



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

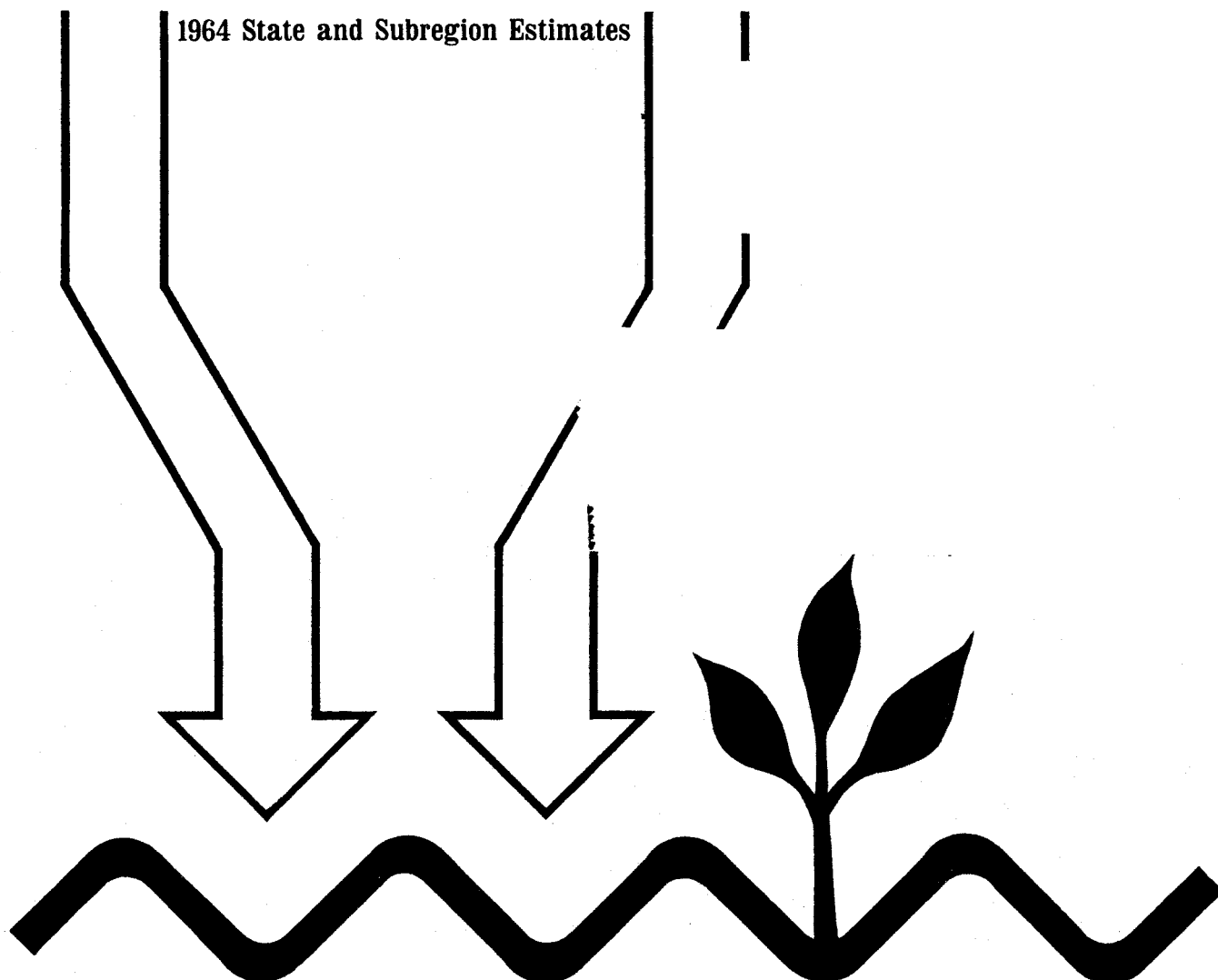
Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

# FERTILIZER USE IN MINNESOTA

1964 State and Subregion Estimates



Boyd M. Buxton  
William A. Elder

**White Memorial Book Collection**  
**Division of Agricultural Economics**

Table of Contents

Page

**IN LIBRARY USE ONLY**

List of Figures	ii
Introduction	1
Method of Obtaining Estimates	3
1964 Fertilizer Use	4
State Estimates	6
Subregion Estimates	7
Harvested acres fertilized by crops and areas	7
Application rates by crops and areas	17
Allocation of plant nutrients by crops and areas	19
Summary and Conclusions	20

	<u>LIST OF FIGURES</u>	<u>PAGE</u>
Figure 1.	Minnesota's Agricultural Subregions, 1964.	5
Figure 2.	Estimated use of principal plant nutrients for the entire state, 1964.	8
Figure 3.	Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 54, 1964.	9
Figure 4.	Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 56, 1964.	10
Figure 5.	Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 57, 1964.	11
Figure 6.	Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 71, 1964.	12
Figure 7.	Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 72, 1964.	13
Figure 8.	Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 73, 1964.	14
Figure 9.	Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 74, 1964.	15

Fertilizer Use in Minnesota:  
1964 State and Sub-region Estimates  
by  
Boyd M. Buxton and William A. Elder<sup>1/</sup>

Introduction

Fertilizer is a major input in Minnesota's agricultural production and its use contributes substantially to improved crop yields and increased productivity. In 1964 about 622,000 tons of dry and liquid fertilizer were applied to more than 19 million acres of harvested crop land and pastures. This compares with about 511,000 tons applied in 1959.<sup>2/</sup>

The increase in total fertilizer use in Minnesota from 1959 to 1968 is illustrated by an index in table 1. Dramatic increases in total commercial fertilizer use have occurred during this ten year period, particularly since 1964. In 1968, commercial fertilizer use in the state was 76 percent higher than in 1964.

---

<sup>1/</sup> Both authors are Agricultural Economists, Farm Production Economics Division, Economic Research Service, U.S. Department of Agriculture, stationed at the University of Minnesota, St. Paul, Minnesota.

<sup>2/</sup> U.S. Bureau of the Census, Census of Agriculture, 1964, Statistics for the State and Counties, Minnesota, U.S. Government Printing Office, Washington, D.C., 1967.

Table 1. Index of total tons of commercial fertilizer (mixed and straight material) used in Minnesota, 1959-1968.

---

Year ending June 30	Index number (1964 = 100)
<hr/>	<hr/>
1959	77
1960	72
1961	79
1962	79
1963	87
1964	100
1965	113
1966	120
1967	158
1968	176

---

Source: "Minnesota Fertilizer Sales by Grade and Material" Minnesota Department of Agriculture, Division of Agronomy Services, St. Paul, Minnesota.

Information on the farm use of fertilizer materials is of particular interest to the fertilizer supply industry for planning future fertilizer production and distribution. Major differences in farm fertilizer use exist among crops and areas of the state and information on these differences will assist in planning fertilizer production and distribution.

This report presents detailed estimates of farm fertilizer use by crops and agricultural subregions of Minnesota for the 1964 census year.<sup>3/</sup> While changes in total fertilizer use have occurred since 1964, 1964 estimates indicate the relative use of fertilizer among crops and areas of the state, and serve as a basis for studying future trends in fertilizer use in Minnesota.

#### Method of Obtaining Estimates

Information on fertilizer use by crops and areas of the state is not available on an annual basis. However, in agricultural census years, the U.S. Census of Agriculture for Minnesota reports by county (1) the total acreage harvested of all crops and pasture, (2) the total acres of primary crops receiving some fertilizer and (3) the tons of dry and liquid fertilizer materials applied to primary crops.<sup>4/</sup> Separate unpublished USDA statistics provide information on tonnages of principal plant nutrients used in Minnesota in 1964.

<sup>3/</sup> Similar estimates for all states are published in D. B. Ibach and J.R. Adams, "Fertilizer Use in the United States by Crops and Areas, 1964 Estimates," Statistical Bulletin No. 408, USDA, ERS and SRS, Washington, D.C., August 1967.

<sup>4/</sup> U.S. Bureau of the Census, Census of Agriculture, 1964, Statistics for the States and Counties, Minnesota, U.S. Government Printing Office, Washington, D.C. , 1967.

Census data and unpublished USDA statistics provided the foundation from which a committee of soil scientists and crop production specialists were able to develop detailed estimates of fertilizer use.<sup>5/</sup> These estimates included the (1) acres of each crop receiving applications of nitrogen (N),phosphorus (P), and potassium (K); (2) tons of plant nutrients used on each crop; and (3) pounds of N, P, and K applied per acre on all crop areas receiving these nutrients.<sup>6/</sup>

Agricultural subregions (ASR), as identified by the agricultural census, are groups of counties with similar types of farming. While the census agricultural subregions often cross state boundaries, only the parts of sub-regions in Minnesota are considered in this report (Figure 1).

#### 1964 Fertilizer Use

Estimates of fertilizer use in 1964 for Minnesota and its agricultural subregions appear in Figures 2 - 9. Each figure shows the area to which the estimates apply. Lists in table form show the number of acres harvested, percent of harvested acres receiving applications of N, P, and K, and the rate applied per acre receiving

---

<sup>5/</sup> The two primary committee members in Minnesota were Curtis Overdahl, Professor of Soil Science and Agriculture Extension, University of Minnesota and Bob Holt, Director of the North Central Soil Conservation Research Center at Morris, Minnesota.

<sup>6/</sup> Principal plant nutrients are nitrogen, phosphorus, and potassium. The symbols N, P, and K refer to elemental nitrogen, phosphorus, and potassium, respectively, and not to oxide forms of these nutrients. (Note: to convert P to  $P_2O_5$  multiply the quantity of P times the conversion factor 2.29137.<sup>25</sup> Likewise, to convert K to  $K_2O$ , multiply the quantity of K times the conversion factor 1.20459).

Figure 1. Minnesota's Agricultural Subregions, 1964

N, P, and K for specified crops and pasture. Diagrams are also presented in Figures 2 - 9, giving total tons of principal nutrients applied and the percentage applied to major crops for the state and subregions.

#### State Estimates

In 1964, Minnesota had a little more than 19 million harvested acres of cropland and pasture (Figure 2). The four largest categories of crops were corn, hay and cropland pasture, oats, and soybeans in decreasing order of the number of acres harvested.

Overall, 34 percent of the harvested acres received applications of some N, 39 percent received some P, and 28 percent received some K. The percentage of harvested acres receiving N, P, and K applications ranged from (1) 2 percent for soybeans to 97 percent for Irish potatoes for N, (2) 6 percent for soybeans to 100 percent for sugarbeets for P, and (3) 1 percent for flax to 63 percent for corn for K.

In general, corn, Irish potatoes, and vegetables had high percentages of harvested acres receiving each of the three principal plant nutrients. Soybeans, hay and cropland pasture, improved permanent pasture, and fruit and nut trees had relatively low percentages of harvested acres receiving each nutrient.

Vegetables received the greatest number of pounds of K applied per acre (98 pounds). Sugarbeets received the greatest number of pounds of P applied per acre (50 pounds), with vegetables a close second (49 pounds).

Of the state's major crops, corn received an average of 30 pounds of N, 17 pounds of P and 30 pounds of K; hay and cropland pasture received an average of 7 pounds of N, 24 pounds of P, and 33 pounds of K; oats received an average of only 10 pounds of N, 10 pounds of P, and 8 pounds of K; and soybeans received 2 pounds of N, 13 pounds of P and 21 pounds of K. The above rates are all per acre receiving applications of the particular plant nutrient.

In terms of total tonnage of plant nutrients, the nearly 622,000 tons of dry and liquid fertilizer materials used on Minnesota farms in 1964 involved an estimated 79,982 tons of elemental N; 61,631 tons of elemental P; and 72,565 tons of elemental K (Figure 2).

Dominance of corn in Minnesota's farm fertilizer consumption is illustrated by the percentage of the three plant nutrients used on principal crops (Figure 2). It is estimated that corn received 78 percent of the nitrogen, 57 percent of the phosphorus, and 72 percent of the potassium used during 1964.

#### Subregion Estimates

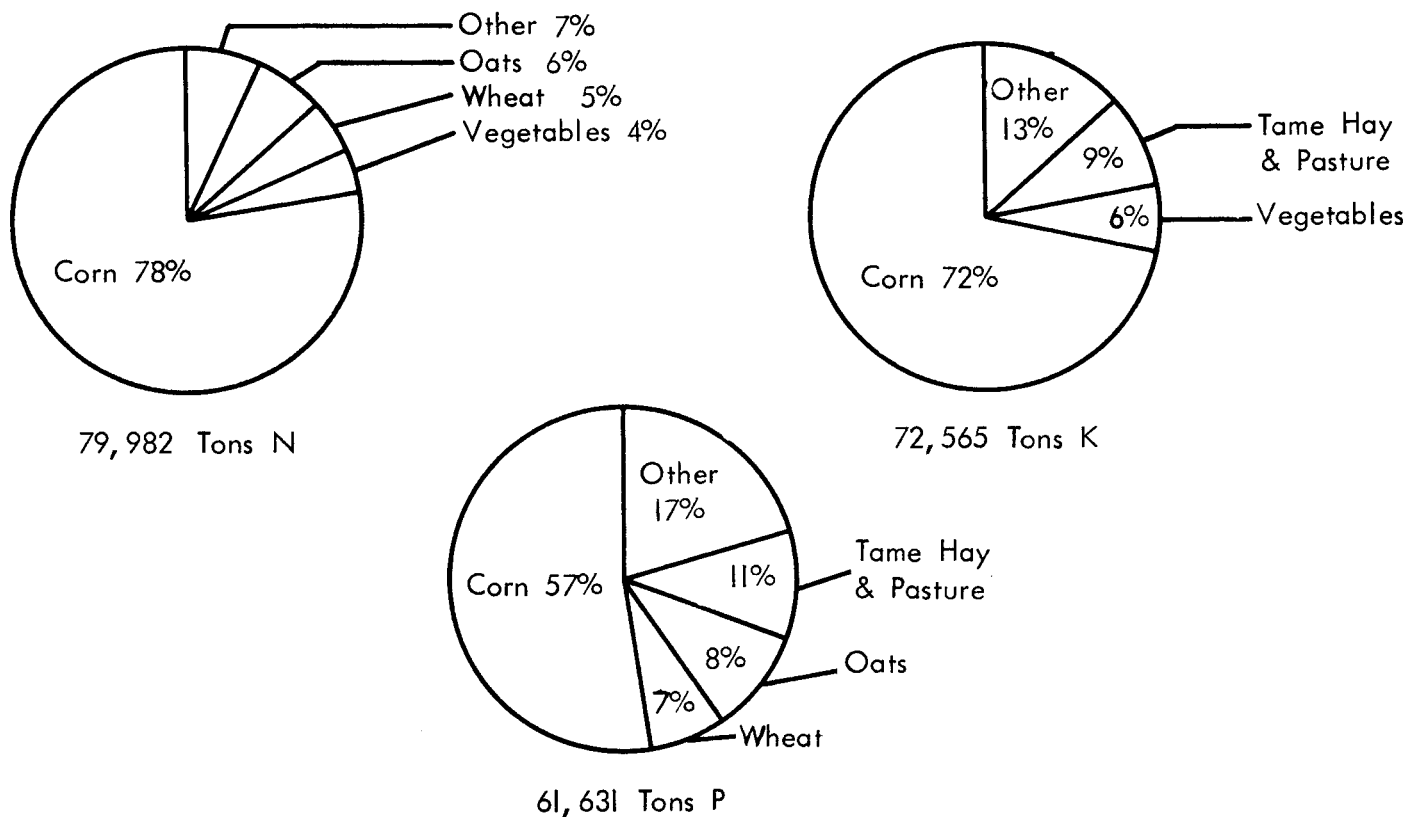
Estimates of 1964 fertilizer use in agricultural subregions illustrate both differences and similarities in fertilizer use among areas of Minnesota (Figures 3 - 9).

Harvested acres fertilized by crops and areas. The acres of crop and pastureland harvested range from 794,780 acres in ASR 54 (Figure 3) to 3,666,977 in ASR 72 (Figure 7). The main reason for differences among regions in acres harvested of all crops is not necessarily the size of the subregion, but rather the intensity and type of agricultural production in the regions.



## STATE OF MINNESOTA

Figure 2. Estimated use of principal plant nutrients for the entire state, 1964

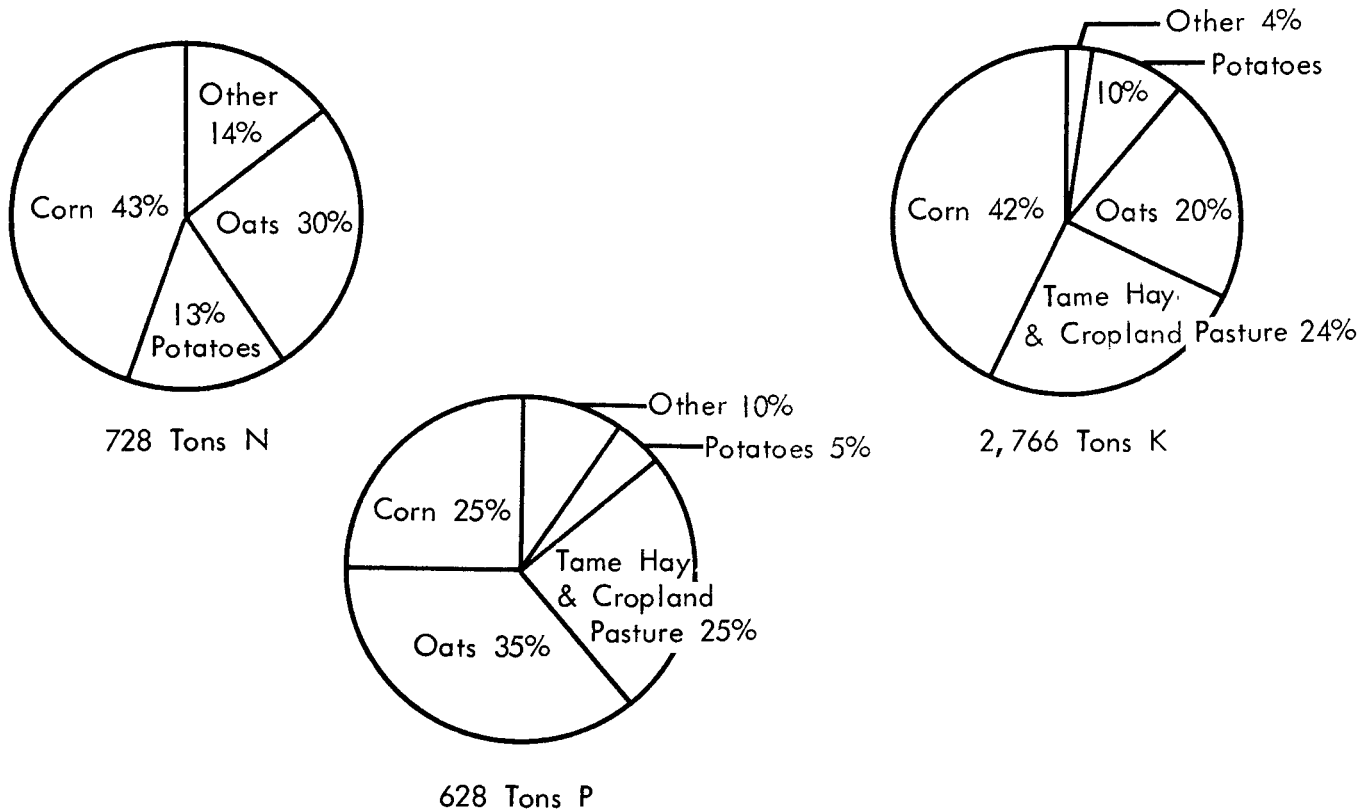


Land use - Specified crops and pasture	Acreage harvested (acres)	Percentage of harvested acres receiving			Rate per acre receiving		
		N (percent)	P	K	N (pounds)	P	K
Corn	5,642,083	73	73	63	30	17	30
Soybeans	2,787,540	2	6	4	2	13	21
Irish potatoes	93,442	27	97	58	35	31	91
Hay and cropland pasture	4,549,438	3	13	9	7	24	33
Wheat	939,410	52	73	36	17	12	8
Oats	3,043,468	32	32	16	10	10	8
Barley	550,289	64	64	31	10	10	7
Sugarbeets	119,946	39	100	28	3	50	13
Rye	83,763	25	25	2	10	10	5
Flax	450,500	39	40	1	10	10	17
All vegetables	145,022	62	62	61	69	49	98
All fruits and nut trees	5,101	17	17	17	10	10	18
Misc. unspecified	412,199	0	0	0	0	0	0
Improved permanent pasture	248,044	14	14	14	19	20	24
Total or average	19,070,252	34	39	28	24	17	27



## SUBREGION 54

Figure 3. Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 54, 1964

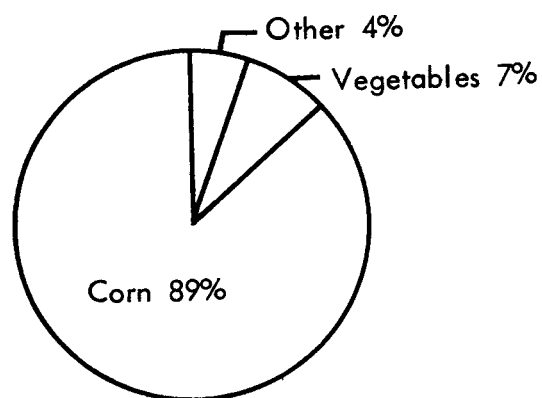


Land use - Specified crops and pasture	Acreage harvested (acres)	Percentage of harvested acres receiving			Rate per acre receiving		
		N	P	K	N	P	K
		(percent)			(pounds)		
Corn	46,334	67	67	67	20	10	74
Soybeans	4,418	2	10	10	2	9	37
Irish potatoes	4,326	89	89	89	50	15	137
Hay and cropland pasture	553,746	1	4	4	10	15	62
Wheat	10,501	55	55	55	10	10	25
Oats	97,008	45	45	45	10	10	25
Barley	3,279	10	10	10	10	10	24
Sugarbeets	- - - -	-	-	-	-	-	-
Rye	2,933	10	10	10	10	10	27
Flax	10,600	20	20	20	10	10	25
All vegetables	511	50	50	50	39	20	102
All fruits and nut trees	134	0	0	0	0	0	0
Misc. unspecified	38,673	0	0	0	0		0
Improved permanent pasture	22,317	9	9	9	36	18	21
Total or average	794,780	12	14	14	16	11	50

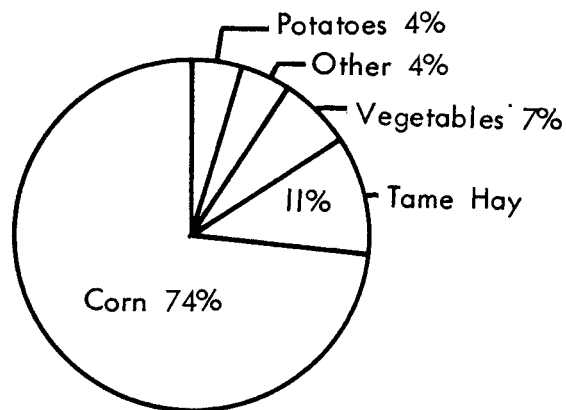


## SUBREGION 56

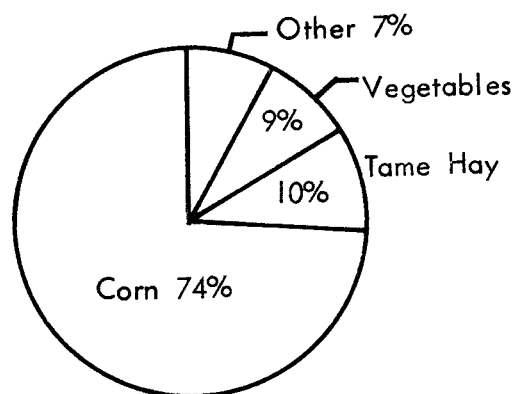
Figure 4. Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 56, 1964



17,658 Tons N



26,521 Tons K



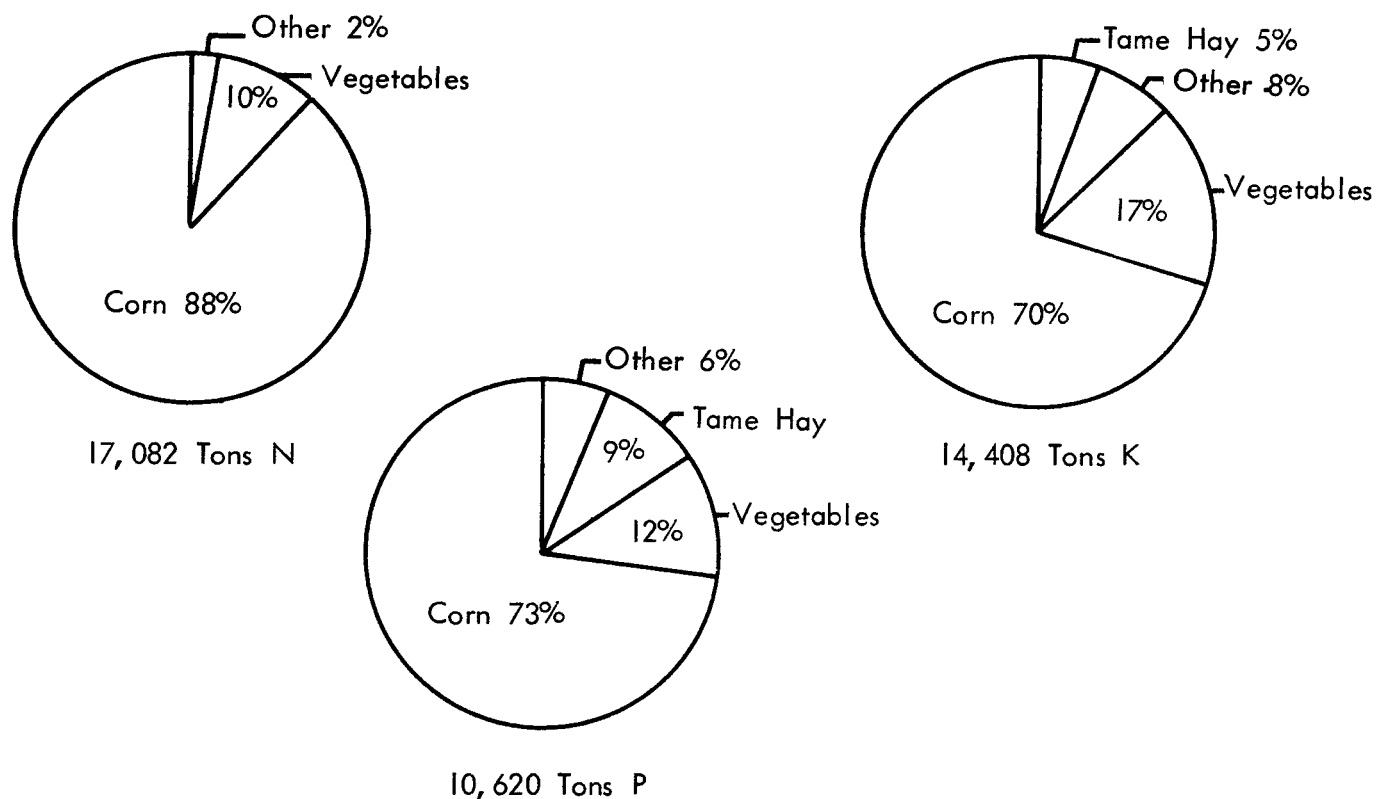
10,161 Tons P

Land use - Specified crops and pasture	Acreage harvested  (acres)	Percentage of harvested acres receiving			Rate per acre receiving		
		N	P	K	N	P	K
		(percent)			(pounds)		
Corn	1,132,259	70	70	70	40	19	50
Soybeans	409,780	4	10	10	2	12	31
Irish potatoes	5,205	89	89	89	70	50	496
Hay and cropland pasture	1,039,205	2	9	9	9	20	62
Wheat	55,134	40	40	40	13	10	12
Oats	538,456	5	5	5	10	10	12
Barley	4,941	5	5	5	10	10	16
Sugarbeets	1,031	50	100	100	3	50	12
Rye	8,764	5	5	3	10	10	9
Flax	1,000	3	5	3	8	8	0
All vegetables	46,280	80	80	80	70	50	99
All fruits and nut trees	2,758	30	30	30	10	10	19
Misc. unspecified	48,338	0	0	0	0	0	0
Improved permanent pasture	57,303	14	14	14	22	22	26
Total or average	3,350,454	28	31	31	38	20	52



SUBREGION 57

Figure 5. Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 57, 1964

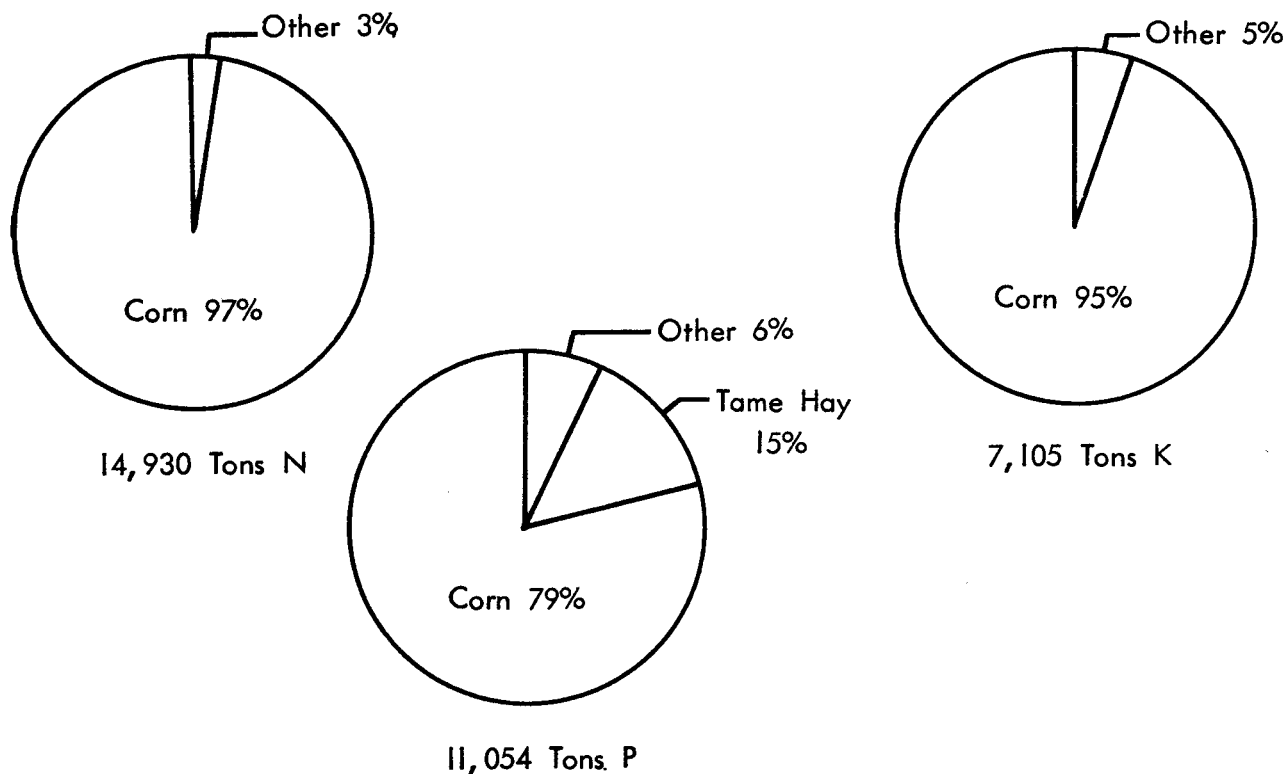


Land use - Specified crops and pasture	Acreage harvested  (Acres)	Percentage of harvested acres receiving			Rate per acre receiving		
		N	P	K	N	P	K
		(Percent)			(Pounds)		
Corn	1,001,752	81	81	81	37	19	25
Soybeans	561,940	1	6	6	2	11	31
Irish potatoes	6,692	97	97	97	35	40	62
Hay and cropland pasture	509,022	2	12	12	5	30	25
Wheat	59,757	15	15	15	13	10	13
Oats	283,146	3	3	3	10	10	12
Barley	2,221	5	5	5	5	9	0
Sugarbeets	8,265	100	100	100	3	50	25
Rye	1,637	5	5	5	10	10	0
Flax	1,100	5	5	5	11	11	0
All vegetables	53,211	95	95	95	70	50	99
All fruits and nut trees	1,136	5	5	5	11	11	0
Misc. unspecified	12,859	0	0	0	0	0	0
Improved permanent pasture	28,145	24	24	24	23	22	26
Total or average	2,530,883	36	40	40	37	21	29

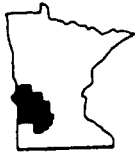


## SUBREGION 71

Figure 6. Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 71, 1964

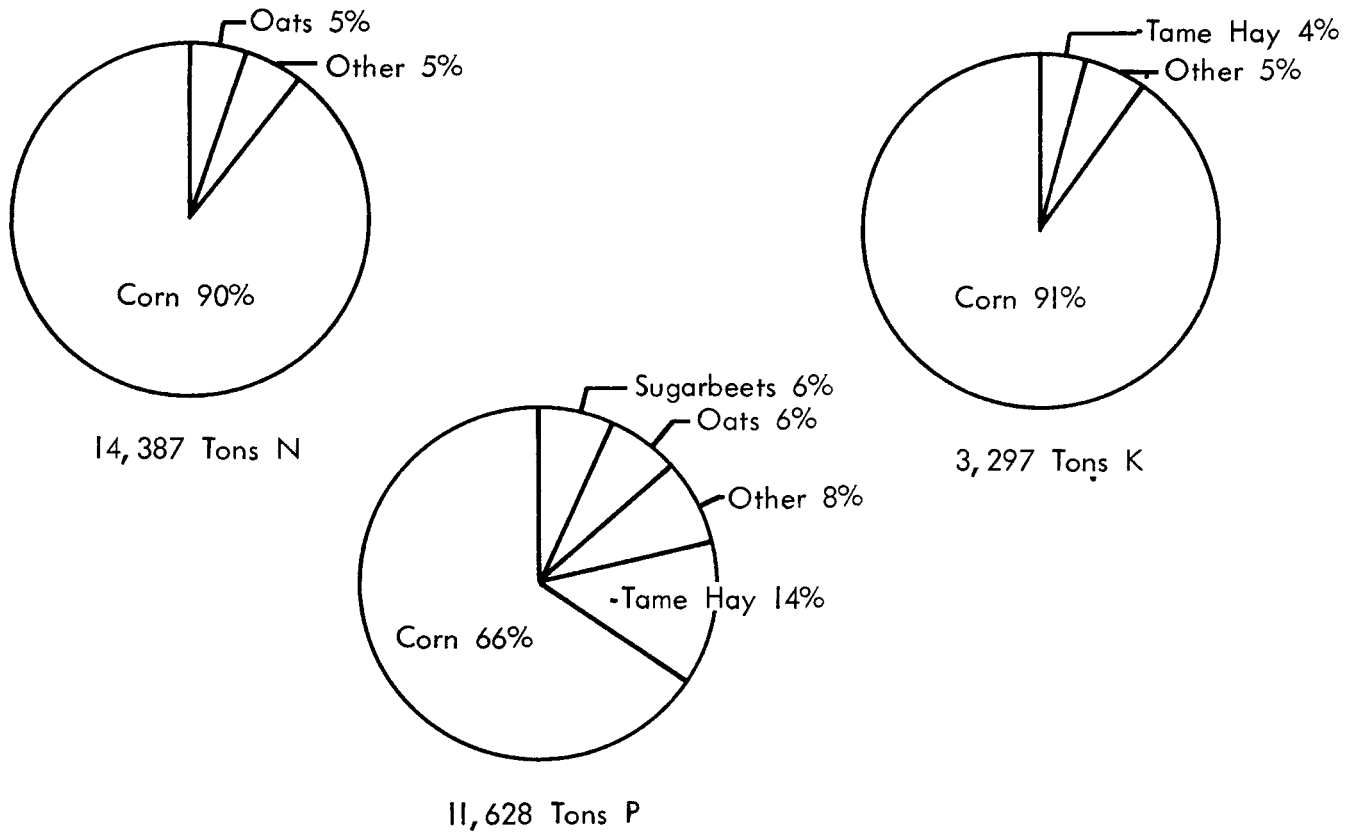


Land use - Specified crops and pasture	Acreage harvested  (Acres)	Percentage of harvested acres receiving			Rate per acre receiving		
		N	P (Percent)	K	N	P (Pounds)	K
Corn	1,466,934	74	74	74	27	16	12
Soybeans	726,220	1	4	2	2	12	12
Irish potatoes	454	55	55	44	35	48	60
Hay and cropland pasture	433,176	5	25	15	5	30	6
Wheat	11,502	40	40	0	10	10	0
Oats	303,852	15	15	0	10	10	0
Barley	1,970	5	5	0	4	10	0
Sugarbeets	6,930	20	100	50	3	50	12
Rye	2,472	3	5	0	10	10	0
Flax	90,400	8	15	0	10	10	0
All vegetables	23,328	0	0	0	0	0	0
All fruits and nut trees	379	0	0	0	0	0	0
Misc. unspecified	20,991	0	0	0	0	0	0
Improved permanent pasture	46,723	12	12	12	15	18	22
Total or average	3,135,331	37	41	37	25	17	12



## SUBREGION 72

Figure 7. Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 72, 1964

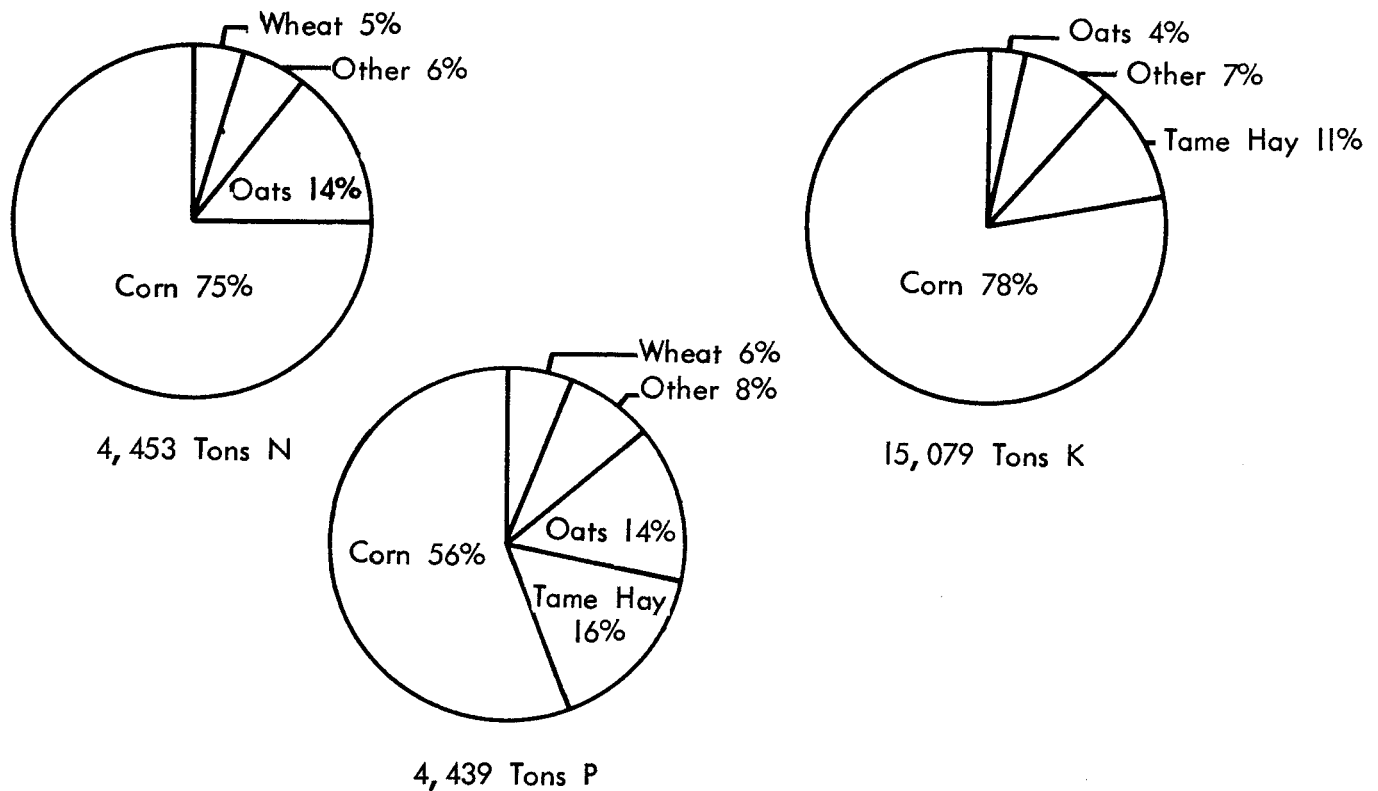


Land use - Specified crops and pasture	Acreage harvested (Acres)	Percentage of harvested acres receiving			Rate per acre receiving		
		N	P	K	N	P	K
		(Percent)			(Pounds)		
Corn	1,344,286	72	72	72	27	16	12
Soybeans	814,677	1	4	2	2	12	12
Irish potatoes	496	81	81	81	30	30	25
Hay and cropland pasture	447,864	5	25	10	5	30	6
Wheat	156,695	40	40	0	10	10	0
Oats	534,218	25	25	0	10	10	0
Barley	62,131	30	30	0	5	10	0
Sugarbeets	26,663	50	100	20	3	50	12
Rye	13,000	5	5	0	10	10	0
Flax	172,900	30	30	0	10	10	0
All vegetables	18,820	2	2	0	40	25	0
All fruits and nut trees	260	0	0	0	0	0	0
Misc. unspecified	49,335	0	0	0	0	0	0
Improved permanent pasture	25,632	17	17	17	17	22	25
Total or average	3,666,977	35	38	15	23	17	12



SUBREGION 73

Figure 8. Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 73, 1964

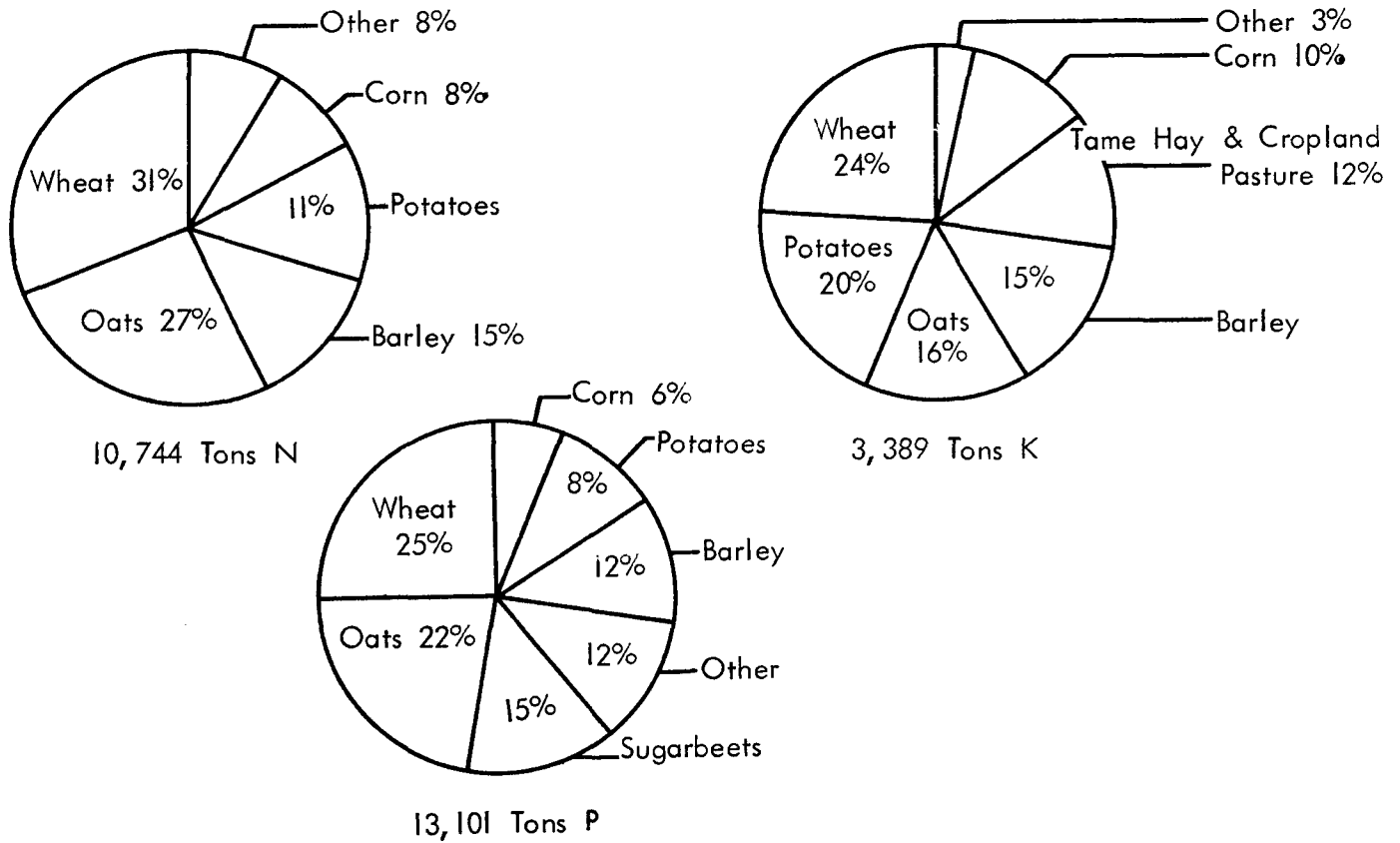


Land use - Specified crops and pasture	Acreage harvested (Acres)	Percentage of harvested acres receiving			Rate per acre receiving		
		N	P	K	N	P	K
		(Percent)			(Pounds)		
Corn	518,945	68	68	61	19	14	74
Soybeans	111,705	3	16	14	2	20	50
Irish potatoes	3,353	76	76	76	50	17	131
Hay and cropland pasture	913,439	2	10	9	9	17	43
Wheat	82,380	55	55	44	10	12	19
Oats	507,559	25	25	20	10	10	12
Barley	43,382	25	25	20	10	10	12
Sugarbeets	25	48	100	48	0	48	0
Rye	31,791	5	5	4	10	10	0
Flax	24,500	5	5	4	10	10	0
All vegetables	1,672	70	70	70	30	10	26
All fruits and nut trees	340	0	0	0	0	0	0
Misc. unspecified	95,391	0	0	0	0	0	0
Improved permanent pasture	49,720	12	12	12	14	18	21
Total or average	2,384,202	24	27	24	16	14	53



SUBREGION 74

Figure 9. Estimated use of principal plant nutrients, Minnesota Agricultural Subregion 74, 1964



Land use - Specified crops and pasture	Acreage harvested (Acres)	Percentage of harvested acres receiving			Rate per acre receiving		
		N	P	K	N	P	K
		(Percent)			(Pounds)		
Corn	131,573	82	82	41	16	14	12
Soybeans	158,800	2	11	2	2	10	6
Irish potatoes	72,923	99	99	49	32	30	38
Hay and cropland pasture	652,986	3	14	7	9	17	19
Wheat	563,441	60	95	48	20	12	6
Oats	779,229	75	75	37	10	10	4
Barley	432,365	75	75	33	10	10	6
Sugarbeets	77,032	30	100	20	3	50	6
Rye	23,166	75	75	0	10	10	0
Flax	150,000	75	75	0	10	10	0
All vegetables	1,200	0	50	0	0	10	0
All fruits and nut trees	94	0	0	0	0	0	0
Misc. unspecified	146,612	0	0	0	0	0	0
Improved permanent pasture	18,204	16	16	16	15	17	20
Total or average	3,207,625	50	60	27	13	14	5

For example, ASR 54 is the largest subregion in area, but has the smallest harvested acreage due to the heavy forest and lake areas and severe weather conditions that limit farming in the northeastern portions of Minnesota.

Corn is the major crop in the southern one-third of the state, reflecting the relatively high intensity cash grain farming in this area (ASR 56, 57, 71, and 72). Hay and cropland pasture are important throughout the state, but are relatively more important in the northern two-thirds of the state (ASR 54, 73, and 74). In addition to corn and hay and cropland pasture, soybeans and oats are the major crops of the intensive farming areas of southern Minnesota. Wheat, barley, rye, and flax are important crops in some of the areas less suited to intensive corn and soybean row cropping (ASR 72, 73, and 74).

The above differences in crops among regions are important in explaining the differences in fertilizer use and differences in percentages of harvested acres receiving applications of N, P, and K among areas. For example, in ASR 54, only 12 percent of the harvested acreage received applications of N, 14 percent received applications of P, and 14 percent received applications of K. In ASR 57, however, 36 percent of the harvested acreage received some N, 40 percent received some P, and 40 percent received some K. The major reason for these differences in percentage of harvested acres receiving applications of plant nutrients lies in the fact that corn, a highly fertilized crop, is a large component of total harvested acres in ASR 57. On the other hand, hay and cropland pasture, a low fertilized crop, is a large component of total harvested acres in ASR 54.

The proportion of harvested cropland receiving N was usually lower in eastern Minnesota (ASR 54, 56, and 73) than in the far south and western parts of the state (ASR 57, 71, 72, and 73). The same was true for the proportion of harvested cropland receiving P. A smaller proportion of harvested cropland received K in the northern two-thirds of the state (ASR 54, 72, 73, and 74) than in the southern one-third of the state (ASR 56, 57, and 71).

In general, the percentage of harvested acres receiving applications of plant nutrients tended to be similar for the same crops among different regions. For example, the percentage of harvested corn and Irish potato acreage receiving each of the nutrients was relatively high in all regions; whereas the percentages were relatively low in all regions for soybeans and hay and cropland pasture.

Application rates by crops and areas. The average number of pounds of N applied per acre of all crops receiving N varied from 13 pounds in subregion 74 to 38 pounds in subregion 56. The application rates were higher in the southern one-third of the state (ASR 56, 57, and 71) than in the northern two-thirds of the state (ASR 54, 72, 73, and 74).

Average pounds of P applied per acre receiving P varied from 11 pounds in subregion 54 to 21 pounds in subregion 57. Like N, the application rate for P was higher in southern than in northern Minnesota.

Average pounds of K applied per acre receiving K had greater variation than for either N or P, ranging from 5 pounds in subregion 74 to 52 pounds in subregion 56. Application rates of K were generally higher in eastern than in western Minnesota because soils are relatively high in K in western Minnesota.

Area to area differences in average applications rates for the three principal plant nutrients reflect the differences in primary crops harvested and percent of these harvested acres fertilized, as well as differences in application rates for the same crop in different areas. For many crops, however, application rates are similar among subregions. For example, soybeans, wheat, oats, barley, rye, flax, and sugarbeets all show little variability in average per acre plant nutrient applications among agricultural subregions. For each of these crops, the application rates for K varied slightly more among regions than did application rates for N and P.

Somewhat greater variability in application rates among agricultural subregions is evident for the remaining crops. Corn, for example, had higher application rates for N and P in the southern one-third of the state where corn is the major crop (ASR 56, 57, 71, and 72) than in the northern two-thirds of the state where corn is of lesser importance (ASR 54, 73, and 74). Application rates for K on corn varied more than rates for N and P, with lower rates in the western part of the state (ASR 71, 72, and 74) and higher rates in the eastern part of the state (ASR 54, 56, and 73).

For improved permanent pasture, application rates for P and K are similar throughout the state. Average pounds of N applied, however, varies more among subregions than rates for P and K, with the higher rates in the northeast and southeast (ASR 54, 56, and 57).

Application rates of all three nutrients vary among subregions for hay and cropland pasture. Highest N and K rates were estimated for the

northern and southeastern high hay and pasture acreage areas (ASR 54, 56, and 73). Lowest N and K rates were estimated for the southwest (ASR 71 and 72). This same southwestern area had the highest estimated rates of P application, however.

Allocation of plant nutrients by crops and areas. The distribution of plant nutrient tonnage among subregions is affected by the total harvested acreage of all crops, the proportion of harvested acreage fertilized, and the nutrient application rates per acre for crops in the subregion. Subregions in the southern one-third of Minnesota (ASR 56, 57, 71, and 72), consumed the largest quantities of N. The same area plus the northwestern subregion (ASR 74) consumed the largest quantities of P. The central and southeastern part of the state consumed the largest quantities of K (ASR 56, 57, and 73). The extreme northeastern region (ASR 54) consumed fewer tons of all three nutrients than any other subregion.

Except in the extreme northern subregions (ASR 54 and 74), at least 75 percent of the N used was applied to corn. In the southwestern regions (ASR 71 and 72), 97 and 90 percent of the nitrogen was used on corn, respectively. In southeastern Minnesota (ASR 56 and 57), corn received 89 and 88 percent of the nitrogen used, respectively.

In the Red River Valley (ASR 74), 31, 27, and 15 percent of the nitrogen was used on wheat, oats, and barley, respectively.

In most subregions, a smaller proportion of P was allocated to corn than N. Except in the three subregions 56, 57, and 71, at least 73 percent of the P was used on corn. In the southwestern regions (ASR 71, 72), 79 and 76 percent of the P was used on corn. Only 6 percent of total P used was applied to corn in the Red River Valley (ASR 74).

Most of the P was used on wheat, oats, sugar beets, and barley.

Over 90 percent of the total K used in the southwestern subregions (ASR 71 and 72) was applied to corn, while about 70 percent was applied to corn in central and southeastern Minnesota (ASR 73, 56, and 57). Like N and P, a relatively small proportion of K was applied to corn in the northern subregions (ASR 74 and 54). Most of the K used in the Red River Valley was applied to wheat, potatoes, oats, and barley.

The higher percentages of nutrient tonnage devoted to corn in the southern subregions of the State reflect the greater corn acreage and higher application rates evident in that area.

#### Summary and Conclusions

Detailed estimates of 1964 farm fertilizer use in Minnesota have been presented in this report to aid the Minnesota fertilizer industry in analyzing and planning fertilizer production and distribution. Estimates were provided by crops and agricultural subregions for (1) acreage harvested, (2) percentage of harvested acreage receiving applications of principal plant nutrients, and (3) rates of principal plant nutrients applied per acre receiving applications of the nutrients. In addition, estimates were given for the tonnages of principal plant nutrients consumed in the state and its subregions and the percent of these tonnages applied to principal crops.

Some general conclusions about Minnesota farm fertilizer use can be drawn from examining the estimates. (1) The percentages of harvested acres receiving applications of principal plant nutrients tend to be high for crops with high per acre value (such as corn, sugar beets, Irish potatoes,

and vegetables) and for areas of the state with a high proportion of these high value crops (such as the subregions of the southern one-third of the state). (2) Per acre application rates for all nutrients tend to be higher also for the same crops and areas that have high percentages of harvested acreage fertilized. (3) Corn is the dominant fertilizer using crop in Minnesota and in all subregions except those in the ' extreme north and northwestern area of the state. (4) Finally, the tremendous increase in total fertilizer use since 1964 is not surprising in light of the relatively large proportion of total cropland not receiving fertilizer in 1964 and the relatively low application rates per acre receiving fertilizer throughout the state in 1964.

This report has not attempted to project future farm fertilizer use in Minnesota nor to suggest the benefits to farmers from increased fertilizer applications. It is expected, however, that the estimates presented in this report will serve as a basis for studying and projecting trends in Minnesota fertilizer use, particularly when similar estimates are available for 1969. In combination with generalized fertilizer production functions, the estimates may also be used in the future to indicate the yield response to increased fertilizer by crops and in various subregions of Minnesota.