.0	18.4
Sample points with one or more crops in the adjusted set	27	327,678	0.8	11.4	12.2
SB-SG only					
Sample points with all crops in the unadjusted set	6	59,268	10.8	0.0	10.8
Sample points with one or more crops in the adjusted set	22	304,555	2.6	11.8	14.4
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	60	428,156	35.9	0.0	36.3
Sample points with one or more crops in the adjusted set	31	321,789	5.9	14.4	20.4
Rice with soybean or other crop					
Sample points with all crops in the unadjusted set	144	1,846,268	19.7	0.0	20.7
Sample points with one or more crops in the adjusted set	139	1,745,211	1.9	15.8	17.8
Hay-crop mix					
Sample points with all crops in the unadjusted set	6	72,827	19.2	0.0	27.0
Sample points with one or more crops in the adjusted set	2	27,302	0.7	18.2	19.0
CT-SB w/ and w/out other crops					
Sample points with all crops in the unadjusted set	43	396,342	21.4	0.0	21.4
Sample points with one or more crops in the adjusted set	43	438,325	1.3	13.5	14.9
Remaining row crops only					
Sample points with all crops in the unadjusted set	31	311,606	18.1	0.0	27.7
Sample points with one or more crops in the adjusted set	77	939,991	4.9	22.8	27.7
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	3	45,941	14.9	0.0	14.9
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	13	125,833	15.2	0.0	15.2
Sample points with one or more crops in the adjusted set	7	109,441	0.6	9.9	10.5
All cropping systems					
Sample points with all crops in the unadjusted set	898	9,086,255	--	--	--
Sample points with one or more crops in the adjusted set	837	9,749,045	--	--	--
Total	1,735	18,835,300	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Great Lakes Region

There were 1,418 sample points for cropped acres in the Great Lakes Region. Survey results provided data for a total of 3,717 crops grown at these sample points during the 3-year period—an average of 2.6 crops per sample point. Of these 3,717 crops, 347 had nitrogen application rate adjustments and 959 had phosphorus application rate adjustments. The number of crops with phosphorous application rate adjustments is higher largely because nitrogen application rate adjustments were not made for soybeans, a dominant crop in this region. On a sample-point basis, 297 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 3.2 million cropped acres—22 percent of cropped acres in the region. For phosphorus, a total of 556 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 5.4 million cropped acres—36 percent of cropped acres in the region.

Nitrogen. Table 21 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Great Lakes Region. The table shows that the average amount of total nitrogen applied per year was less for the adjusted set than the unadjusted set for all crop and cropping system combinations. The cropping system “corn and soybean only” had the most crops—1,536, of which 769 were corn. Of these corn crops, 92 had nitrogen added for the model simulation. The average commercial nitrogen fertilizer application per year as reported was only 26 pounds per acre for the adjusted set, compared to an average of 141 pounds per acre for corn crops in the unadjusted set. The average amount of nitrogen added to these 92 corn crops was 54 pounds per acre per year, increasing the total amount applied to 80 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the corn crops in the unadjusted set was much higher, averaging 148 pounds per acre per year.

Table 22 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. For all cropping systems, the average amount of total nitrogen applied for sample points with all crops in the unadjusted set was about the same as or more than the average for sample points with one or more crops in the adjusted set. For example, a total of 80 of the 627 sample points in the “corn and soybean only” cropping system have one or more crops with nitrogen added, representing 12 percent of the acres in the cropping system. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 77 pounds per acre per year, compared to 41 pounds per acre per year for the sample points in the adjusted set.

Overall, a total of 297 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 3.2 million cropped acres—22 percent of cropped acres in the region. As shown in the cumulative distribution in figure 11—

- 78 percent of cropped acres had no nitrogen added,
- 4 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 8 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 3 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 3 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Phosphorus. Table 23 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Great Lakes Region. The cropping system “corn and soybean only” had 1,536 crops, of which 769 were corn and 760 were soybeans. Of the corn crops, 189 had phosphorus added for the model simulation. The average commercial phosphorus fertilizer application per year as reported was 5.5 pounds per acre for the adjusted set, compared to an average of 25.1 pounds per acre for corn crops in the unadjusted set. The average amount of phosphorus added to these 189 corn crops was 17.9 pounds per acre per year, increasing the total amount applied to 23.7 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the crops in the unadjusted set was higher, averaging 29.7 pounds per acre per year.

Of the soybean crops in the “corn and soybean only” cropping system, 381 had phosphorus added for the model simulation (table 23). The average phosphorus fertilizer application per year as reported was only 0.6 pound per acre for the adjusted set, compared to an average of 7.8 pounds per acre for soybean crops in the unadjusted set. The average amount of phosphorus added to these 381 soybean crops was 11.2 pounds per acre per year, increasing the

total amount applied to 11.9 pounds per acre per year. The average amount of total phosphorus applied to the crops in the unadjusted set was slightly lower, averaging 11.0 pounds per acre per year.

For crops in other cropping systems, table 23 shows that the average amount of total phosphorus applied per year was about the same or less for the adjusted set than the unadjusted set for all but one crop and cropping system combinations shown in the table.

Table 24 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is about the same as or more than the average for sample points with one or more crops in the adjusted set for all cropping systems. Total phosphorus applied in the “soybean only” cropping system was somewhat higher for the adjusted set than for the unadjusted set, averaging 18.3 pounds per acre per year for the adjusted set compared to 13.2 pounds per acre per year for the unadjusted set.

Overall, a total of 556 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 5.4 million cropped acres—36 percent of cropped acres in the region. As shown in the cumulative distribution in figure 12—

- 64 percent of cropped acres had no phosphorus added,
- 9 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 6 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 12 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 9 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 11. Cumulative distribution of amount of nitrogen added to sample points in the Great Lakes Region

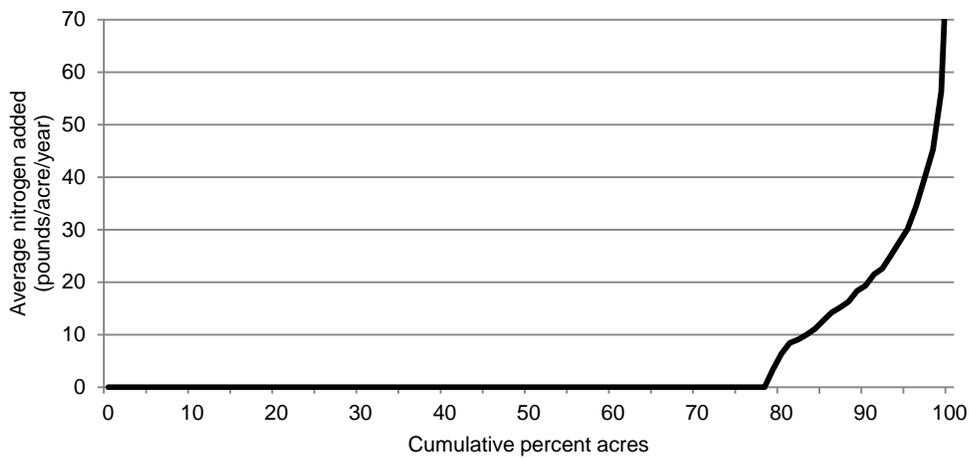


Figure 12. Cumulative distribution of amount of phosphorus added to sample points in the Great Lakes Region

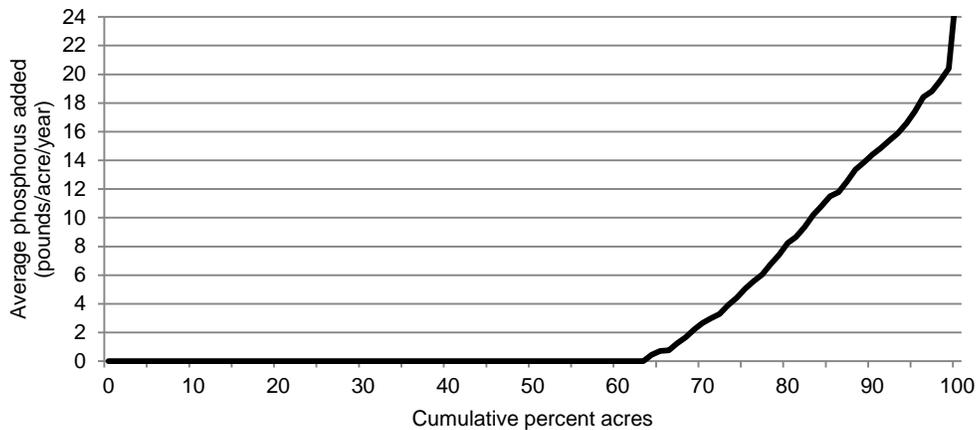


Table 21. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Great Lakes Region*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	677	141	0	148
CN, adjusted set	92	26	54	80
Corn only				
CN, unadjusted set	198	90	0	136
CN, adjusted set	37	39	52	93
SB-WT only				
WH, unadjusted set	71	113	0	113
WH, adjusted set	43	44	42	86
CN and close grown crops				
CN, unadjusted set	74	78	0	103
CN, adjusted set	4	5	69	74
WH, unadjusted set	18	93	0	113
WH, adjusted set	12	21	84	104
Veg/tobacco w/ and w/out other crops				
CN, unadjusted set	48	113	0	118
CN, adjusted set	5	15	60	75
CN-SB with close grown crops				
CN, unadjusted set	183	138	0	144
CN, adjusted set	3	2	64	69
WH, unadjusted set	110	107	0	109
WH, adjusted set	65	38	50	88
Hay-crop mix				
CN, unadjusted set	153	66	0	110
CN, adjusted set	24	34	48	86
Remaining mix of crops				
CN, unadjusted set	21	145	0	146
CN, adjusted set	3	32	81	114

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 22. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Great Lakes Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	547	5,184,893	72	0	77
Sample points with one or more crops in the adjusted set	80	709,810	15	26	41
Corn only					
Sample points with all crops in the unadjusted set	109	1,204,264	96	0	138
Sample points with one or more crops in the adjusted set	28	352,691	46	36	84
Soybean only					
Sample points with all crops in the unadjusted set	82	714,208	3	0	4
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
SB-WT only					
Sample points with all crops in the unadjusted set	65	618,532	51	0	52
Sample points with one or more crops in the adjusted set	40	430,245	19	17	37
CN and close grown crops					
Sample points with all crops in the unadjusted set	23	243,637	84	0	113
Sample points with one or more crops in the adjusted set	21	241,014	36	32	74
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	60	852,325	78	0	82
Sample points with one or more crops in the adjusted set	13	239,445	47	20	67
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	117	1,171,406	86	0	91
Sample points with one or more crops in the adjusted set	68	719,315	56	16	73
Hay-crop mix					
Sample points with all crops in the unadjusted set	88	1,193,342	33	0	56
Sample points with one or more crops in the adjusted set	36	435,212	18	19	43
Remaining mix of crops					
Sample points with all crops in the unadjusted set	30	398,188	86	0	89
Sample points with one or more crops in the adjusted set	11	94,972	31	24	56
All cropping systems					
Sample points with all crops in the unadjusted set	1,121	11,580,796	--	--	--
Sample points with one or more crops in the adjusted set	297	3,222,704	--	--	--
Total	1,418	14,803,500	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 23. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Great Lakes Region

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	580	25.1	0.0	29.7
CN, adjusted set	189	5.5	17.9	23.7
SB, unadjusted set	379	7.8	0.0	11.0
SB, adjusted set	381	0.6	11.2	11.9
Corn only				
CN, unadjusted set	199	15.4	0.0	39.4
CN, adjusted set	36	4.3	15.7	20.3
Soybean only				
SB, unadjusted set	29	18.3	0.0	18.8
SB, adjusted set	81	1.1	16.4	17.6
SB-WT only				
SB, unadjusted set	93	10.9	0.0	12.7
SB, adjusted set	75	0.1	13.8	13.9
WH, unadjusted set	97	23.4	0.0	23.7
WH, adjusted set	17	0.0	9.1	9.1
CN and close grown crops				
CN, unadjusted set	73	17.7	0.0	33.0
CN, adjusted set	5	1.4	11.5	12.9
WH, unadjusted set	26	13.2	0.0	22.2
WH, adjusted set	4	2.2	7.5	9.7
Veg/tobacco w/ and w/out other crops				
CN, unadjusted set	50	20.3	0.0	22.3
CN, adjusted set	3	5.6	17.2	22.8
SB, unadjusted set	21	7.0	0.0	7.0
SB, adjusted set	2	0.0	6.9	6.9
WH, unadjusted set	22	9.7	0.0	10.2
WH, adjusted set	2	0.0	2.5	2.5
CN-SB with close grown crops				
CN, unadjusted set	179	24.6	0.0	28.2
CN, adjusted set	7	0.9	4.4	6.0
SB, unadjusted set	143	6.1	0.0	8.9
SB, adjusted set	44	0.3	17.0	17.3
WH, unadjusted set	152	22.7	0.0	24.1
WH, adjusted set	23	0.4	9.4	9.8
Hay-crop mix				
CN, unadjusted set	167	14.7	0.0	37.6
CN, adjusted set	10	3.1	9.4	12.6
HY, unadjusted set	188	3.6	0.0	10.0
HY, adjusted set	51	0.0	7.3	7.3
Remaining mix of crops				
CN, unadjusted set	21	24.2	0.0	25.4
CN, adjusted set	3	7.4	14.6	22.0
SB, unadjusted set	23	7.6	0.0	7.6
SB, adjusted set	7	0.0	3.5	5.9

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 24. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Great Lakes Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	305	2,887,205	18.1	0.0	22.3
Sample points with one or more crops in the adjusted set	322	3,007,497	7.0	9.7	16.9
Corn only					
Sample points with all crops in the unadjusted set	111	1,271,634	16.1	0.0	35.7
Sample points with one or more crops in the adjusted set	26	285,321	3.8	14.8	19.6
Soybean only					
Sample points with all crops in the unadjusted set	21	217,917	12.9	0.0	13.2
Sample points with one or more crops in the adjusted set	61	496,292	2.6	15.6	18.3
SB-WT only					
Sample points with all crops in the unadjusted set	59	592,516	16.1	0.0	17.8
Sample points with one or more crops in the adjusted set	46	456,261	5.2	8.5	13.7
CN and close grown crops					
Sample points with all crops in the unadjusted set	38	430,064	14.5	0.0	27.7
Sample points with one or more crops in the adjusted set	6	54,587	5.8	4.9	10.7
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	67	1,026,847	15.3	0.0	17.1
Sample points with one or more crops in the adjusted set	6	64,923	4.8	6.2	11.0
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	132	1,343,964	19.4	0.0	22.6
Sample points with one or more crops in the adjusted set	53	546,757	9.2	6.2	15.8
Hay-crop mix					
Sample points with all crops in the unadjusted set	96	1,272,344	8.7	0.0	21.4
Sample points with one or more crops in the adjusted set	28	356,211	2.8	5.9	11.0
Remaining mix of crops					
Sample points with all crops in the unadjusted set	33	395,994	22.9	0.0	23.8
Sample points with one or more crops in the adjusted set	8	97,165	5.8	4.9	11.8
All cropping systems					
Sample points with all crops in the unadjusted set	862	9,438,485	--	--	--
Sample points with one or more crops in the adjusted set	556	5,365,015	--	--	--
Total	1,418	14,803,500	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Chesapeake Bay Region

There were 771 sample points for cropped acres in the Chesapeake Bay Region. Survey results provided data for a total of 2,277 crops grown at these sample points during the 3-year period—an average of 3.0 crops per sample point. Of these 2,277 crops, 303 had nitrogen application rate adjustments and 465 had phosphorus application rate adjustments. The number of crops with phosphorus application rate adjustments is higher largely because nitrogen application rate adjustments were not made for soybeans, a dominant crop in this region. On a sample-point basis, 211 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 1.3 million cropped acres—29 percent of cropped acres in the region. For phosphorus, a total of 231 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 1.1 million cropped acres—26 percent of cropped acres in the region.

Nitrogen. Table 25 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Chesapeake Bay Region. The table shows that the average amount of total nitrogen applied per year for the adjusted set was about the same as or less than the unadjusted set for all crop and cropping system combinations. The cropping system “corn and soybean only” had the most crops—634, of which 318 were corn. Of these corn crops, 62 had nitrogen added for the model simulation. The average commercial nitrogen fertilizer application per year as reported was only 20 pounds per acre for the adjusted set, compared to an average of 114 pounds per acre for corn crops in the unadjusted set. The average amount of nitrogen added to these 62 corn crops was 60 pounds per acre per year, increasing the total amount applied to 86 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the corn crops in the unadjusted set was much higher, averaging 155 pounds per acre per year.

Table 26 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. For all cropping systems, the average amount of total nitrogen applied for sample points with all crops in the unadjusted set was about the same as or more than the average for sample points with one or more crops in the adjusted set. For example, a total of 49 of the 246 sample points in the “corn and soybean only” cropping system have one or more crops with nitrogen added, representing 29 percent of the acres in the cropping system. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 87 pounds per acre per year, compared to 48 pounds per acre per year for the sample points in the adjusted set.

Overall, a total of 211 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 1.3 million cropped acres—29 percent of cropped acres in the region. As shown in the cumulative distribution in figure 13—

- 71 percent of cropped acres had no nitrogen added,
- 6 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 5 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 8 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 3 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 7 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Phosphorus. Table 27 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Chesapeake Bay Region. The cropping system “corn and soybean only” had 634 crops, of which 318 were corn. Of these, 66 had phosphorus added for the model simulation. The average commercial phosphorus fertilizer application per year as reported was 1.9 pounds per acre for the adjusted set, compared to an average of 16.6 pounds per acre for corn crops in the unadjusted set. The average amount of phosphorus added to these 66 corn crops was 15.9 pounds per acre per year, increasing the total amount applied to 17.9 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the corn crops in the unadjusted set was higher, averaging 35.3 pounds per acre per year.

Of the 307 soybean crops in the “corn and soybean only” cropping system, 86 had phosphorus added for the model simulation (table 27). The average phosphorus fertilizer application per year as reported was only 0.1 pound per acre for the adjusted set, compared to an average of 7.6 pounds per acre for soybean crops in the unadjusted set. The average amount of phosphorus added to these 86 soybean crops was 10.6 pounds per acre per year, increasing the

total amount applied to 10.7 pounds per acre per year. The average amount of total phosphorus applied to the crops in the unadjusted set was slightly higher, averaging 11.4 pounds per acre per year.

For crops in other cropping systems, table 27 shows that the average amount of total phosphorus applied per year was about the same or less for the adjusted set than the unadjusted set for all but two crop and cropping system combinations shown in the table. These two were the soybean crop in the “soybean and wheat only” cropping system and the soybean crop in the “corn-soybean with close grown crop” cropping system. The adjusted set had average total application rates about 4-5 pounds per acre higher than the unadjusted set for both of these cases.

Table 28 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is about the same as or more than the average for sample points with one or more crops in the adjusted set for all cropping systems. Overall, a total of 331 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 1.1 million cropped acres—26 percent of cropped acres in the region. As shown in the cumulative distribution in figure 14—

- 74 percent of cropped acres had no phosphorus added,
- 4 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 3 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 14 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 5 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 13. Cumulative distribution of amount of nitrogen added to sample points in the Chesapeake Bay Region

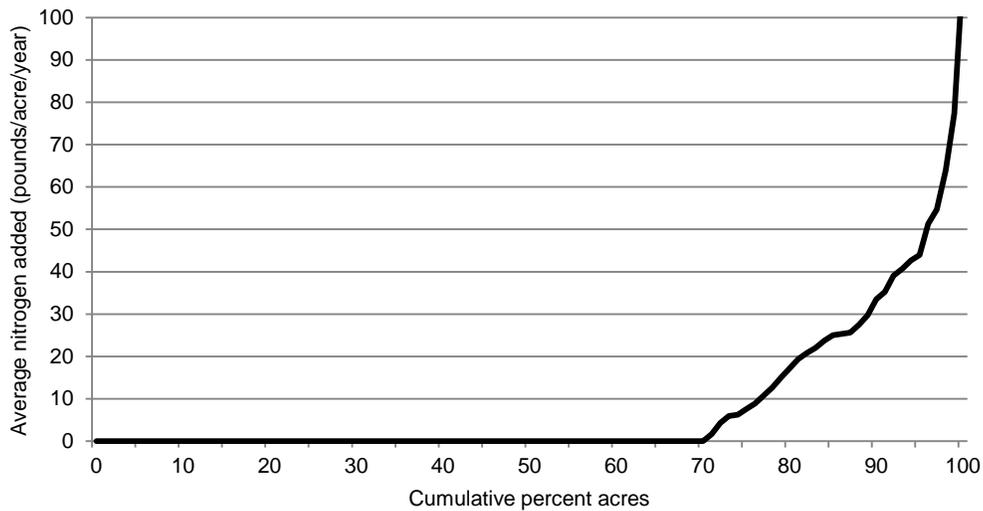


Figure 14. Cumulative distribution of amount of phosphorus added to sample points in the Chesapeake Bay Region

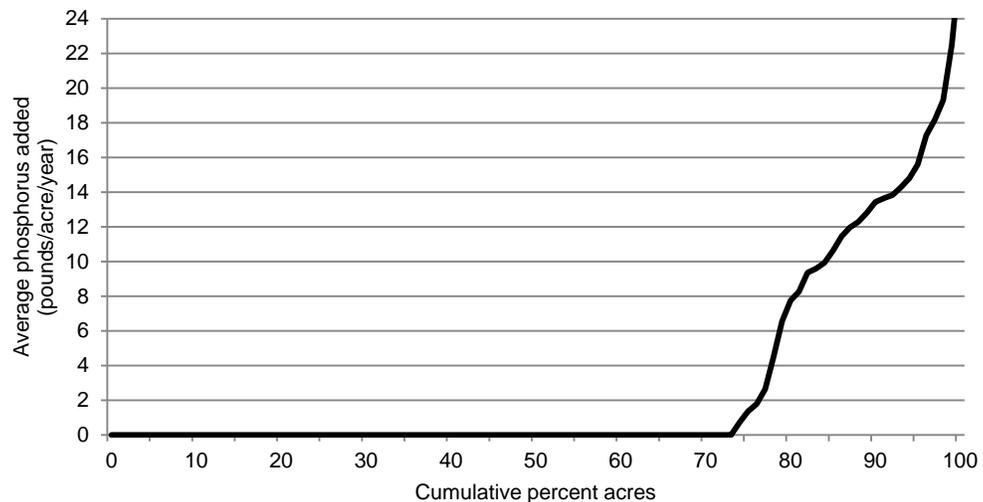


Table 25. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Chesapeake Bay Region*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	256	114	0	155
CN, adjusted set	62	20	60	86
Corn only				
CN, unadjusted set	131	101	0	151
CN, adjusted set	33	26	54	82
SB-WT only				
WH, unadjusted set	13	94	0	109
WH, adjusted set	13	31	55	94
CN and close grown crops				
CN, unadjusted set	70	83	0	131
CN, adjusted set	15	10	47	66
WH, unadjusted set	19	67	0	87
WH, adjusted set	10	42	44	86
Veg/tobacco w/ and w/out other crops				
CN, unadjusted set	26	117	0	143
CN, adjusted set	5	18	70	90
CN-SB with close grown crops				
BY, unadjusted set	36	78	0	81
BY, adjusted set	9	20	50	71
CN, unadjusted set	200	120	0	150
CN, adjusted set	24	8	64	72
WH, unadjusted set	100	87	0	94
WH, adjusted set	54	28	49	77
Hay-crop mix				
CN, unadjusted set	86	76	0	125
CN, adjusted set	38	18	48	72
Remaining mix of crops				
CN, unadjusted set	8	121	0	121
CN, adjusted set	3	3	88	91

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 26. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Chesapeake Bay Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	197	905,232	62	0	87
Sample points with one or more crops in the adjusted set	49	269,504	17	29	48
Corn only					
Sample points with all crops in the unadjusted set	80	532,799	88	0	153
Sample points with one or more crops in the adjusted set	23	157,604	29	43	75
Soybean only					
Sample points with all crops in the unadjusted set	40	161,087	3	0	6
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
SB-WT only					
Sample points with all crops in the unadjusted set	11	49,106	57	0	63
Sample points with one or more crops in the adjusted set	11	75,543	18	30	60
CN and close grown crops					
Sample points with all crops in the unadjusted set	27	157,509	98	0	143
Sample points with one or more crops in the adjusted set	19	138,176	35	26	70
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	18	104,245	101	0	127
Sample points with one or more crops in the adjusted set	6	34,819	28	30	59
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	114	517,249	96	0	115
Sample points with one or more crops in the adjusted set	66	313,059	39	26	70
Hay-crop mix					
Sample points with all crops in the unadjusted set	57	467,659	34	0	63
Sample points with one or more crops in the adjusted set	28	220,596	21	23	49
Remaining mix of crops					
Sample points with all crops in the unadjusted set	16	125,905	66	0	69
Sample points with one or more crops in the adjusted set	9	49,808	41	30	74
All cropping systems					
Sample points with all crops in the unadjusted set	560	3,020,790	--	--	--
Sample points with one or more crops in the adjusted set	211	1,259,110	--	--	--
Total	771	4,279,900	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 27. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Chesapeake Bay Region

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	252	16.6	0.0	35.3
CN, adjusted set	66	1.9	15.9	17.9
SB, unadjusted set	221	7.6	0.0	11.4
SB, adjusted set	86	0.1	10.6	10.7
Corn only				
CN, unadjusted set	126	14.8	0.0	40.4
CN, adjusted set	38	1.1	17.7	19.7
Soybean only				
SB, unadjusted set	24	18.6	0.0	23.7
SB, adjusted set	28	0.8	11.5	12.4
SB-WT only				
SB, unadjusted set	28	4.8	0.0	7.3
SB, adjusted set	18	1.3	10.1	11.5
WH, unadjusted set	20	17.8	0.0	26.5
WH, adjusted set	6	0.0	5.7	5.7
CN and close grown crops				
CN, unadjusted set	71	11.6	0.0	43.1
CN, adjusted set	14	1.1	12.9	14.4
WH, unadjusted set	26	10.8	0.0	21.5
WH, adjusted set	3	0.0	9.0	9.0
Veg/tobacco w/ and w/out other crops				
CN, unadjusted set	29	21.0	0.0	34.2
CN, adjusted set	2	0.0	5.8	5.8
CN-SB with close grown crops				
BY, unadjusted set	29	11.0	0.0	13.3
BY, adjusted set	16	0.5	4.8	5.5
CN, unadjusted set	165	14.4	0.0	29.6
CN, adjusted set	59	1.8	21.6	25.9
SB, unadjusted set	215	3.5	0.0	5.7
SB, adjusted set	39	0.6	9.6	10.2
WH, unadjusted set	125	13.5	0.0	16.2
WH, adjusted set	29	0.2	5.9	6.1
Hay-crop mix				
CN, unadjusted set	107	15.1	0.0	34.1
CN, adjusted set	17	1.3	13.6	18.2
HY, unadjusted set	136	8.0	0.0	13.0
HY, adjusted set	14	0.0	7.3	7.7
Remaining mix of crops				
CT, unadjusted set	16	20.8	0.0	20.8
CT, adjusted set	3	0.0	12.6	12.6

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 28. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Chesapeake Bay Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	175	836,914	12.6	0.0	25.3
Sample points with one or more crops in the adjusted set	71	337,822	2.5	10.7	14.1
Corn only					
Sample points with all crops in the unadjusted set	76	553,866	11.6	0.0	44.6
Sample points with one or more crops in the adjusted set	27	136,538	1.2	18.7	20.6
Soybean only					
Sample points with all crops in the unadjusted set	16	70,821	13.3	0.0	15.9
Sample points with one or more crops in the adjusted set	24	90,266	0.8	11.5	12.3
SB-WT only					
Sample points with all crops in the unadjusted set	11	85,187	15.8	0.0	28.0
Sample points with one or more crops in the adjusted set	11	39,462	4.9	10.5	15.3
CN and close grown crops					
Sample points with all crops in the unadjusted set	38	247,187	13.0	0.0	35.1
Sample points with one or more crops in the adjusted set	8	48,498	0.6	11.9	13.6
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	17	109,040	35.0	0.0	48.0
Sample points with one or more crops in the adjusted set	7	30,024	1.6	3.4	5.1
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	116	512,928	14.1	0.0	22.9
Sample points with one or more crops in the adjusted set	64	317,380	3.8	10.3	16.0
Hay-crop mix					
Sample points with all crops in the unadjusted set	71	588,214	11.4	0.0	22.7
Sample points with one or more crops in the adjusted set	14	100,041	1.6	7.5	10.5
Remaining mix of crops					
Sample points with all crops in the unadjusted set	20	142,686	18.9	0.0	19.9
Sample points with one or more crops in the adjusted set	5	33,027	3.6	11.7	16.1
All cropping systems					
Sample points with all crops in the unadjusted set	540	3,146,842	--	--	--
Sample points with one or more crops in the adjusted set	231	1,133,058	--	--	--
Total	771	4,279,900	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Delaware River Basin

There were 186 sample points for cropped acres in the Delaware River Basin. Survey results provided data for a total of 538 crops grown at these sample points during the 3-year period—an average of 2.9 crops per sample point. Of these 538 crops, 92 had nitrogen application rate adjustments and 115 had phosphorus application rate adjustments. On a sample-point basis, 71 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 347,000 cropped acres—41 percent of cropped acres in the region. For phosphorus, a total of 62 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 274,000 cropped acres—32 percent of cropped acres in the region.

Nitrogen. Table 29 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Delaware River Basin. The table shows that the average amount of total nitrogen applied per year for the adjusted set was less than the unadjusted set for all crop and cropping system combinations. The cropping system “corn and soybean only” had 74 corn crops; of these, 21 had nitrogen added for the model simulation. The average commercial nitrogen fertilizer application per year as reported was only 31 pounds per acre for the adjusted set, compared to an average of 127 pounds per acre for corn crops in the unadjusted set. The average amount of nitrogen added to these 74 corn crops was 58 pounds per acre per year, increasing the total amount applied to 89 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the corn crops in the unadjusted set was much higher, averaging 152 pounds per acre per year.

Table 30 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. For all cropping systems, the average amount of total nitrogen applied for sample points with all crops in the unadjusted set was about the same as or more than the average for sample points with one or more crops in the adjusted set. For example, a total of 19 of the 57 sample points in the “corn and soybean only” cropping system have one or more crops with nitrogen added, representing 32 percent of the acres in the cropping system. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 44 pounds per acre per year, compared to 93 pounds per acre per year for the sample points in the adjusted set.

Overall, a total of 71 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 41 percent of cropped acres in the region. As shown in the cumulative distribution in figure 15—

- 59 percent of cropped acres had no nitrogen added,
- 11 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 14 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 6 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 6 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Phosphorus. Table 31 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Delaware River Basin. The cropping system “corn and soybean only” had 152 crops, of which 64 were corn. Of these, 11 had phosphorus added for the model simulation. The average commercial phosphorus fertilizer application per year as reported was 2.3 pounds per acre for the adjusted set, compared to an average of 18.3 pounds per acre for corn crops in the unadjusted set. The average amount of phosphorus added to these 11 corn crops was 11.7 pounds per acre per year, increasing the total amount applied to 14.3 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the corn crops in the unadjusted set was higher, averaging 28.3 pounds per acre per year.

Of the 77 soybean crops in the “corn and soybean only” cropping system, 21 had phosphorus added for the model simulation (table 31). The average phosphorus fertilizer application per year as reported was only 0.2 pound per acre for the adjusted set, compared to an average of 11.0 pounds per acre for soybean crops in the unadjusted set. The average amount of phosphorus added to these 21 soybean crops was 10.9 pounds per acre per year, increasing the total amount applied to 11.4 pounds per acre per year. The average amount of total phosphorus applied to the crops in the unadjusted set was higher, averaging 20.1 pounds per acre per year.

For crops in other cropping systems, table 31 shows that the average amount of total phosphorus applied per year was less for the adjusted set than the unadjusted set for all crop and cropping system combinations shown in the table.

Table 32 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is about the same as or more than the average for sample points with one or more crops in the adjusted set for all cropping systems. Overall, a total of 62 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 32 percent of cropped acres in the region. As shown in the cumulative distribution in figure 16—

- 68 percent of cropped acres had no phosphorus added,
- 8 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 8 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 12 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 4 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 15. Cumulative distribution of amount of nitrogen added to sample points in the Delaware River Basin

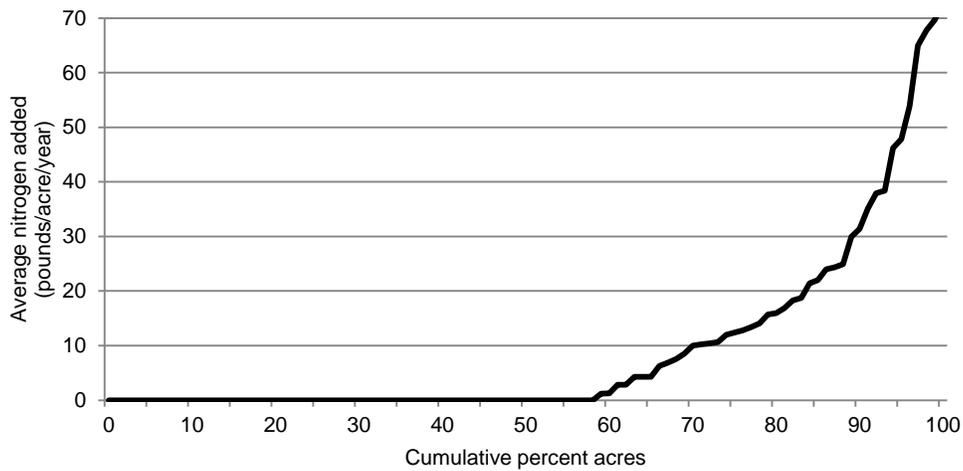


Figure 16. Cumulative distribution of amount of phosphorus added to sample points in Delaware River Basin

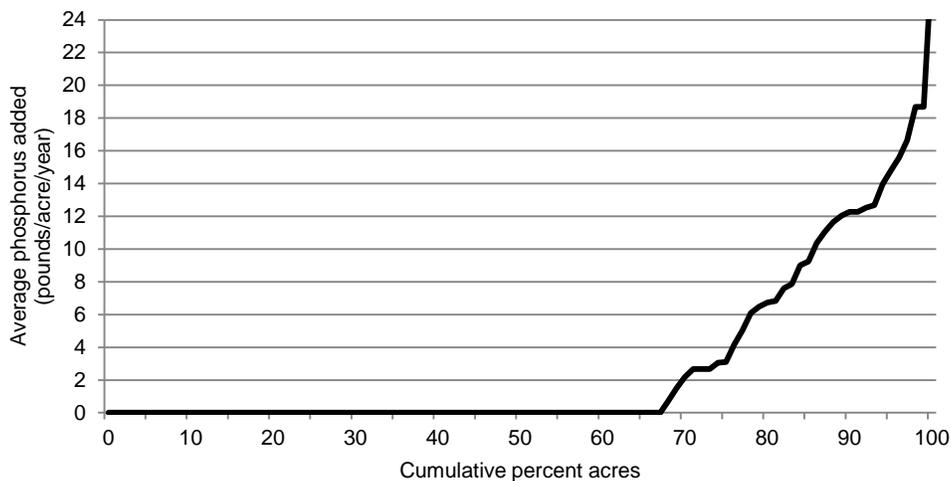


Table 29. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Delaware River Basin*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	53	127	0	152
CN, adjusted set	21	31	58	89
Corn only				
CN, unadjusted set	24	116	0	134
CN, adjusted set	10	28	55	83
CN and close grown crops				
CN, unadjusted set	17	80	0	146
CN, adjusted set	4	11	54	66
CN-SB with close grown crops				
CN, unadjusted set	38	100	0	141
CN, adjusted set	7	5	60	69
WH, unadjusted set	11	90	0	98
WH, adjusted set	20	20	64	85
Hay-crop mix				
CN, unadjusted set	12	101	0	129
CN, adjusted set	6	23	28	57

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 30. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Delaware River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	38	153,799	66	0	93
Sample points with one or more crops in the adjusted set	19	72,792	22	20	44
Corn only					
Sample points with all crops in the unadjusted set	19	80,371	110	0	124
Sample points with one or more crops in the adjusted set	6	36,957	27	47	79
Soybean only					
Sample points with all crops in the unadjusted set	15	65,764	11	0	12
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
SB-WT only					
Sample points with all crops in the unadjusted set	4	14,963	29	0	31
Sample points with one or more crops in the adjusted set	4	27,951	28	10	38
CN and close grown crops					
Sample points with all crops in the unadjusted set	6	38,551	92	0	131
Sample points with one or more crops in the adjusted set	5	32,934	39	38	77
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	10	45,508	101	0	106
Sample points with one or more crops in the adjusted set	3	7,727	63	20	83
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	15	55,299	82	0	118
Sample points with one or more crops in the adjusted set	24	103,402	41	20	63
Hay-crop mix					
Sample points with all crops in the unadjusted set	7	41,966	44	0	62
Sample points with one or more crops in the adjusted set	8	58,016	22	12	38
Remaining mix of crops					
Sample points with all crops in the unadjusted set	1	2,283	157	0	157
Sample points with one or more crops in the adjusted set	2	7,317	22	18	40
All cropping systems					
Sample points with all crops in the unadjusted set	115	498,504	--	--	--
Sample points with one or more crops in the adjusted set	71	347,096	--	--	--
Total	186	845,600	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 31. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Delaware River Basin

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	63	18.3	0.0	28.3
CN, adjusted set	11	2.3	11.7	14.3
SB, unadjusted set	56	11.0	0.0	20.1
SB, adjusted set	21	0.2	10.9	11.4
Corn only				
CN, unadjusted set	25	14.9	0.0	23.2
CN, adjusted set	9	4.8	15.0	20.7
Soybean only				
SB, unadjusted set	7	12.6	0.0	18.4
SB, adjusted set	14	1.3	10.3	11.7
CN-SB with close grown crops				
CN, unadjusted set	32	14.3	0.0	35.1
CN, adjusted set	13	1.0	14.0	15.0
SB, unadjusted set	37	3.4	0.0	7.2
SB, adjusted set	18	1.8	4.4	6.3
WH, unadjusted set	20	9.8	0.0	15.7
WH, adjusted set	11	0.0	8.4	8.4
Hay-crop mix				
CN, unadjusted set	13	15.5	0.0	28.4
CN, adjusted set	5	9.2	9.9	19.1

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 32. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Delaware River Basin

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	41	170,466	15.4	0.0	28.1
Sample points with one or more crops in the adjusted set	16	56,124	4.3	7.9	12.4
Corn only					
Sample points with all crops in the unadjusted set	16	78,368	19.0	0.0	25.8
Sample points with one or more crops in the adjusted set	9	38,959	3.1	15.9	19.7
Soybean only					
Sample points with all crops in the unadjusted set	5	20,304	19.0	0.0	20.3
Sample points with one or more crops in the adjusted set	10	45,460	1.2	10.6	11.8
SB-WT only					
Sample points with all crops in the unadjusted set	4	20,549	15.0	0.0	15.0
Sample points with one or more crops in the adjusted set	4	22,365	0.0	12.9	13.4
CN and close grown crops					
Sample points with all crops in the unadjusted set	11	71,486	11.8	0.0	29.6
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	12	50,952	19.8	0.0	22.1
Sample points with one or more crops in the adjusted set	1	2,283	0.0	2.3	2.3
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	21	72,765	13.6	0.0	26.9
Sample points with one or more crops in the adjusted set	18	85,935	4.4	6.0	10.7
Hay-crop mix					
Sample points with all crops in the unadjusted set	11	76,638	10.7	0.0	18.2
Sample points with one or more crops in the adjusted set	4	23,345	4.6	5.5	10.1
Remaining mix of crops					
Sample points with all crops in the unadjusted set	3	9,600	14.1	0.0	14.1
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
All cropping systems					
Sample points with all crops in the unadjusted set	124	571,128	--	--	--
Sample points with one or more crops in the adjusted set	62	274,472	--	--	--
Total	186	845,600	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

South Atlantic Gulf Region

There were 968 sample points for cropped acres in the South Atlantic Gulf Region. Survey results provided data for a total of 2,502 crops grown at these sample points during the 3-year period—an average of 2.6 crops per sample point. Of these 2,502 crops, 194 had nitrogen application rate adjustments and 258 had phosphorus application rate adjustments. On a sample-point basis, 147 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 1.9 million cropped acres—14 percent of cropped acres in the region. For phosphorus, a total of 153 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 1.8 million cropped acres—14 percent of cropped acres in the region.

Nitrogen. Table 33 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the South Atlantic Gulf Region. The table shows that the average amount of total nitrogen applied per year for the adjusted set was about the same as or less than the unadjusted set for all but two crop and cropping system combinations. For example, the cropping system “cotton only” had 162 crops; of these, 7 had nitrogen added for the model simulation. The average commercial nitrogen fertilizer application per year as reported was only 6 pounds per acre for the adjusted set, compared to an average of 80 pounds per acre for cotton crops in the unadjusted set. The average amount of nitrogen added to these 7 cotton crops was 38 pounds per acre per year, increasing the total amount applied to 44 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the cotton crops in the unadjusted set was much higher, averaging 85 pounds per acre per year.

Table 34 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. The average amount of total nitrogen applied for sample points with all crops in the unadjusted set was about the same as or more than the average for sample points with one or more crops in the adjusted set for all but the “hay-crop mix” cropping system. For example, a total of 7 of the 131 sample points in the “cotton only” cropping system have one or more crops with nitrogen added. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 47 pounds per acre per year, compared to 84 pounds per acre per year for the sample points in the adjusted set.

Overall, a total of 147 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 14 percent of cropped acres in the region. As shown in the cumulative distribution in figure 17—

- 86 percent of cropped acres had no nitrogen added,
- 2 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 2 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 3 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 3 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Phosphorus. Table 35 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the South Atlantic Gulf Region. The cropping system “cotton only” had 162 cotton crops; of these, 3 had phosphorus added for the model simulation. The average commercial phosphorus fertilizer application per year as reported was 0.0 pounds per acre for the adjusted set, compared to an average of 18.6 pounds per acre for crops in the unadjusted set. The average amount of phosphorus added to these 3 crops was 8.8 pounds per acre per year, increasing the total amount applied to 8.8 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the corn crops in the unadjusted set was higher, averaging 21.1 pounds per acre per year.

For crops in other cropping systems, table 35 shows that the average amount of total phosphorus applied per year was about the same or less for the adjusted set than the unadjusted set for all but two crop and cropping system combinations shown in the table. These two were the soybean crop in the “corn-soybean with close grown crop” cropping system and the soybean crop in the “remaining mix of row and close-grown crops” cropping system. The adjusted set had average total application rates about 7-10 pounds per acre higher than the unadjusted set for both of these cases.

Table 36 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is about the same as or more than the average for sample points with one or more crops in the

adjusted set for all cropping systems. Overall, a total of 153 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 14 percent of cropped acres in the region. As shown in the cumulative distribution in figure 18—

- 86 percent of cropped acres had no phosphorus added,
- 2 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 2 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 6 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 4 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 17. Cumulative distribution of amount of nitrogen added to sample points in the South Atlantic Gulf Region

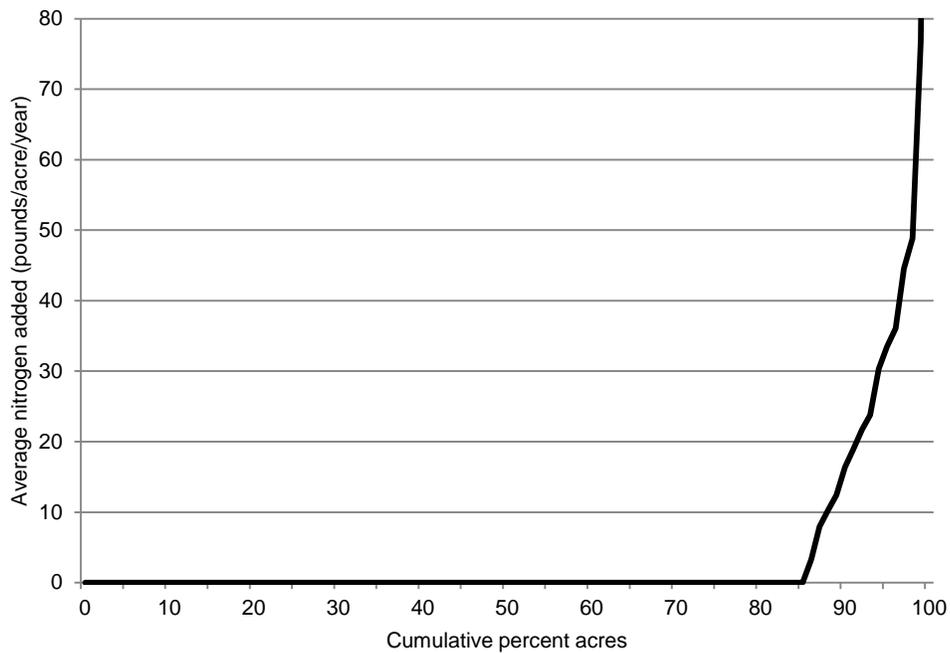


Figure 18. Cumulative distribution of amount of phosphorus added to sample points in South Atlantic Gulf Region

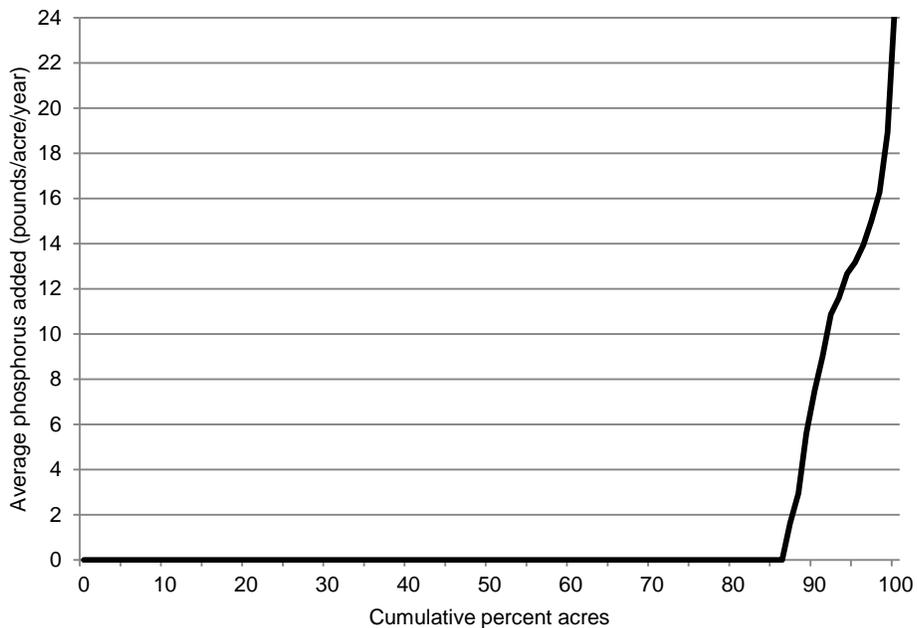


Table 33. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the South Atlantic Gulf Region*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
CN-SB only				
CN, unadjusted set	128	135	0	147
CN, adjusted set	36	27	74	101
Corn only				
CN, unadjusted set	42	108	0	146
CN, adjusted set	7	28	72	100
Cotton only				
CT, unadjusted set	155	80	0	85
CT, adjusted set	7	6	38	44
SB-WT only				
WH, unadjusted set	30	84	0	112
WH, adjusted set	15	19	56	75
CT-PN only				
CT, unadjusted set	144	84	0	89
CT, adjusted set	4	10	47	57
Veg/tobacco w/ and w/out other crops				
CN, unadjusted set	22	132	0	145
CN, adjusted set	2	30	74	104
VT, unadjusted set	91	79	0	79
VT, adjusted set	13	15	34	48
WH, unadjusted set	20	40	0	40
WH, adjusted set	7	19	57	76
CN-SB with close grown crops				
CN, unadjusted set	72	111	0	125
CN, adjusted set	8	6	93	100
WH, unadjusted set	40	83	0	103
WH, adjusted set	30	19	42	61
Peanuts w/ and w/out other crops				
CN, unadjusted set	33	110	0	119
CN, adjusted set	2	20	57	77
CT, unadjusted set	50	91	0	91
CT, adjusted set	1	7	92	99
CT-SB w/ and w/out other crops				
CT, unadjusted set	101	68	0	73
CT, adjusted set	18	7	47	54
Remaining mix of row AND close crops				
CN, unadjusted set	28	126	0	148
CN, adjusted set	5	19	64	83
CT, unadjusted set	29	69	0	69
CT, adjusted set	1	0	35	35
SM, unadjusted set	20	44	0	55
SM, adjusted set	7	53	50	103
WH, unadjusted set	36	39	0	39
WH, adjusted set	6	22	45	67

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 34. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for South Atlantic Gulf Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	103	1,180,715	73	0	82
Sample points with one or more crops in the adjusted set	31	365,796	18	40	58
Corn only					
Sample points with all crops in the unadjusted set	33	501,203	101	0	135
Sample points with one or more crops in the adjusted set	4	54,565	31	47	78
Soybean only					
Sample points with all crops in the unadjusted set	79	923,035	11	0	17
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Cotton only					
Sample points with all crops in the unadjusted set	124	1,507,017	81	0	84
Sample points with one or more crops in the adjusted set	7	94,268	11	36	47
SB-WT only					
Sample points with all crops in the unadjusted set	23	244,509	80	0	97
Sample points with one or more crops in the adjusted set	11	139,809	13	32	48
CT-PN only					
Sample points with all crops in the unadjusted set	93	1,639,628	54	0	61
Sample points with one or more crops in the adjusted set	2	41,154	12	33	45
CN-CT only					
Sample points with all crops in the unadjusted set	34	393,737	103	0	107
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	79	1,321,249	94	0	99
Sample points with one or more crops in the adjusted set	20	231,328	32	23	55
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	37	456,392	92	0	107
Sample points with one or more crops in the adjusted set	32	356,772	41	22	69
Peanuts w/ and w/out other crops					
Sample points with all crops in the unadjusted set	74	1,069,022	53	0	56
Sample points with one or more crops in the adjusted set	5	128,067	12	15	52
Hay-crop mix					
Sample points with all crops in the unadjusted set	4	84,331	109	0	112
Sample points with one or more crops in the adjusted set	4	102,098	25	111	137
CT-SB w/ and w/out other crops					
Sample points with all crops in the unadjusted set	76	747,587	46	0	51
Sample points with one or more crops in the adjusted set	13	156,584	10	23	33
Remaining row crops only					
Sample points with all crops in the unadjusted set	8	543,010	232	0	232
Sample points with one or more crops in the adjusted set	1	6,339	15	20	35
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	8	161,306	97	0	97
Sample points with one or more crops in the adjusted set	2	35,600	36	29	65
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	46	554,906	78	0	96
Sample points with one or more crops in the adjusted set	15	191,774	33	23	58
All cropping systems					
Sample points with all crops in the unadjusted set	821	11,327,646	--	--	--
Sample points with one or more crops in the adjusted set	147	1,904,154	--	--	--
Total	968	13,231,800	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 35. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the South Atlantic Gulf Region

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	139	22.8	0.0	26.7
CN, adjusted set	25	2.5	18.7	21.2
SB, unadjusted set	132	12.5	0.0	15.5
SB, adjusted set	43	0.6	13.6	14.1
Corn only				
CN, unadjusted set	37	17.9	0.0	38.6
CN, adjusted set	12	0.7	14.8	15.6
Soybean only				
SB, unadjusted set	66	11.8	0.0	16.5
SB, adjusted set	34	0.5	12.3	13.1
Cotton only				
CT, unadjusted set	159	18.6	0.0	21.1
CT, adjusted set	3	0.0	8.8	8.8
SB-WT only				
SB, unadjusted set	49	12.3	0.0	15.2
SB, adjusted set	17	1.3	14.5	15.9
WH, unadjusted set	43	10.9	0.0	21.3
WH, adjusted set	2	0.0	5.1	5.1
CT-PN only				
CT, unadjusted set	144	22.1	0.0	24.9
CT, adjusted set	4	0.0	11.4	11.4
CN-CT only				
CN, unadjusted set	36	19.9	0.0	22.4
CN, adjusted set	2	0.0	8.7	8.7
CT, unadjusted set	49	19.4	0.0	22.6
CT, adjusted set	3	0.0	19.1	19.1
Veg/tobacco w/ and w/out other crops				
CN, unadjusted set	23	18.0	0.0	22.3
CN, adjusted set	1	0.0	16.6	16.6
CT, unadjusted set	30	14.8	0.0	15.9
CT, adjusted set	1	0.0	21.4	21.4
SB, unadjusted set	50	9.6	0.0	10.0
SB, adjusted set	5	0.0	8.2	8.2
VT, unadjusted set	102	30.8	0.0	30.8
VT, adjusted set	2	0.0	14.3	14.3
CN-SB with close grown crops				
CN, unadjusted set	67	19.6	0.0	25.5
CN, adjusted set	13	3.7	19.7	23.7
SB, unadjusted set	85	5.2	0.0	5.8
SB, adjusted set	11	0.7	15.1	15.8
WH, unadjusted set	60	10.4	0.0	15.2
WH, adjusted set	10	0.0	7.7	7.7

Table 35. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the South Atlantic Gulf Region--**continued**

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
Peanuts w/ and w/out other crops				
CN, unadjusted set	32	21.4	0.0	24.5
CN, adjusted set	3	0.0	28.7	28.7
CT, unadjusted set	49	20.1	0.0	20.1
CT, adjusted set	2	0.0	16.0	16.0
PN, unadjusted set	79	10.2	0.0	11.2
PN, adjusted set	4	0.6	13.5	14.1
SB, unadjusted set	20	15.4	0.0	15.4
SB, adjusted set	1	0.0	4.6	4.6
CT-SB w/ and w/out other crops				
CT, unadjusted set	105	17.0	0.0	18.8
CT, adjusted set	14	0.0	16.4	16.4
SB, unadjusted set	92	9.7	0.0	9.7
SB, adjusted set	16	0.2	12.7	13.0
Remaining mix of row AND close crops				
CN, unadjusted set	32	26.3	0.0	33.4
CN, adjusted set	1	0.0	7.2	7.2
CT, unadjusted set	28	21.0	0.0	21.0
CT, adjusted set	2	0.0	11.1	11.1
PN, unadjusted set	23	6.4	0.0	6.4
PN, adjusted set	1	0.0	19.2	19.2
SB, unadjusted set	28	8.7	0.0	8.7
SB, adjusted set	9	2.4	13.3	15.7
SM, unadjusted set	23	6.2	0.0	9.7
SM, adjusted set	4	0.0	10.5	10.5
WH, unadjusted set	40	7.7	0.0	7.7
WH, adjusted set	2	0.0	4.6	4.6

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 36. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for South Atlantic Gulf Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	98	1,076,637	17.8	0.0	21.1
Sample points with one or more crops in the adjusted set	36	469,874	4.6	12.3	17.3
Corn only					
Sample points with all crops in the unadjusted set	26	423,749	16.0	0.0	32.3
Sample points with one or more crops in the adjusted set	11	132,019	1.4	14.6	16.0
Soybean only					
Sample points with all crops in the unadjusted set	52	648,819	12.8	0.0	16.5
Sample points with one or more crops in the adjusted set	27	274,216	0.6	12.1	12.9
Cotton only					
Sample points with all crops in the unadjusted set	128	1,536,672	21.9	0.0	23.2
Sample points with one or more crops in the adjusted set	3	64,613	0.0	9.0	9.0
SB-WT only					
Sample points with all crops in the unadjusted set	26	283,536	21.7	0.0	27.4
Sample points with one or more crops in the adjusted set	8	100,781	4.6	11.0	17.5
CT-PN only					
Sample points with all crops in the unadjusted set	93	1,665,069	17.3	0.0	22.8
Sample points with one or more crops in the adjusted set	2	15,712	0.0	8.0	8.0
CN-CT only					
Sample points with all crops in the unadjusted set	31	375,433	20.8	0.0	22.9
Sample points with one or more crops in the adjusted set	3	18,303	0.0	7.0	7.0
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	93	1,484,140	25.9	0.0	27.6
Sample points with one or more crops in the adjusted set	6	68,437	1.8	6.6	8.5
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	51	590,243	17.0	0.0	22.4
Sample points with one or more crops in the adjusted set	18	222,921	4.4	8.7	13.2
Peanuts w/ and w/out other crops					
Sample points with all crops in the unadjusted set	72	1,120,908	15.0	0.0	17.6
Sample points with one or more crops in the adjusted set	7	76,182	6.3	10.3	16.7
Hay-crop mix					
Sample points with all crops in the unadjusted set	4	67,999	16.7	0.0	19.1
Sample points with one or more crops in the adjusted set	4	118,430	3.2	10.5	13.9
CT-SB w/ and w/out other crops					
Sample points with all crops in the unadjusted set	72	726,681	13.7	0.0	15.8
Sample points with one or more crops in the adjusted set	17	177,490	1.8	9.7	11.5
Remaining row crops only					
Sample points with all crops in the unadjusted set	8	541,301	27.5	0.0	27.5
Sample points with one or more crops in the adjusted set	1	8,048	8.8	4.9	13.7
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	10	196,906	16.9	0.0	16.9
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	51	649,082	20.2	0.0	26.1
Sample points with one or more crops in the adjusted set	10	97,598	2.3	9.4	11.7
All cropping systems					
Sample points with all crops in the unadjusted set	815	11,387,175	--	--	--
Sample points with one or more crops in the adjusted set	153	1,844,625	--	--	--
Total	968	13,231,800	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Souris-Red-Rainy Region

There were 476 sample points for cropped acres in the Souris-Red-Rainy Region. Survey results provided data for a total of 1,266 crops grown at these sample points during the 3-year period—an average of 2.7 crops per sample point. Of these 1,266 crops, 130 had nitrogen application rate adjustments and 202 had phosphorus application rate adjustments. On a sample-point basis, 102 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 3.8 million cropped acres—22 percent of cropped acres in the region. For phosphorus, a total of 115 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 4.1 million cropped acres—23 percent of cropped acres in the region.

Nitrogen. Table 37 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Souris-Red-Rainy Region. The table shows that the average amount of total nitrogen applied per year for the adjusted set was less than the unadjusted set for all crop and cropping system combinations. For example, the cropping system “soybean-wheat only” had 132 wheat crops; of these, 20 had nitrogen added for the model simulation. The average commercial nitrogen fertilizer application per year as reported was only 25 pounds per acre for the adjusted set, compared to an average of 88 pounds per acre for wheat crops in the unadjusted set. The average amount of nitrogen added to these 20 wheat crops was 42 pounds per acre per year, increasing the total amount applied to 67 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the wheat crops in the unadjusted set was higher, averaging 88 pounds per acre per year.

Table 38 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. The average amount of total nitrogen applied for sample points with all crops in the unadjusted set was more than the average for sample points with one or more crops in the adjusted set for all cropping systems. For example, a total of 17 of the 110 sample points in the “soybean-wheat only” cropping system have one or more crops with nitrogen added. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 46 pounds per acre per year, compared to 34 pounds per acre per year for the sample points in the adjusted set.

Overall, a total of 102 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 22 percent of cropped acres in the region. As shown in the cumulative distribution in figure 19—

- 78 percent of cropped acres had no nitrogen added,
- 6 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 8 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 5 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 1 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 2 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Phosphorus. Table 39 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Souris-Red-Rainy Region. The cropping system “soybean-wheat only” had 141 soybean crops and 138 wheat crops. Of the 141 soybean crops, 31 had additional nitrogen added. The average commercial phosphorus fertilizer application per year for these 31 crops as reported was 1.0 pound per acre for the adjusted set, compared to an average of 10.1 pounds per acre for crops in the unadjusted set. The average amount of phosphorus added to these 31 crops was 6.9 pounds per acre per year, increasing the total amount applied to 7.9 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the soybean crops in the unadjusted set was higher, averaging 10.1 pounds per acre per year.

For crops in other cropping systems, table 39 shows that the average amount of total phosphorus applied per year was about the same or less for the adjusted set than the unadjusted set for all but two crop and cropping system combinations shown in the table. These two were the six wheat crops in the “sunflower and close grown crops” cropping system and the 7 beans/peas crops in the “vegetable or tobacco with or without other crops” cropping system. The adjusted set had average total application rates about 5-6 pounds per acre higher than the unadjusted set for both of these cases.

Table 40 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is about the same as or more than the average for sample points with one or more crops in the

adjusted set for all cropping systems. Overall, a total of 115 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 23 percent of cropped acres in the region. As shown in the cumulative distribution in figure 20—

- 76 percent of cropped acres had no phosphorus added,
- 8 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 7 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 8 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 1 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 19. Cumulative distribution of amount of nitrogen added to sample points in the Souris-Red-Rainy Basin

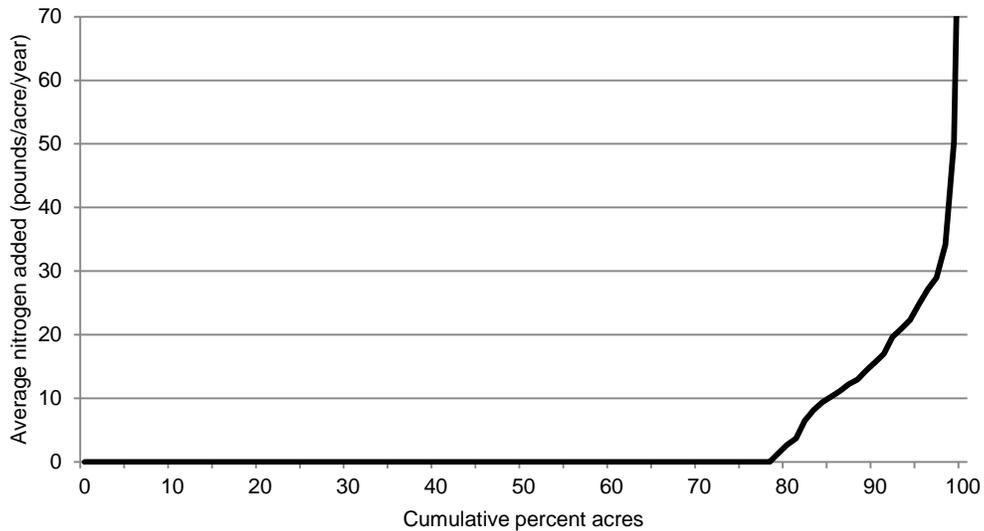


Figure 20. Cumulative distribution of amount of phosphorus added to sample points in the Souris-Red-Rainy Basin

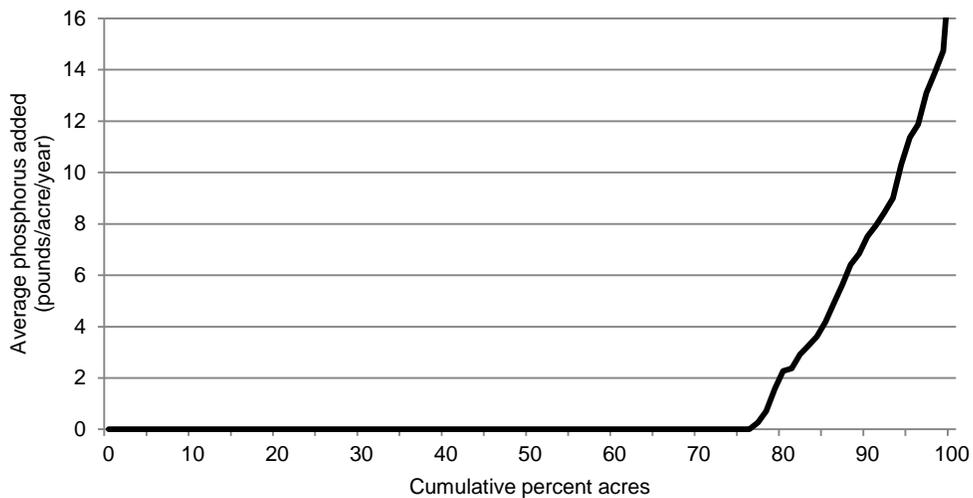


Table 37. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Souris-Red-Rainy Region*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
Wheat only				
WH, unadjusted set	21	70	0	70
WH, adjusted set	12	34	30	64
SB-WT only				
WH, unadjusted set	112	88	0	88
WH, adjusted set	20	25	42	67
SF and close grown crops				
OS, unadjusted set	29	80	0	81
OS, adjusted set	17	49	21	70
WH, unadjusted set	49	79	0	79
WH, adjusted set	2	16	53	69
Veg/tobacco w/ and w/out other crops				
WH, unadjusted set	50	80	0	80
WH, adjusted set	6	8	52	60
Sugar beets w/ and w/out other crops				
WH, unadjusted set	27	104	0	104
WH, adjusted set	6	29	57	86
Remaining mix of row and close grown crops				
BY, unadjusted set	36	63	0	64
BY, adjusted set	4	32	29	61
CG, unadjusted set	57	66	0	67
CG, adjusted set	10	29	19	48
WH, unadjusted set	72	82	0	83
WH, adjusted set	24	45	35	79

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 38. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Souris-Red-Rainy Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	39	1,341,993	63	0	66
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Soybean only					
Sample points with all crops in the unadjusted set	21	556,750	8	0	8
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Wheat only					
Sample points with all crops in the unadjusted set	14	403,631	63	0	63
Sample points with one or more crops in the adjusted set	9	348,485	25	14	40
SB-WT only					
Sample points with all crops in the unadjusted set	93	3,207,524	46	0	46
Sample points with one or more crops in the adjusted set	17	608,672	14	20	34
SB and close grown crops					
Sample points with all crops in the unadjusted set	22	635,473	47	0	47
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
SF and close grown crops					
Sample points with all crops in the unadjusted set	23	1,045,001	82	0	82
Sample points with one or more crops in the adjusted set	18	524,163	51	9	60
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	47	2,037,592	49	0	49
Sample points with one or more crops in the adjusted set	6	223,416	8	20	28
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	13	443,604	67	0	71
Sample points with one or more crops in the adjusted set	4	145,667	18	15	33
Hay-crop mix					
Sample points with all crops in the unadjusted set	11	381,562	45	0	74
Sample points with one or more crops in the adjusted set	3	149,628	3	36	39
Sugar beets w/ and w/out other crops					
Sample points with all crops in the unadjusted set	24	923,609	73	0	73
Sample points with one or more crops in the adjusted set	7	291,702	33	19	52
Remaining row crops only					
Sample points with all crops in the unadjusted set	8	215,257	83	0	86
Sample points with one or more crops in the adjusted set	3	141,661	18	36	61
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	1	92,783	80	0	80
Sample points with one or more crops in the adjusted set	4	132,512	14	22	35
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	58	2,443,698	71	0	72
Sample points with one or more crops in the adjusted set	31	1,276,316	43	16	60
All cropping systems					
Sample points with all crops in the unadjusted set	374	13,728,476	--	--	--
Sample points with one or more crops in the adjusted set	102	3,842,224	--	--	--
Total	476	17,570,700	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 39. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Souris-Red-Rainy Basin

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
CN-SB only				
CN, unadjusted set	36	24.4	0.0	24.4
CN, adjusted set	9	3.8	14.0	17.9
SB, unadjusted set	30	12.6	0.0	14.1
SB, adjusted set	18	0.0	9.7	9.7
Soybean only				
SB, unadjusted set	11	12.0	0.0	12.0
SB, adjusted set	20	1.1	13.7	14.8
Wheat only				
WH, unadjusted set	31	10.7	0.0	10.7
WH, adjusted set	2	1.7	7.9	9.6
SB-WT only				
SB, unadjusted set	110	10.1	0.0	10.1
SB, adjusted set	31	1.0	6.9	7.9
WH, unadjusted set	117	16.4	0.0	16.4
WH, adjusted set	15	2.0	13.5	15.5
SB and close grown crops				
SB, unadjusted set	18	10.6	0.0	10.6
SB, adjusted set	7	0.0	4.9	4.9
SF and close grown crops				
OS, unadjusted set	42	7.0	0.0	7.0
OS, adjusted set	4	0.0	5.4	5.4
WH, unadjusted set	45	12.2	0.0	12.2
WH, adjusted set	6	3.4	14.7	18.1
Veg/tobacco w/ and w/out other crops				
BP, unadjusted set	50	7.5	0.0	7.5
BP, adjusted set	7	2.1	10.1	12.2
WH, unadjusted set	49	14.0	0.0	14.0
WH	7	1.3	9.5	10.8
Hay-crop mix				
HY, unadjusted set	22	5.3	0.0	22.9
HY, adjusted set	5	0.0	4.6	5.5
SU w/ and w/out other crops				
SU, unadjusted set	30	18.8	0.0	18.8
SU, adjusted set	2	0.0	8.8	8.8
Remaining mix of row AND close crops				
BY, unadjusted set	38	12.0	0.0	12.2
BY, adjusted set	2	0.0	10.9	10.9
CG, unadjusted set	50	9.4	0.0	10.2
CG, adjusted set	17	3.0	8.0	11.0
WH, unadjusted set	81	12.6	0.0	13.2
WH, adjusted set	15	0.0	11.1	11.1

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 40. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Souris-Red-Rainy Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
CN-SB only					
Sample points with all crops in the unadjusted set	23	855,013	18.9	0.0	20.7
Sample points with one or more crops in the adjusted set	16	486,980	6.9	7.2	14.1
Soybean only					
Sample points with all crops in the unadjusted set	8	208,775	13.4	0.0	13.4
Sample points with one or more crops in the adjusted set	13	347,975	2.0	12.8	14.7
Wheat only					
Sample points with all crops in the unadjusted set	21	687,671	8.1	0.0	8.1
Sample points with one or more crops in the adjusted set	2	64,445	2.4	7.4	9.9
SB-WT only					
Sample points with all crops in the unadjusted set	84	2,864,336	13.1	0.0	13.1
Sample points with one or more crops in the adjusted set	26	951,860	5.5	6.0	11.5
SB and close grown crops					
Sample points with all crops in the unadjusted set	17	510,365	14.4	0.0	14.4
Sample points with one or more crops in the adjusted set	5	125,108	3.4	4.2	7.5
SF and close grown crops					
Sample points with all crops in the unadjusted set	33	1,285,624	10.6	0.0	10.6
Sample points with one or more crops in the adjusted set	8	283,541	3.3	4.8	8.1
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	44	1,934,913	10.5	0.0	10.5
Sample points with one or more crops in the adjusted set	9	326,095	2.9	7.1	10.0
CN-SB with close grown crops					
Sample points with all crops in the unadjusted set	14	485,569	15.1	0.0	16.9
Sample points with one or more crops in the adjusted set	3	103,702	8.3	2.3	11.5
Hay-crop mix					
Sample points with all crops in the unadjusted set	11	402,516	9.7	0.0	21.4
Sample points with one or more crops in the adjusted set	3	128,673	2.7	7.2	10.2
Sugar beets w/ and w/out other crops					
Sample points with all crops in the unadjusted set	26	959,846	15.9	0.0	15.9
Sample points with one or more crops in the adjusted set	5	255,465	5.1	7.4	12.4
Remaining row crops only					
Sample points with all crops in the unadjusted set	9	257,065	16.5	0.0	20.6
Sample points with one or more crops in the adjusted set	2	99,854	5.4	8.1	13.5
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	4	184,698	8.2	0.0	8.2
Sample points with one or more crops in the adjusted set	1	40,597	0.0	13.6	13.6
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	67	2,862,514	10.8	0.0	11.6
Sample points with one or more crops in the adjusted set	22	857,500	3.1	6.5	9.6
All cropping systems					
Sample points with all crops in the unadjusted set	361	13,498,904	--	--	--
Sample points with one or more crops in the adjusted set	115	4,071,796	--	--	--
Total	476	17,570,700	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Pacific Northwest Region

There were 918 sample points for cropped acres in the Pacific Northwest Region. Survey results provided data for a total of 2,407 crops grown at these sample points during the 3-year period—an average of 2.6 crops per sample point. Of these 2,407 crops, 595 had nitrogen application rate adjustments and 629 had phosphorus application rate adjustments. On a sample-point basis, 418 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 5.3 million cropped acres—46 percent of cropped acres in the region. For phosphorus, a total of 347 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 4.8 million cropped acres—41 percent of cropped acres in the region.

Nitrogen. Table 41 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Pacific Northwest Region. The table shows that the average amount of total nitrogen applied per year for the adjusted set was about the same or less than the unadjusted set for all but 4 of the crop and cropping system combinations. For example, the cropping system “wheat only” had 405 wheat crops; of these, 234 had nitrogen added for the model simulation. The average commercial nitrogen fertilizer application per year as reported was only 44 pounds per acre for the adjusted set, compared to an average of 95 pounds per acre for wheat crops in the unadjusted set. The average amount of nitrogen added to these 234 wheat crops was 44 pounds per acre per year, increasing the total amount applied to 88 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the wheat crops in the unadjusted set was higher, averaging 95 pounds per acre per year.

Table 41 further shows that most cropping systems also had lower, or about the same, total nitrogen applied for the adjusted set than for the unadjusted set. The four exceptions were—

- the 22 barley crops in the “potatoes with and without other crops” cropping system,
- the 10 hay crops in the “hay-crop mix” cropping system,
- the 6 close grown crops in the “remaining close grown crops only” cropping system, and
- the 44 barley crops in the “remaining mix of row and close grown crops” cropping system.

Table 42 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. The average amount of total nitrogen applied for sample points with all crops in the unadjusted set was more than the average for sample points with one or more crops in the adjusted set for all but the 4 points in the cropping system “remaining close grown crops only.” For example, a total of 200 of the 329 sample points in the “wheat only” cropping system have one or more crops with nitrogen added. The amount of total nitrogen applied per year for the sample points in the unadjusted set averaged 60 pounds per acre per year, compared to 53 pounds per acre per year for the sample points in the adjusted set.

Overall, a total of 418 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 46 percent of cropped acres in the region. As shown in the cumulative distribution in figure 21—

- 54 percent of cropped acres had no nitrogen added,
- 12 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 10 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 8 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 4 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 12 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Phosphorus. Table 43 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Pacific Northwest Region. Of the 188 wheat crops that had additional nitrogen added, the average commercial phosphorus fertilizer application per year as reported was 0.6 pound per acre for the adjusted set, compared to an average of 4.6 pounds per acre for crops in the unadjusted set. The average amount of phosphorus added to these 188 crops was 5.2 pounds per acre per year, increasing the total amount applied to 5.8 pounds per acre per year in the model simulations (including manure applications). The average amount of phosphorus applied to the wheat crops in the unadjusted set was about the same, averaging 4.9 pounds per acre per year.

For crops in other cropping systems, table 43 shows that the average amount of total phosphorus applied per year was about the same or less for the adjusted set than for the unadjusted set for all but one crop and cropping system combination—the 2 barley crops in the “potatoes with and without other crops “ cropping system.

Table 44 shows that the average amount of total phosphorus applied for sample points with all crops in the unadjusted set is about the same as or more than the average for sample points with one or more crops in the adjusted set for all cropping systems except the “remaining close grown crops only” cropping system. Overall, a total of 347 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 41 percent of cropped acres in the region. As shown in the cumulative distribution in figure 22—

- 59 percent of cropped acres had no phosphorus added,
- 22 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 9 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 6 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 4 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Figure 21. Cumulative distribution of amount of nitrogen added to sample points in the Pacific Northwest Region

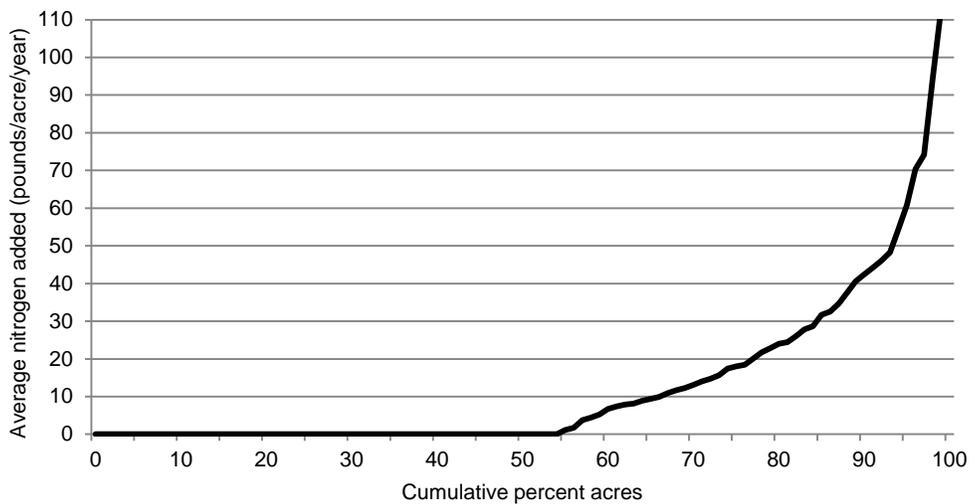


Figure 22. Cumulative distribution of amount of phosphorus added to sample points in the Pacific Northwest Region

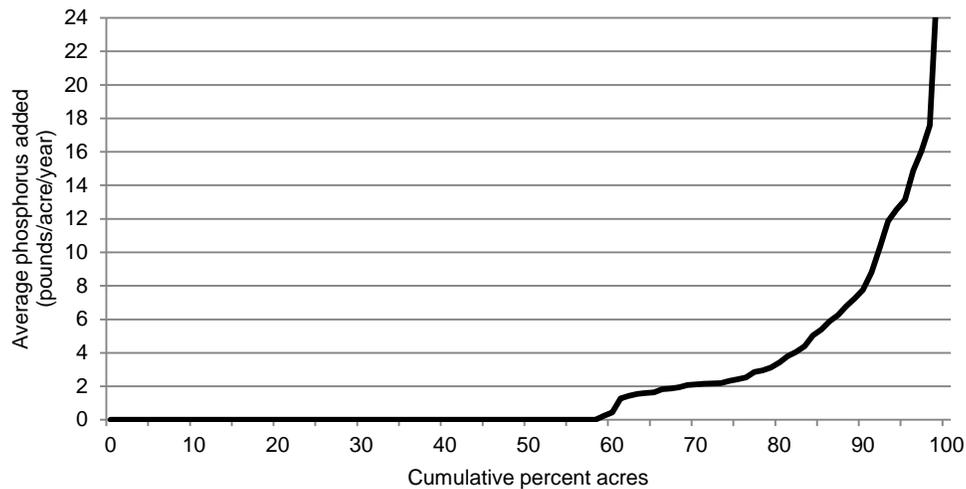


Table 41. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Pacific Northwest Region*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
Wheat only				
WH, unadjusted set	171	95	0	95
WH, adjusted set	234	44	44	88
Barley only				
BY, unadjusted set	15	99	0	158
BY, adjusted set	50	56	64	122
CN and close grown crops				
CN, unadjusted set	30	120	0	154
CN, adjusted set	3	27	76	111
Veg/tobacco w/ and w/out other crops				
CN, unadjusted set	22	174	0	189
CN, adjusted set	1	0	119	133
VT, unadjusted set	19	204	0	204
VT, adjusted set	2	150	28	178
WH, unadjusted set	79	127	0	127
WH, adjusted set	21	68	45	113
Potatoes w/ and w/out other crops				
BY, unadjusted set	20	85	0	86
BY, adjusted set	22	53	70	122
PO, unadjusted set	72	234	0	234
PO, adjusted set	8	98	40	137
WH, unadjusted set	54	131	0	131
WH, adjusted set	3	80	28	109
Hay-crop mix				
BY, unadjusted set	15	96	0	96
BY, adjusted set	20	16	70	89
CN, unadjusted set	32	102	0	195
CN, adjusted set	9	19	127	159
HY, unadjusted set	112	21	0	43
HY, adjusted set	10	24	171	209
WH, unadjusted set	17	112	0	118
WH, adjusted set	23	24	93	119
Sugar beets w/ and w/out other crops				
SU, unadjusted set	31	160	0	160
SU, adjusted set	22	85	52	137
WH, unadjusted set	30	162	0	162
WH, adjusted set	10	73	51	123
Remaining row crops only				
CN, unadjusted set	40	120	0	231
CN, adjusted set	11	13	101	115
Remaining close grown crops only				
CG, unadjusted set	402	121	0	121
CG, adjusted set	6	189	111	300
Remaining mix of row AND close crops				
BY, unadjusted set	27	73	0	73
BY, adjusted set	44	63	47	110
WH, unadjusted set	55	102	0	102
WH, adjusted set	44	54	53	107

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 42. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Pacific Northwest Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
Wheat only					
Sample points with all crops in the unadjusted set	129	2,111,096	60	0	60
Sample points with one or more crops in the adjusted set	200	2,848,559	31	22	53
Barley only					
Sample points with all crops in the unadjusted set	12	102,258	93	0	125
Sample points with one or more crops in the adjusted set	33	289,798	43	63	110
CN and close grown crops					
Sample points with all crops in the unadjusted set	10	105,515	132	0	154
Sample points with one or more crops in the adjusted set	10	82,652	78	46	145
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	81	1,133,954	103	0	105
Sample points with one or more crops in the adjusted set	30	372,123	62	18	82
Potatoes w/ and w/out other crops					
Sample points with all crops in the unadjusted set	54	562,688	189	0	199
Sample points with one or more crops in the adjusted set	22	166,657	99	31	130
Hay-crop mix					
Sample points with all crops in the unadjusted set	36	526,649	87	0	105
Sample points with one or more crops in the adjusted set	36	516,544	19	42	63
Sugar beets w/ and w/out other crops					
Sample points with all crops in the unadjusted set	25	217,471	170	0	173
Sample points with one or more crops in the adjusted set	25	200,318	105	32	137
Remaining row crops only					
Sample points with all crops in the unadjusted set	27	200,507	159	0	212
Sample points with one or more crops in the adjusted set	7	75,930	10	117	128
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	95	878,474	110	0	110
Sample points with one or more crops in the adjusted set	4	32,902	116	92	208
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	31	500,451	81	0	81
Sample points with one or more crops in the adjusted set	51	725,354	53	25	79
All cropping systems					
Sample points with all crops in the unadjusted set	500	6,339,063	--	--	--
Sample points with one or more crops in the adjusted set	418	5,310,837	--	--	--
Total	918	11,649,900	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 43. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Pacific Northwest Region

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
Wheat only				
WH, unadjusted set	217	4.6	0.0	4.9
WH, adjusted set	188	0.6	5.2	5.8
Barley only				
BY, unadjusted set	40	12.0	0.0	26.4
BY, adjusted set	25	1.9	10.7	12.6
CN and close grown crops				
CN, unadjusted set	25	19.6	0.0	48.4
CN, adjusted set	8	2.2	18.8	22.8
Veg/tobacco w/ and w/out other crops				
BP, unadjusted set	83	13.5	0.0	19.4
BP, adjusted set	18	0.0	14.0	14.0
WH, unadjusted set	91	13.0	0.0	13.0
WH, adjusted set	9	0.5	7.9	8.4
Potatoes w/ and w/out other crops				
BY, unadjusted set	40	6.5	0.0	6.9
BY, adjusted set	2	0.0	19.2	19.2
PO, unadjusted set	78	73.5	0.0	73.5
PO, adjusted set	2	0.0	11.9	11.9
WH, unadjusted set	54	12.7	0.0	12.7
WH, adjusted set	3	0.0	10.6	10.6
Hay-crop mix				
BY, unadjusted set	18	7.6	0.0	9.1
BY, adjusted set	17	0.7	8.8	9.5
CN, unadjusted set	35	15.5	0.0	94.7
CN, adjusted set	6	1.6	24.9	26.5
HY, unadjusted set	78	17.0	0.0	35.4
HY, adjusted set	44	2.5	12.8	15.3
WH, unadjusted set	23	8.5	0.0	12.9
WH, adjusted set	17	1.9	9.4	11.3
Sugar beets w/ and w/out other crops				
SU, unadjusted set	48	40.8	0.0	40.8
SU, adjusted set	5	0.0	16.8	16.8
WH, unadjusted set	30	19.4	0.0	19.4
WH, adjusted set	10	0.0	13.2	13.2
Remaining row crops only				
CN, unadjusted set	35	34.2	0.0	99.4
CN, adjusted set	16	0.5	22.7	23.4
Remaining close grown crops only				
CG, unadjusted set	246	16.9	0.0	16.9
CG, adjusted set	162	4.6	18.2	22.8
Remaining mix of row AND close crops				
BY, unadjusted set	35	6.5	0.0	6.5
BY, adjusted set	36	0.9	9.7	10.6
WH, unadjusted set	60	10.7	0.0	10.7
WH, adjusted set	39	1.6	5.7	7.4

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 44. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Pacific Northwest Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
Wheat only					
Sample points with all crops in the unadjusted set	170	2,428,042	3.0	0.0	3.2
Sample points with one or more crops in the adjusted set	159	2,531,613	0.7	3.0	3.7
Barley only					
Sample points with all crops in the unadjusted set	30	272,396	12.2	0.0	21.2
Sample points with one or more crops in the adjusted set	15	119,661	2.4	9.8	12.2
CN and close grown crops					
Sample points with all crops in the unadjusted set	14	149,820	13.7	0.0	30.5
Sample points with one or more crops in the adjusted set	6	38,346	5.5	14.2	23.0
Veg/tobacco w/ and w/out other crops					
Sample points with all crops in the unadjusted set	82	993,929	17.9	0.0	20.4
Sample points with one or more crops in the adjusted set	29	512,149	4.2	6.3	10.6
Potatoes w/ and w/out other crops					
Sample points with all crops in the unadjusted set	72	672,150	42.6	0.0	50.4
Sample points with one or more crops in the adjusted set	4	57,195	8.2	8.9	17.1
Hay-crop mix					
Sample points with all crops in the unadjusted set	44	704,751	19.0	0.0	32.8
Sample points with one or more crops in the adjusted set	28	338,441	2.9	11.8	14.7
Sugar beets w/ and w/out other crops					
Sample points with all crops in the unadjusted set	40	349,295	35.9	0.0	36.8
Sample points with one or more crops in the adjusted set	10	68,493	7.9	10.7	18.6
Remaining row crops only					
Sample points with all crops in the unadjusted set	24	169,301	39.0	0.0	74.6
Sample points with one or more crops in the adjusted set	10	107,136	0.2	25.8	26.2
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	57	515,301	14.8	0.0	14.8
Sample points with one or more crops in the adjusted set	42	396,075	3.7	15.3	19.0
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	38	618,407	11.2	0.0	11.2
Sample points with one or more crops in the adjusted set	44	607,399	1.7	4.2	5.8
All cropping systems					
Sample points with all crops in the unadjusted set	571	6,873,392	--	--	--
Sample points with one or more crops in the adjusted set	347	4,776,508	--	--	--
Total	918	11,649,900	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Texas Gulf Region

There were 693 sample points for cropped acres in the Texas Gulf Region. Survey results provided data for a total of 1,443 crops grown at these sample points during the 3-year period—an average of 2.1 crops per sample point. Of these 1,443 crops, 87 had nitrogen application rate adjustments and 81 had phosphorus application rate adjustments. On a sample-point basis, 62 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 1.4 million cropped acres—8 percent of cropped acres in the region. For phosphorus, a total of 58 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 1.3 million cropped acres—7 percent of cropped acres in the region.

Nitrogen. Table 45 summarizes the number of crops for which nitrogen applications were adjusted and the average amount of additional nitrogen added by crop for the Texas Gulf Region. The table shows that the average amount of total nitrogen applied per year for the adjusted set was mostly either about the same as or higher than for the unadjusted set. Among the 10 crop and cropping system combinations, seven had higher average total nitrogen application rates for the adjusted set than for the unadjusted set. Results for this region differ from other regions in two respects:

- The number of crops with nitrogen adjustments is much fewer relative to the total number of crops than in all the other regions, and
- The nitrogen adjustment for the small number of crops in the adjusted set was often higher than the average for the unadjusted set.

For example, the “cotton only” cropping system had the most crops—284 crops, with 25 crops in the adjusted set. The average commercial nitrogen fertilizer application per year as reported was only 6 pounds per acre for the adjusted set, compared to an average of 45 pounds per acre for cotton crops in the unadjusted set. The average amount of nitrogen added to these 25 cotton crops was 43 pounds per acre per year, increasing the total amount applied to 50 pounds per acre per year in the model simulations (including manure applications). The average amount of total nitrogen applied to the cotton crops in the unadjusted set was lower, averaging 45 pounds per acre per year.

Table 46 summarizes the number of sample points and acres for which nitrogen application rates for one or more crops in the cropping system were adjusted and the average amount of additional nitrogen added by sample point. Acres and average nitrogen application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. Of the 13 cropping systems in this region, 5 cropping systems had an average total nitrogen application rate for the adjusted set that was higher than the average for the unadjusted set. Two cropping systems had no sample points with nitrogen adjustments. The other 6 cropping systems had an average nitrogen application rate for the adjusted set less than that for the unadjusted set. (Small sample sizes reduce the usefulness of these comparisons.)

Overall, a total of 693 sample points had additional nitrogen applications for one or more crops in the crop rotation, representing 8 percent of cropped acres in the region. As shown in the cumulative distribution in figure 23—

- 92 percent of cropped acres had no nitrogen added,
- 0 percent of cropped acres had less than 10 pounds per acre per year of nitrogen added,
- 1 percent of cropped acres had 10-20 pounds per acre per year of nitrogen added,
- 2 percent of cropped acres had 20-30 pounds per acre per year of nitrogen added,
- 1 percent of cropped acres had 30-40 pounds per acre per year of nitrogen added, and
- 4 percent of cropped acres had more than 40 pounds per acre per year of nitrogen added.

Thus, on a sample point basis, half of the acres in the adjusted set had more than 40 pounds per acre of nitrogen added; this proportion of adjusted acres with high levels of nitrogen added differs markedly from results for other CEAP regions shown in previous sections.

Phosphorus. Table 47 summarizes the number of crops for which phosphorus applications were adjusted and the average amount of additional phosphorus added by crop for the Texas Gulf Region. The table shows that the average amount of total phosphorus applied per year for the adjusted set was mostly either about the same as or higher than for the unadjusted set. Among the 8 crop and cropping system combinations, five had higher average total phosphorus application rates for the adjusted set than for the unadjusted set. As observed for nitrogen, results for this region differ from other regions in two respects:

- The number of crops with phosphorus adjustments is much fewer relative to the total number of crops than in all the other regions, and

- The phosphorus adjustment for the small number of crops in the adjusted set was often higher than the average for the unadjusted set.

For example, the “cotton only” cropping system had 27 crops in the adjusted set. The average commercial phosphorus fertilizer application per year as reported was 0.0 pounds per acre for the adjusted set, compared to an average of 9.1 pounds per acre for cotton crops in the unadjusted set. The average amount of phosphorus added to these 27 cotton crops was 13.6 pounds per acre per year, increasing the total amount applied to 13.6 pounds per acre per year in the model simulations (including manure applications). The average amount of total phosphorus applied to the cotton crops in the unadjusted set was lower, averaging 9.4 pounds per acre per year.

Table 48 summarizes the number of sample points and acres for which phosphorus application rates for one or more crops in the cropping system were adjusted and the average amount of additional phosphorus added by sample point. Acres and average phosphorus application rates are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point. Of the 13 cropping systems in this region, 7 cropping systems had an average total phosphorus application rate for the adjusted set that was higher than the average for the unadjusted set. Three cropping systems had no sample points with phosphorus adjustments. The other 3 cropping systems had an average phosphorus application rate for the adjusted set less than that for the unadjusted set. (Small sample sizes reduce the usefulness of these comparisons.)

Overall, a total of 58 sample points had additional phosphorus applications for one or more crops in the crop rotation, representing 7 percent of cropped acres in the region. As shown in the cumulative distribution in figure 24—

- 93 percent of cropped acres had no phosphorus added,
- 1 percent of cropped acres had less than 4 pounds per acre per year of phosphorus added,
- 0 percent of cropped acres had 4-8 pounds per acre per year of phosphorus added,
- 3 percent of cropped acres had 8-15 pounds per acre per year of phosphorus added, and
- 3 percent of cropped acres had more than 15 pounds per acre per year of phosphorus added.

Thus, on a sample point basis, most of the acres in the adjusted set had more than 8 pounds per acre of phosphorus added; this proportion of adjusted acres with high levels of phosphorus added differs markedly from results for other CEAP regions shown in previous sections.

Figure 23. Cumulative distribution of amount of nitrogen added to sample points in the Texas Gulf Region

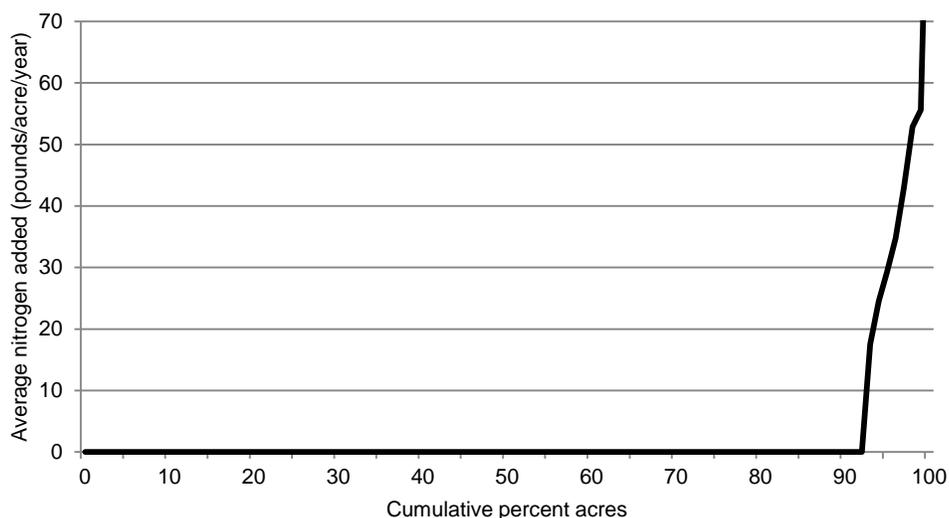


Figure 24. Cumulative distribution of amount of phosphorus added to sample points in the Texas Gulf Region

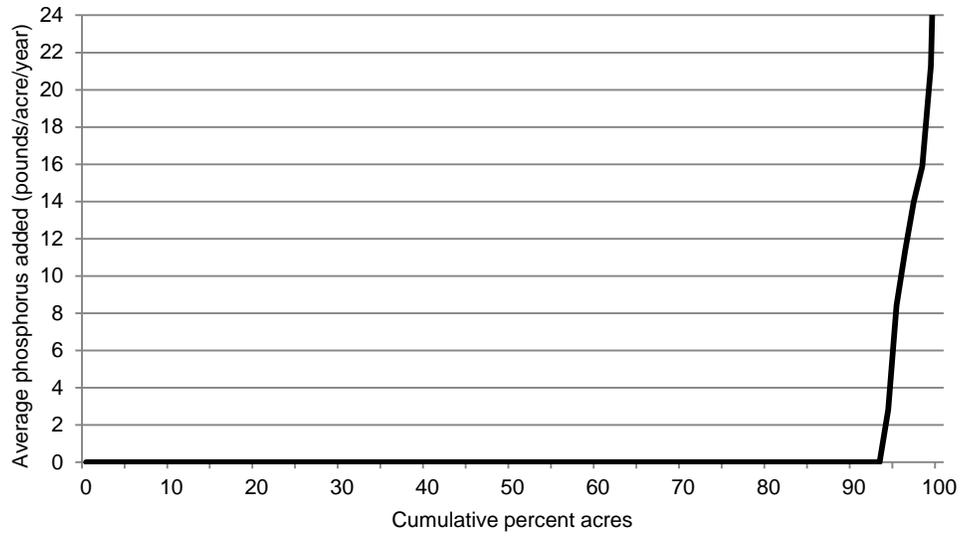


Table 45. Comparison by crop of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for the Texas Gulf Region*

Cropping system and crop**	Number of crops	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)***
Cotton only				
CT, unadjusted set	259	45	0	45
CT, adjusted set	25	6	43	50
Wheat only				
WH, unadjusted set	152	32	0	35
WH, adjusted set	12	4	51	55
CN-CT only				
CT, unadjusted set	31	72	0	90
CT, adjusted set	8	16	40	56
CT-SG only				
CT, unadjusted set	83	46	0	49
CT, adjusted set	9	19	38	56
SG, unadjusted set	71	46	0	46
SG, adjusted set	2	0	56	56
CT and close grown crops				
CT, unadjusted set	72	43	0	45
CT, adjusted set	8	9	30	39
WH, unadjusted set	52	21	0	23
WH, adjusted set	1	0	67	67
Sorghum w/ and w/out wheat				
SG, unadjusted set	52	68	0	71
SG, adjusted set	7	0	34	34
WH, unadjusted set	21	49	0	53
WH, adjusted set	3	0	67	67
Remaining mix of row AND close crops				
WH, unadjusted set	49	49	0	52
WH, adjusted set	2	23	38	61

* Soybean and other legume crops are not shown in the table because nutrient applications were not adjusted for these crops.

** A few minor crops are excluded from some cropping systems in this table.

*** Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 46. Comparison by cropping system of nitrogen applied between the unadjusted set of crops and the adjusted set of crops for Texas Gulf Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average nitrogen fertilizer applied per year as reported (pounds/acre)	Average nitrogen fertilizer applied per year <i>added</i> (pounds/acre)	Average total nitrogen applied per year (pounds/acre)*
Cotton only					
Sample points with all crops in the unadjusted set	192	3,690,184	38	0	38
Sample points with one or more crops in the adjusted set	20	345,959	6	44	51
Wheat only					
Sample points with all crops in the unadjusted set	102	2,905,203	31	0	32
Sample points with one or more crops in the adjusted set	10	236,746	1	59	60
CN-CT only					
Sample points with all crops in the unadjusted set	21	575,187	101	0	108
Sample points with one or more crops in the adjusted set	6	162,212	28	22	50
CN-SG only					
Sample points with all crops in the unadjusted set	13	593,966	83	0	83
Sample points with one or more crops in the adjusted set	1	26,221	0	97	97
CT-SG only					
Sample points with all crops in the unadjusted set	54	1,557,164	56	0	57
Sample points with one or more crops in the adjusted set	7	136,538	23	24	47
CT and close grown crops					
Sample points with all crops in the unadjusted set	46	1,047,515	41	0	42
Sample points with one or more crops in the adjusted set	6	100,134	15	24	38
Sorghum w/ and w/out wheat					
Sample points with all crops in the unadjusted set	37	874,501	64	0	64
Sample points with one or more crops in the adjusted set	7	185,940	0	38	38
Peanuts w/ and w/out other crops					
Sample points with all crops in the unadjusted set	23	617,294	43	0	44
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Rice w/ and w/out other crops					
Sample points with all crops in the unadjusted set	28	904,041	82	0	83
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Hay-crop mix					
Sample points with all crops in the unadjusted set	26	1,042,241	59	0	60
Sample points with one or more crops in the adjusted set	2	38,542	0	40	40
Remaining row crops only					
Sample points with all crops in the unadjusted set	32	1,227,060	125	0	125
Sample points with one or more crops in the adjusted set	1	28,628	0	22	22
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	16	696,501	26	0	26
Sample points with one or more crops in the adjusted set	1	131,672	0	53	53
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	41	1,219,667	83	0	84
Sample points with one or more crops in the adjusted set	1	25,182	33	25	58
All cropping systems					
Sample points with all crops in the unadjusted set	631	16,950,525	--	--	--
Sample points with one or more crops in the adjusted set	62	1,417,775	--	--	--
Total	693	18,368,299	--	--	--

* Includes nitrogen from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Table 47. Comparison by crop of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for the Texas Gulf Region

Cropping system and crop*	Number of crops	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)**
Cotton only				
CT, unadjusted set	257	9.1	0.0	9.4
CT, adjusted set	27	0.0	13.6	13.6
Wheat only				
WH, unadjusted set	150	4.7	0.0	7.1
WH, adjusted set	14	1.1	17.1	18.2
CN-CT only				
CT, unadjusted set	36	15.3	0.0	22.5
CT, adjusted set	3	0.0	7.7	7.7
CT-SG only				
CT, unadjusted set	85	9.5	0.0	10.9
CT, adjusted set	7	1.3	11.9	13.1
CT and close grown crops				
CT, unadjusted set	75	9.6	0.0	10.2
CT, adjusted set	5	0.9	9.5	10.4
Sorghum w/ and w/out wheat				
SG, unadjusted set	56	8.8	0.0	11.6
SG, adjusted set	3	0.0	17.5	17.5
WH, unadjusted set	21	6.0	0.0	9.8
WH, adjusted set	3	0.0	9.0	9.0
Peanuts w/ and w/out other crops				
PN, unadjusted set	25	15.5	0.0	15.5
PN, adjusted set	1	0.0	17.9	17.9

* A few minor crops are excluded from some cropping systems in this table. Results without any crops in the adjusted set are also not shown.

** Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are simple averages over the crops within each cropping system, and are not adjusted for sample weights. See appendix A for definition of crop abbreviations.

Table 48. Comparison by cropping system of phosphorus applied between the unadjusted set of crops and the adjusted set of crops for Texas Gulf Region

Cropping system and set of sample points	Number of samples	Estimated acres	Average phosphorus fertilizer applied per year as reported (pounds/acre)	Average phosphorus fertilizer applied per year <i>added</i> (pounds/acre)	Average total phosphorus applied per year (pounds/acre)*
Cotton only					
Sample points with all crops in the unadjusted set	189	3,690,062	8.4	0.0	8.6
Sample points with one or more crops in the adjusted set	23	346,082	0.0	13.2	13.2
Wheat only					
Sample points with all crops in the unadjusted set	103	2,909,555	5.1	0.0	5.6
Sample points with one or more crops in the adjusted set	9	232,394	0.5	13.1	13.7
CN-CT only					
Sample points with all crops in the unadjusted set	24	636,486	19.7	0.0	22.7
Sample points with one or more crops in the adjusted set	3	100,912	3.5	3.4	6.9
CN-SG only					
Sample points with all crops in the unadjusted set	11	509,979	4.5	0.0	4.5
Sample points with one or more crops in the adjusted set	3	110,208	0.0	19.8	19.8
CT-SG only					
Sample points with all crops in the unadjusted set	57	1,627,422	8.3	0.0	8.7
Sample points with one or more crops in the adjusted set	4	66,281	0.8	7.5	8.2
CT and close grown crops					
Sample points with all crops in the unadjusted set	49	1,103,027	7.4	0.0	7.9
Sample points with one or more crops in the adjusted set	3	44,622	1.1	14.5	15.6
Sorghum w/ and w/out wheat					
Sample points with all crops in the unadjusted set	39	954,526	7.1	0.0	7.5
Sample points with one or more crops in the adjusted set	5	105,916	2.4	11.5	13.9
Peanuts w/ and w/out other crops					
Sample points with all crops in the unadjusted set	22	604,426	15.1	0.0	15.7
Sample points with one or more crops in the adjusted set	1	12,868	7.3	6.0	13.3
Rice w/ and w/out other crops					
Sample points with all crops in the unadjusted set	28	904,041	11.4	0.0	12.0
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Hay-crop mix					
Sample points with all crops in the unadjusted set	26	1,042,241	3.4	0.0	4.1
Sample points with one or more crops in the adjusted set	2	38,542	0.0	12.5	12.5
Remaining row crops only					
Sample points with all crops in the unadjusted set	28	1,030,864	11.6	0.0	11.6
Sample points with one or more crops in the adjusted set	5	224,824	2.4	20.4	22.8
Remaining close grown crops only					
Sample points with all crops in the unadjusted set	17	828,174	2.7	0.0	2.7
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
Remaining mix of row AND close crops					
Sample points with all crops in the unadjusted set	42	1,244,849	13.7	0.0	15.4
Sample points with one or more crops in the adjusted set	0	0	NA	NA	NA
All cropping systems					
Sample points with all crops in the unadjusted set	635	17,085,650	--	--	--
Sample points with one or more crops in the adjusted set	58	1,282,649	--	--	--
Total	693	18,368,299	--	--	--

* Includes phosphorus from manure applications that would be available for plant growth.

Note: The average application rates shown in this table are weighted averages over the specified sample points, where the weights are the acreage weights assigned to each sample point.

Appendix A: Crop Groups

The NRI-CEAP Cropland Survey reported 144 different specific crops grown at 18,722 sample points. Specific crops were often a combination of crop species and crop use; for example, corn for grain and corn for silage and corn for seed were reported as separate crops. These 144 specific crops were aggregated into 20 CEAP crop groups, as shown in Table A1. The CEAP crop groups were similar to those used for NRI crop reporting, also shown in Table A1.

While the majority of samples consist of a single crop for each of the three years, it is common to have 2 crops per year. In a few cases, more than 2 crops per year occur. The maximum number of crops reported per year ranged from 3 in 2005 and 2006 to 5 in 2003 and 2004. Multiple harvests within a year were often reported as separate crops as well. In most cases, samples with 3 or more crops reported per year were instances of split fields, which were simplified by dropping the crops in the part of the field that did not correspond to the NRI cropping history.

The crop sequence for each sample point was constructed using the 20 CEAP crop groups to represent the specific crops. Typical crop sequences look like the following:

	Year 1	Year 2	Year 3
Sample point A	CN_ _ _	SB_ _ _	CN_ _ _
Sample point B	CN_WH_ _	SB_WH_ _	CN_WH_ _
Sample point C	VT_VT_VT_ _	VT_VT_VT_ _	VT_VT_VT_ _
Sample point D	WH_HY_ _	HY_HY_ _	VT_SB_CG_ _

Cropping systems were then defined using the sequence of crop groups that were reported over the (usually) 3 years of survey data for each point. (Some sample points only had a single year reported and a few others only reported 2 years of crops grown. The vast majority reported 3 years of cropping history at the point.)

Table A1. Crop groups used to define cropping systems. (CEAP crops listed are those reported in the CEAP surveys.)

Crop groups	Crop Group Abbreviation	CEAP crop code	CEAP crop	NRI crop code	NRI crop
Row Crops					
Corn	CN	191	Corn, All	11	Corn
	CN	218	Corn, dry fodder, hogged	11	Corn
	CN	6	Corn, grain	11	Corn
	CN	38	Corn, seed	11	Corn
	CN	5	Corn, silage	11	Corn
	CN	7	Corn, white	11	Corn
	CN	19	Popcorn	11	Corn
	CN	2110	Sweet corn, fresh	11	Corn
	CN	4110	Sweet corn, processing	11	Corn
	CN	246	Sweet corn for seed	11	Corn
Sorghum	SG	192	Sorghum, All	12	Sorghum
	SG	25	Sorghum, grain	12	Sorghum
	SG	24	Sorghum, silage	12	Sorghum
Soybean	SB	26	Soybeans	13	Soybeans
Cotton	CT	401	Cotton, Pima	14	Cotton
	CT	402	Cotton, Upland	14	Cotton
Peanuts	PN	16	Peanuts	15	Peanuts
Sugar beets	SU	28	Sugar beets for sugar	17	Sugar beets
Potatoes	PO	20	Potatoes	18	Potatoes
Sugarcane	SC	29	Sugarcane for sugar	20	Other Row Crops
Sunflower	OS	148	Sunflower seed, non-oil	21	Sunflower
	OS	30	Sunflower seed, oil	21	Sunflower
Other row crops	OR	160	Guar	20	Other Row Crops
	OR	181	Kenaf	20	Other Row Crops
	OR	98	Safflower	20	Other Row Crops
Beans and Peas	BP	3	Beans, dry edible	19	Vegetables
	BP	2122	Green peas, Fresh	19	Vegetables
	BP	4122	Green peas, Processing	19	Vegetables
	BP	169	Lentils	19	Vegetables
	BP	268	Lima beans, dry	19	Vegetables
	BP	2115	Lima beans, fresh	19	Vegetables
	BP	4115	Lima beans, processing	19	Vegetables
	BP	197	Mung beans	19	Vegetables
	BP	123	Peas, all other	19	Vegetables
	BP	200	Peas, Austrian winter	19	Vegetables
	BP	124	Peas, black eye	19	Vegetables
	BP	125	Peas, cowpeas	19	Vegetables
	BP	17	Peas, dry edible	19	Vegetables
	BP	4131	Snap bean, processing	19	Vegetables
	BP	2131	Snap beans, fresh	19	Vegetables
BP	243	Southern peas, cowpeas, etc	19	Vegetables	
Vegetables and Tobacco	VT	32	Tobacco, (other)	16	Tobacco

VT	193	Tobacco, burley	16	Tobacco	
VT	196	Tobacco, flue-cured	16	Tobacco	
VT	103	Beets	19	Vegetables	
VT	104	Broccoli	19	Vegetables	
VT	105	Brussel sprouts	19	Vegetables	
VT	2106	Cabbage, Fresh	19	Vegetables	
VT	4106	Cabbage, Processing	19	Vegetables	
VT	4	Cantaloupe	19	Vegetables	
VT	107	Carrots	19	Vegetables	
VT	108	Cauliflower	19	Vegetables	
VT	109	Celery	19	Vegetables	
VT	249	Chinese cabbage	19	Vegetables	
VT	185	Collards	19	Vegetables	
VT	2111	Cucumbers, Fresh	19	Vegetables	
VT	4111	Cucumbers, Processing	19	Vegetables	
VT	112	Eggplant	19	Vegetables	
VT	114	Garlic	19	Vegetables	
VT	117	Lettuce, head	19	Vegetables	
VT	149	Lettuce, other	19	Vegetables	
VT	146	Lettuce, romaine	19	Vegetables	
VT	13	Melons, honeydew	19	Vegetables	
VT	187	Mustard greens	19	Vegetables	
VT	135	Onions, dehydrated	19	Vegetables	
VT	120	Onions, dry	19	Vegetables	
VT	126	Peppers, bell	19	Vegetables	
VT	127	Peppers, chili	19	Vegetables	
VT	244	Peppers, hot	19	Vegetables	
VT	128	Pumpkins	19	Vegetables	
VT	129	Radishes	19	Vegetables	
VT	2132	Spinach, fresh	19	Vegetables	
VT	4132	Spinach, processing	19	Vegetables	
VT	133	Squash, summer	19	Vegetables	
VT	150	Squash, winter	19	Vegetables	
VT	31	Sweet potatoes	19	Vegetables	
VT	2134	Tomatoes, fresh	19	Vegetables	
VT	4134	Tomatoes, processing	19	Vegetables	
VT	145	Turnips	19	Vegetables	
VT	236	Vegetables, other	19	Vegetables	
VT	37	Vegetables, seeds	19	Vegetables	
VT	33	Watermelons	19	Vegetables	
Hay, Pasture, Fallow, and Idle					
Pasture	PS	316	Pasture as crop rotation	200	Pasture
Fallow and Idle	FI	333	Idle or fallow (2003 only)		summer fallow or idle
	FW	333	Summer fallow	170	summer fallow
	ID	318	Idle cropland	180	Idle cropland
Hay	HY	219	Sorghum, hay	12	Sorghum
	HY	310	Clover	144	Hay, all types
	HY	311	Grasses, other than clover	144	Hay, all types
	HY	1	Hay, Alfalfa and alfalfa Mix	144	Hay, all types
	HY	232	Hay, Bahia	144	Hay, all types
	HY	231	Hay, Bermuda grass	144	Hay, all types
	HY	11	Hay, other	144	Hay, all types
	HY	217	Hay, small grain	144	Hay, all types
	HY	23	Silage & haylage	144	Hay, all types
	HY	180	Sorghum-sudan cross	144	Hay, all types
	HY	167	Sudan	144	Hay, all types

	HY	199	Teff	144	Hay, all types
	HY	405	Brome grass mountain	144	Hay, all types
	HY	406	Brome grass smooth	144	Hay, all types
	HY	407	Coastal Bermuda	144	Hay, all types
	HY	414	Orchard grass	144	Hay, all types
	HY	201	Wheat grass seed (cover starter for hay first year)	116	Other close grown
	HY	39	Vetchseed, hairy	144	Hay, all types
Close Grown Crops					
Wheat	WH	34	Wheat, All	111	wheat
	WH	172	Wheat, All, for seed	111	wheat
	WH	163	Wheat, durum	111	wheat
	WH	164	Wheat, other spring	111	wheat
	WH	165	Wheat, winter	111	wheat
Rice	RI	21	Rice	113	Rice
	RI	319	Rice, sweet	113	Rice
	RI	178	Rice, wild	113	Rice
Barley	BY	190	Barley, All	114	Barley
	BY	290	Barley, Feed	114	Barley
	BY	2	Barley, feed or malt	114	Barley
	BY	291	Barley, Malt	114	Barley
	BY	173	Barley, seed	114	Barley
Small grain crops	SM	15	Oats	112	Oats
	SM	84	Buckwheat	116	Other Close Grown
	SM	161	Emmer and spelt	116	Other Close Grown
	SM	22	Rye	116	Other Close Grown
	SM	162	Triticale	116	Other Close Grown
Other close grown crops	CG	35	Alfalfa seed	116	Other Close Grown
	CG	228	Bentgrass seed	116	Other Close Grown
	CG	229	Bermuda grass seed	116	Other Close Grown
	CG	40	Bluegrass seed	116	Other Close Grown
	CG	215	Brome grass seed	116	Other Close Grown
	CG	85	Canola	116	Other Close Grown
	CG	153	Cilantro	116	Other Close Grown
	CG	194	Clover seed	116	Other Close Grown
	CG	214	Clover seed, crimson	116	Other Close Grown
	CG	43	Clover seed, red	116	Other Close Grown
	CG	203	Clover seed, white	116	Other Close Grown
	CG	317	Field and forage crops, Other	116	Other Close Grown
	CG	9	Flaxseed	116	Other Close Grown
	CG	10	Forage and green chop	116	Other Close Grown
	CG	138	Grass seed, other	116	Other Close Grown
	CG	41	Lespedeza seed	116	Other Close Grown
	CG	141	Millet	116	Other Close Grown
	CG	94	Mustard seed	116	Other Close Grown
	CG	42	Orchard grass seed	116	Other Close Grown
	CG	18	Peppermint	116	Other Close Grown
	CG	170	Rapeseed	116	Other Close Grown
	CG	136	Rye grass seed	116	Other Close Grown
	CG	168	Sage	116	Other Close Grown
	CG	44	Tall fescue seed	116	Other Close Grown
	CG	45	Timothy seed	116	Other Close Grown

END