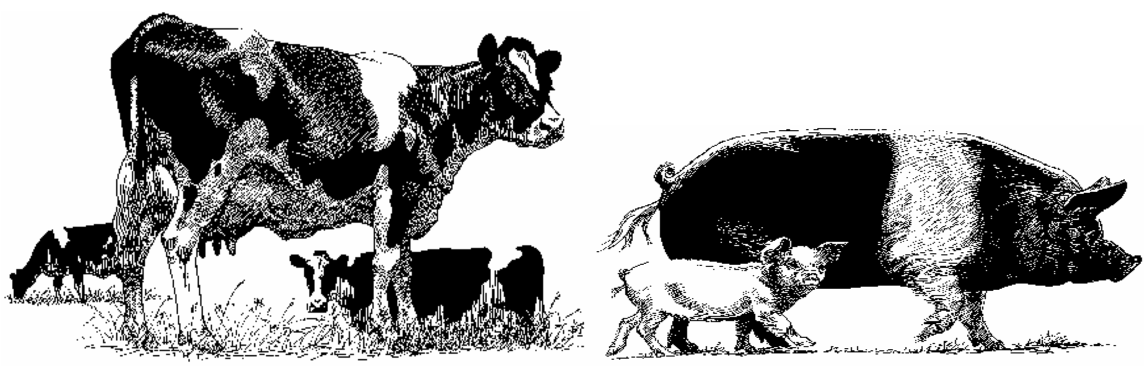
Survey of 23 Farms in West Central Minnesota



General Information

County educators (MN Extension Service) from Douglas, Grant, Stevens, and Swift counties were contacted and individually interviewed in the fall of 1994. Purpose of the interviews was to: inform them of the specifics of the project and overall goals; obtain pertinent county information (i.e. dominant farm types); and potential candidates (farmers) and their agronomic management skills as perceived by the County Educator. County Educators also served as an important link between the farmers and MDA researchers. Educators commonly made personal telephone contacts to the potential participants after the introduction letter was mailed (Appendix E-1). Approximately eight farmers were contacted in each of the four counties. Producers were selected on perceived management skills and farm types. Introduction letters, signed by the Commissioner of Agriculture, were mailed out in September, 1994. The letter's intent was to identify to the farmers: the overall LCMR project and purpose; the specific purpose of the nutrient management assessment; why they were specifically selected; and what types of information and amount of their time would be necessary to successfully complete the project.

Nutrient Management Data Collection

Inventory forms and database design were patterned after a previous successful project[1] . A copy of the inventory form is included in Appendix E-1. Timing, rates, method of applications were collected for all nitrogen (N) and phosphate (P_2O_5) inputs (fertilizers, manures, and legumes) on **a field-by-field basis for all acres owned or rented**. Soil and manure testing results were also collected if available. Specific field information focused on the 1994 cropping season. Crop types and manure applications[2] were also collected from the 1993 season for purposes of 1994 nitrogen crediting. Long term yield data generally reflected the past 3 to 5 years. Livestock census and other specifics for the entire farm (i.e. types of manure storage systems, total farm sizes) were also recorded.

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[1]Effective Nitrogen and Water Management for Water Quality Sensitive Regions of Minnesota, LCMR 1991-93

[2] Manure applications starting with fall, 1993.

Farm Size and Crop Characteristics of the Selected Farms

Twenty three farms (Douglas-7, Grant-4, Stevens-3, Swift-6, and 3 Misc. farms connected with MDA Sustainable Agriculture demonstrations[3]) went through the inventory process. Fourteen (14) farms were dominantly dairy, eight (8) pork, and one (1) turkey (Table E.1.1). Total 1994 area covered was 13,649 acres of which 11,525 was cropland[4]. Average farm size was 593 acres ranging from 369 (Douglas) to 1,056 (Stevens) acres. Approximately 85% (501 acres) of the total acreage was classified as cropland.

Table E.1.1. General description of all farms participating in the nutrient management survey, 1994

		Total Acreage Inventoried			Average Acreage by Farm			
County	Farm	Total(1)	Crop(2)	Non-Crop	Total(1)	Crop(2)	Non-Crop	Average Herd Size (Cows)
		.... Number of Acres						
Douglas	7	2584	1691	893	369	241	128	58.6
Grant	4	1830	1547	283	458	387	71	60.0
Stevens	3	3168	2684	484	1056	895	161	0.0
Swift	6	2738	2336	402	456	389	67	61.5
Other(3)	3	3329	3269	60	1110	1090	20	67.0
Mean		**2730**	**2305**	**425**	**593**	**501**	**92**	**61.8**
Total	**23**	**13,650**	**11,525**	**2125**				
Percent Total		**100**	**84.4**	**15.6**				

(1) Includes owned, rented and rented out acres; (2) Includes pasture and set-aside acres; and (3) Includes farms in Montevideo, Sauk Centre and Fergus Falls.

Corn (43%), soybeans (31%), small grains (13%) and alfalfa (11%) accounted for over 99% of the cropland acres (Figure E.1.1 and Table E.1.2). In contrast, the cropland distribution across all farms in the four county area[5] was comprised of corn (32%), soybeans (36%), small grains (24%), hay (7%), and miscellaneous crops (7%) (Figure E.1.2). The selected farms were skewed towards higher corn and alfalfa acres and less

[3] Includes farms in Montevideo, Sauk Centre, and Fergus Falls. These farms were involved in demonstrations within different objectives of this LCMR project.

[4] Defined here as including row crops, forages, grains, fertilized pasture, set-aside and CRP acreage

[5] MN Agricultural Statistics 1994. National Agricultural Statistics Service, St. Paul, MN.

small grains than the overall four county distribution. County-specific data are presented in Table E.1.2.

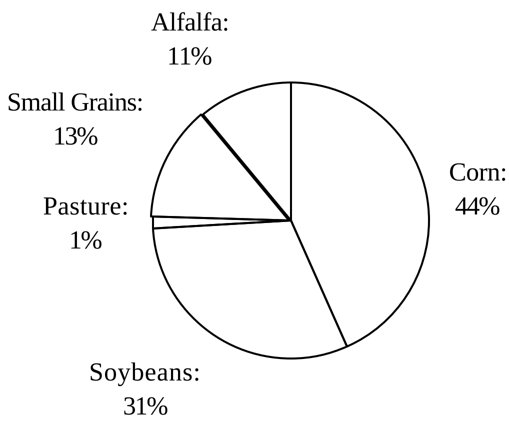

Figure E.1.1. Crop type distribution across all cropland acres of the 23 farms.

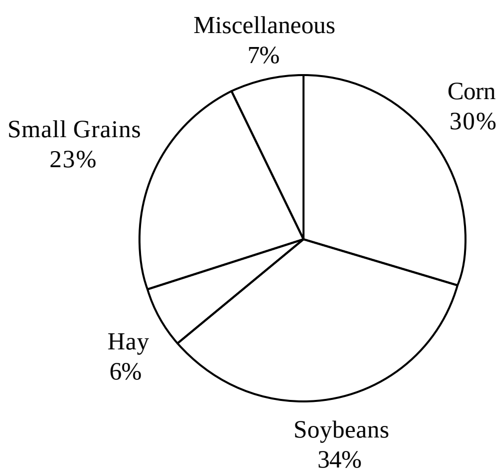

Figure E.1.2. Crop type distribution across all cropland acres in Douglas, Grant, Stevens and Swift Counties. Acreage based on 1993 statistics (MN Agricultural Statistics, 1994).

Table E.1.2. Average Distribution of Cropland Acres Per Farm By County - 1994								
County	**Corn**	**Soybeans**	**Alfalfa**	**Small Grains**	**Edible Beans**	**Other**	**Pasture**	**TOTAL**
	In Acres							
Douglas	116	16	72	35	0	0	2	241
Grant	122	95	37	114	9	10	0	387
Stevens	365	416	0	101	0	13	0	895
Swift	139	106	80	42	0	2	20	389
Other	564	386	49	91	0	0	0	1090
Mean	**261**	**204**	**48**	**77**	**2**	**5**	**4**	
Total	**4924**	**3533**	**1273**	**1527**	**37**	**95**	**138**	
Total By Percent	**42.7**	**30.6**	**11.0**	**13.2**	**0.3**	**0.8**	**1.2**	

Commercial Fertilizer Use Characteristics on Selected Farms

Corn (84%) and small grains (14%) accounted for 98% of the total N commercial fertilizer use (Figure E.1.3). Mean N use was approximately 27,000 lb/farm. Average fertilizer N rate on corn acres was 116 lb/A (Figure E.1.4); this rate is calculated as the means across all commercially fertilized corn acres regardless of past manure or legume N credits. Total N inputs will be discussed later in the "Nitrogen Balances and Economic Considerations" section. Soybeans and alfalfa received 12 and 13 lb/A, respectively, however the total acreage of either of these crops receiving commercial N is very limited (Table E.1.3).

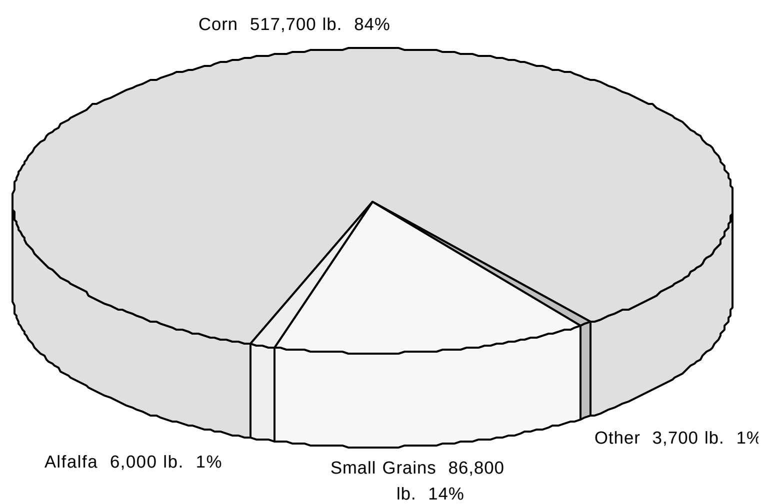

Figure E.1.3. Distribution of commercial nitrogen fertilizer by crop type. Total nitrogen supplied by fertilizer was 614,000 pounds across all 23 farms.

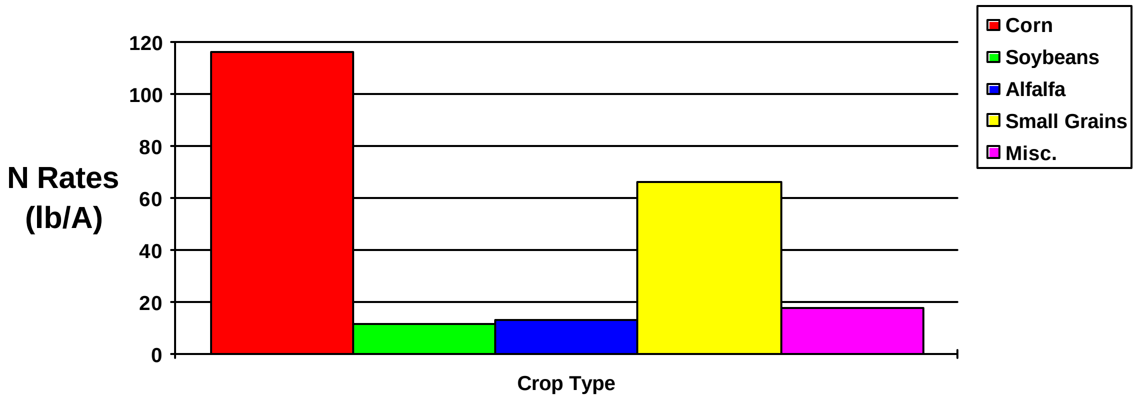

Figure E.1.4. Average N fertilizer rates across fertilized acres by crop type.

Table E.1.3. Distribution of Fertilizer Nitrogen and Phosphate On Cropland - 1994

Crop	Acres Receiving N Fertilizer	Total N Applied (LBS X 1000)	Acres Receiving Phosphate Fertilizers	Total Applied Phosphate (LBS X 1000)
Corn	4447	517.7	4063	91.5
Soybeans	57	0.7	387	56.0
Alfalfa	456	6.0	604	41.4
Small Grains	1305	86.8	1165	22.9
Other	165	3.0	248	9.4
TOTALS	**6430**	**614**	**6467**	**221**

Ninety (90%) and 83% of the corn acres received N and P_2O_5 fertilizer applications. Forty two (42) percent of the P_2O_5 tonnage was applied to the 1994 corn acres at an average P_2O_5 rate of 23 lb/A. Rates to other crops were considerably higher. One possible explanation is that producers may be building up fertility levels prior to bringing corn back into the rotation. Also it is a common practice to apply P_2O_5 and potassium fertilizers at sufficient inputs in a single application to maintain optimum production for 3-4 years.

Timing of N fertilizer applications is an important consideration in maximizing fertilizer use efficiency and minimizing environmental effects. Fall application of N is considered a BMP[6] in West-Central and Southwestern Minnesota if the proper source (anhydrous ammonia or urea) are selected and proper soil temperatures are reached. Fall applications should be delayed until the soil temperature is below 50 F at the 6-inch depth. Long-term climatic data from the West Central Experiment Station (Morris) indicate that soil temperatures will generally remain below 50 F after October 15. The average fall fertilization date from the selected farms was October 15± 2 days. The total time range for all fall N applications was October 14 through 21. Producers seem to be very consistent with the recommended practice.

Seventy-six (76%) of all N fertilizer to corn was either applied in the fall (45%), spring preplant (26%) or starter (5%) (Table E.1.4). Early sidedress[7] (2%) and late sidedress[8] (22%) made up the balance of the applications. Distribution of remaining N to non-corn acres focused on spring application (77%). As previously mentioned, a high percentage of "non-corn" N was applied to small grains.

Table E.1.4. Timing of N Fertilizer Applications On Corn and Non-Corn Acres - 1994

	Corn				Non-Corn			
Timing of Fertilizer N Applications	**Total Acre**	**Total N (LBS X 1000)**	**% Total**		**Total Acre**	**Total N (LBS X 1000)**	**% Total**	
Fall	1116	236	45.3		343	14.0	15.0	
Spring Preplant	1054	135	25.9		991	71.3	76.5	
Starter	1512	26	5.0		398	5.5	5.9	
Early SD	178	10	1.9		21	0.5	0.5	
Late SD	587	114	21.9		230	1.9	2.0	
TOTALS	**4447**	**521**	**100**		**1983**	**93**	**100**	

Nitrogen sources were dominated by anhydrous (59%), granulars (34%) which represented a large array of various formulas which were dominantly ammonium based, UAN[9] (5%) and urea (2%) (Figure E.1.7). UAN should not be fall-applied and is also not an ideal source for spring preplant applications. Timing of UAN has

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[6]Best Management Practices for Nitrogen Use in Southwestern and West-Central MN. 1993. G.W. Randall and M.A. Schmitt. AG-FO-6128-C.

[7]Defined as N applications while the corn height was between 2 to 8" tall.

[8]Defined as N applications on corn after height development of 8".

[9]Urea Ammonium Nitrate (28% N by weight)

not yet been examined in this data set. However the total tonnage is low and the overall impacts from improper timing would probably be minimal.

The soil nitrate test is a recommended BMP[10] in West-Central and Southwestern Minnesota on medium-to-fine soil textures. Samples should be collected in either early spring (preferred time) or in the fall after soil temperatures drop below 50 F at the 6-inch depth. This test was used for only 16% of the corn acres (Figure E.1.6). Considerably more cropland acres were soil sampled for phosphorus and potassium (data not available at this time).

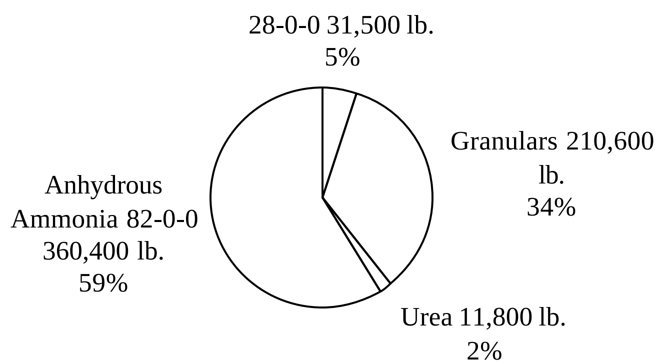

Figure E.1.5. Contributions of N from various fertilizer sources on selected farms.

[10]Best Management Practices for Nitrogen Use in Southwestern and West-Central MN. 1993. G.W. Randall and M.A. Schmitt. AG-FO-6128-C.

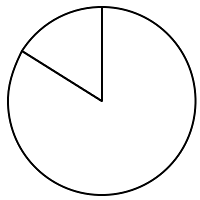

Figure E.1.6. Percentage of corn acreage which used the soil nitrate test.

Livestock and Manure Characteristics of the Selected Farms

Factors directly affecting nutrient availability from land-applied manure (including manure storage, types, manure amounts being generated, application methods, incorporation factors and rates) were also quantified to complete the "whole farm" nutrient balance. Over 2,400 dairy animals (cows, calves, heifers, and steers) and a significant number of hogs were inventoried. A complete animal inventory, including nitrogen and phosphate produced and collected, are summarized in Table E.1.5[11].

Table E.1.5. Total Livestock Numbers: Manure Nitrogen and P_2O_5 Produced and Collected By Livestock Type In Sample Population - 1994

Livestock Type	Livestock Number	Manure Nitrogen Produced	Manure Nitrogen Collected	Manure P_2O_5 Produced	P_2O_5 Collected
		Pounds X 1000		Pounds X 1000	
Dairy Cows	908	177.1	160.9	71.7	65.2
Calves & Heifers	1076	98.6	74.2	39.5	29.6
Dairy Steers	119	17.8	15.6	7.3	6.3
Boars	19	0.5	0.5	0.4	0.4
Sows & Litters	300	9.6	9.6	7.5	7.5
Feeders (20 - 50 pounds)	7885	0.9	0.9	0.7	0.7
Finishers (50 -240 pounds)	6955	31.5	31.5	23.9	23.9
Bulls	3	0.5	0.1	0.3	0.1
Beef Cows & Calves *	111	17.0	4.9	12.9	3.7
Beef Feeders	150	12.4	5.7	9.0	4.1
Sheep Ewes	80	1.3	0.8	0.4	0.3
Feeder Lambs	130	1.0	0.7	0.4	0.2
TOTAL	**17,736**	**368**	**305**	**174**	**142**

* Includes 106 calves

Estimated amounts of N and P_2O_5 produced from all livestock were 368,000 and 174, 000 pounds, respectively. Dairy and beef (cows, steers, calves and heifers) generated approximately 80% of the associated N and P_2O_5 produced from manure.

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Figure E.1.7. Amounts of nitrogen (total) generated by animal types across all selected farms. Total N produced was 368,000 pounds.

[11] Overall feeder and finisher inventory numbers reflect some "double counting" due to growth stage advancements.

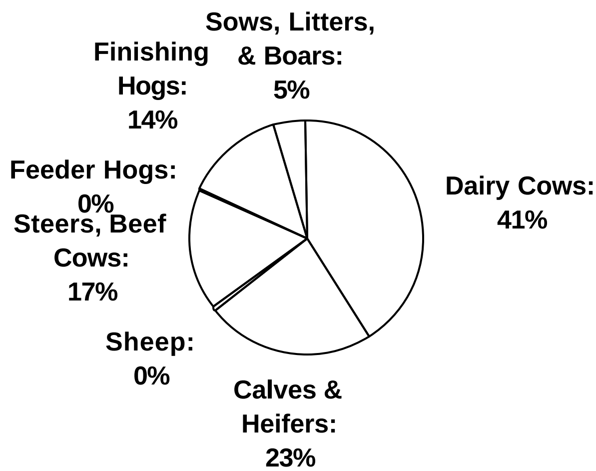

Figure E.1.8. Amounts of P_2O_5 generated by animal types across all selected farms. Total P_2O_5 produced was 174,000 pounds.

Types of storage systems available for producers is an important consideration in efficiently retaining nutrients and allowing enough storage to field-apply the manure in an environmentally safe manner.Table E.1.6 contains information on amounts of N and P_2O_5 collected and lost due to the various storage system. Figure E.1.9 illustrates the relative importance, ranked by the amount of total N retained after storage, of the various collection systems. For purposes of this report, the following definitions were used: *Daily Scrape and Haul*-No storage available, manure is hauled generally on a daily basis. Common in dairy operations with stanchion or tie-stall barn designs; *Paved and Unpaved Pads*-Areas where solid manure is stacked on either the ground or cement pads to allow storage through the winter months until fields are accessible for spreading; *Paved and Unpaved Lots*-Cement or gravel covered areas that confine cattle. Manure (solid) is often hauled once or twice a year although some are cleaned monthly: *Animal Barns*- Buildings used to house livestock. The floors can either be cement, such as in a normal frame barn, or commonly a dirt floor often found in pole barns. Manure (solid) is often hauled in spring and fall, although the barns housing young calves are usually hauled more frequently; *Earthen Pits*- A majority of these pits are designed to meet Minnesota Pollution Control Agency and Natural Resource Conservation Service standards. Bottoms are frequently lined with compacted clay or other near-impervious material. Pits are usually emptied once or twice a year and are not covered; and *Slurry Store*-Above ground steel tanks which are generally emptied once or twice per year. Tanks are generally not covered.

Table E.1.6. Manure Nitrogen and Phosphate Collected And Storage Losses by All Livestock On All Farms - 1994						
	Nitrogen Pounds X 1000			Phosphate Pounds X 1000		
Livestock Type	**Collected**	**Lost**	**Retained**	**Collected**	**Lost**	**Retained**
Daily Scrape/Haul	68.5	17.2	51.3	27.7	0	27.7
Unpaved Lot	16.1	8.1	8	6.6	1.96	4.64
Paved Lot	15.1	7.6	7.5	8.1	2.4	5.7
Animal Barn	52.1	15.6	36.5	22.1	0	22.1
Paved Pad	2.9	0.6	2.3	1.2	0	1.2
Slurry Store	17.9	3.9	14	9	0	9
Unpaved Pad	4.1	1.2	2.9	1.6	0	1.6
Earthen Pit	125.2	37.6	87.6	63.2	0	63.2
SUBTOTAL	**301.9**	**91.8**	**210.1**	**139.5**	**4.4**	**135.1**

Most of the dominant storage systems (earthen pits, slurry store, and barn storage) on these selected farms allowed produces some flexibility in the timing of manure application. Daily scrape and haul systems accounted for 24% of the total N retained (Figure E.1.9) and poses the one of the largest environmental potential threats due to winter application.

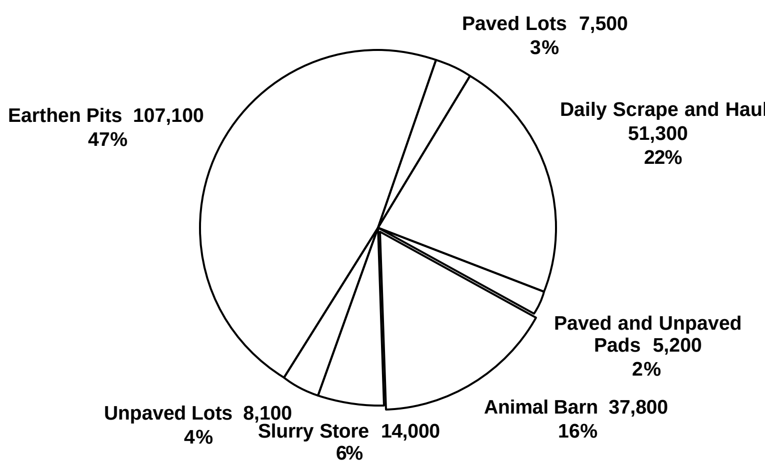

Figure E.1.9. Contributions of total **nitrogen retained after storage** by manure collection systems.

Nutrient losses from collection and storage were estimated from accepted guidelines[12] for each individual storage system. Losses as a function of application methods and timing factors were calculated on a field-by-field basis (Table E.1.7). Participants were offered manure testing services as part of the program. Only four producers requested to have the manure tested even at no cost to them. None of the farms had manure testing data from samplings prior to the study.

Approximately 65,000 pounds of N was brought onto the farms from other sources[13]. The overall fate of manure-N, from excretion to "first year plant available", is summarized in Figure E.1.10. Accounting for all the various losses mechanisms by the time the manure-N is plant available, there were 146,000 pounds of N produced in 1994 across all farms.

Table E.1.7. Distribution of Applied Manure to Cropland, Application and Timing Loses, and Manure Nitrogen Plant Available - 1994*

	Manure Nitrogen Applied Pounds X 1,000			Nitrogen Losses Pounds X 1,000			
Crop	**Total N**	**NH_4^+ (Inorganic)**	**Organic N**	**Mineralized Organic N 1st Yr. Avail**	**Application Losses**	**Timing Losses**	**Manure-N First Yr. Available**
	Pounds Manure Nitrogen X 1000						
Corn	201.2	107.1	94.2	28.8	24.2	8.5	103.2
Soybeans	26.7	14.6	12.1	3.9	2.4	1.0	15.1
Alfalfa	8.5	4.3	4.2	1.3	1.5	0.3	3.8
Small Grains	22.5	11.3	11.2	3.3	2.9	0.8	11.0
Other	16.2	10.2	6.0	2.4	1.8	0.8	8.6
TOTAL	**275**	**148**	**128**	**39.7**	**32.8**	**11.4**	**142**

* Includes imported manure.

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[12]Livestock Waste Facilities Handbook, Midwest Plan Services, Iowa State University, Ames, Iowa. 1985.

[13]Therein referred to as "imported manure".

Fate and Amounts of Manure N Across the 23 Farms

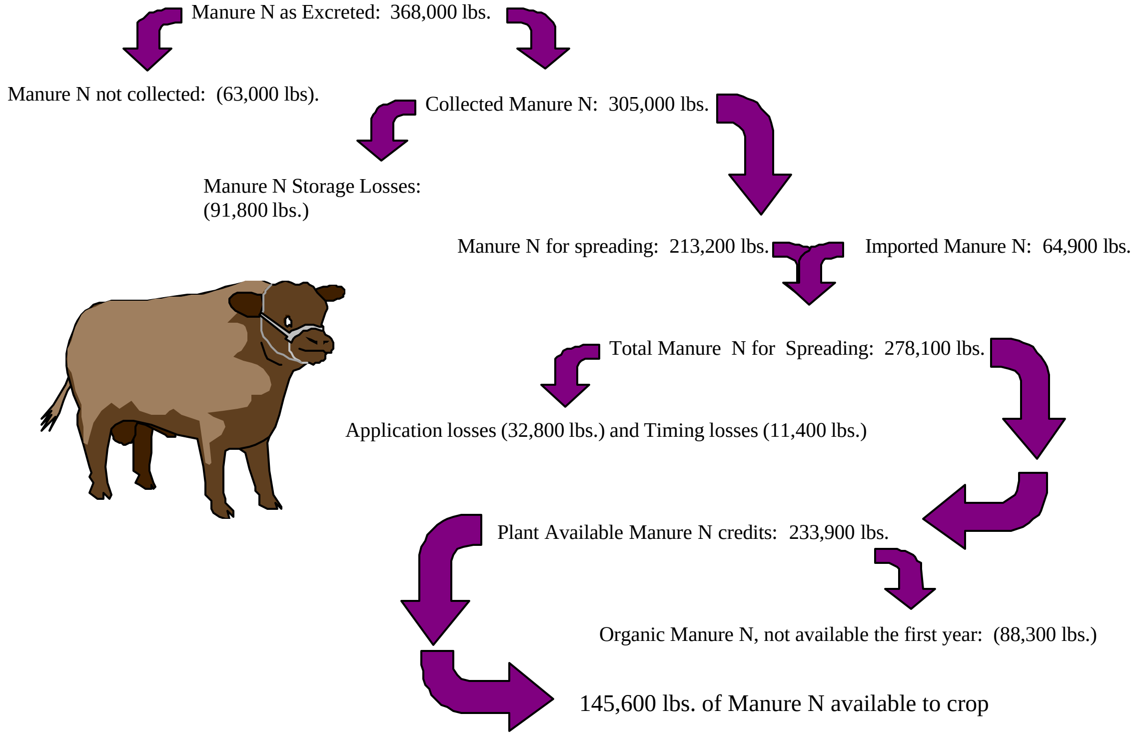

Figure E.1.10. Fate of manure-N across all storage and management factors.

In this study of West Central Minnesota farmers, a high percentage (72%) of the "first year available" N was applied to fields planted to corn in 1994 (Figure E.1.11 and Table E.1.7).

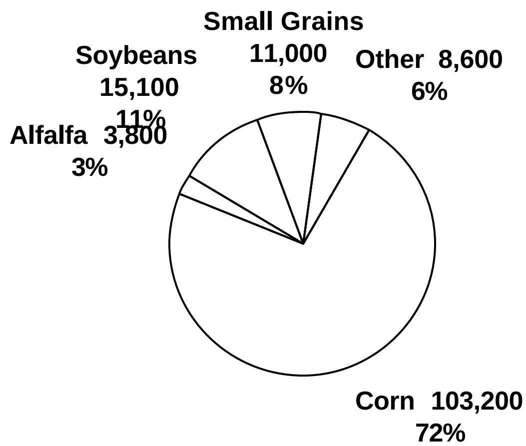

Figure E.1.11. Distribution of "first year available" nitrogen by crop type calculated on a tonnage basis.

Relative Importance of N and P Sources on the Selected Farms

Commercial fertilizer (73%), manure (17%), and legume[14] (10%) contributed a total of 835,400 pounds of "first year available" N across all acreage. Commercial fertilizer (62%) and manure (38%) contributed a total of 356,100 pounds of phosphate.

Commercial fertilizer (74%), manure (15%), and legume (11%) contributed a total of 703,581 pounds of first year available N to **corn acres**. This is an average N rate of 143 lb/A across all corn acres.

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[14]Approximated value; total legume credits have been calculated however the value across all crops has not yet been determined.

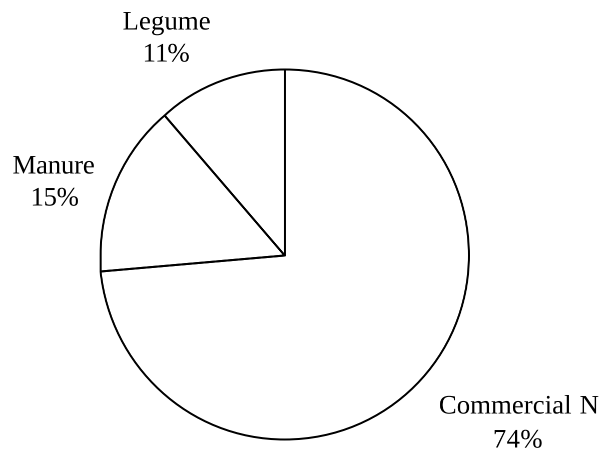

Figure E.1.12. Relative contributions from fertilizers, manures and legumes on first year available N across all corn acres. Total N inputs is 703,500 pounds.

Nitrogen Balances and Economic Considerations

The corn yield goal across all participating counties was 116 bushels/A. Current University of Minnesota N recommendations to fulfill this goal is 112[15] lb/N/A. It is important to note that these recommendations[16] are based on information that was not available to producers during the 1993 cropping season. Fertilizer rates have been decreased from previous recommendations. In 1990[17], N recommendations for 116-135 bushel corn following a Group 2 previous crop (crops with no residual N credit such as corn) would have been between 150 and 120 lb/A for soil organic matter groups of low-to-medium and high, respectively. In 1994, 100 lb/N/A would have been recommended for 111-130 bushel corn (now classified as medium to high soil organic matter).

Factoring in all appropriate credits from fertilizer, legumes and manures, there was an over-application rate of 45 lb/N/A. Within this report, averages across fields (on a county basis) have been reported. More detailed analysis will follow which will "weight" the data to account for the wide range in field sizes.

These numbers are somewhat conservative in nature due to the fact that only "first year credits" from manure are included in the analysis. A vast majority of the producers did not have adequate records from the previous year (1993[18]) to accurately credits these sources. Also the producers generally did not have sufficient information regarding alfalfa stand densities prior to terminating the crop therefore an average credit of 100 lb/A was assumed. A previous soybean crop is now given a 40 lb/A credit. We inadvertently used a 30 pound credit which would have been correct several years ago. However, some producers in the western portion of Minnesota credit the soybeans similar to North and South Dakota by using a one pound credit for each bushel of beans produced. Due to the poor 1993 growing conditions and an average yield of 20 bu/A throughout most of west central MN, growers may have taken less than normal credits. Based only on the N fertilizer replacement value, proper crediting could save these producers approximately $5/A assuming no additional transportation and labor costs.

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[15] Averaged across all fields classified as "Group 2" in the classification scheme of the UM recommendations.

[16] G.Rehm, M. Schmitt and R. Munter. 1994. Fertilizer recommendations for agronomic crops in Minnesota. BU-6240-E.

[17] G.Rehm and M. Schmitt 1990. Fertilizer recommendations for agronomic crops in Minnesota. AG-MI-3901.

[18] Referring to any manure applications prior to those made in the fall of 1992.

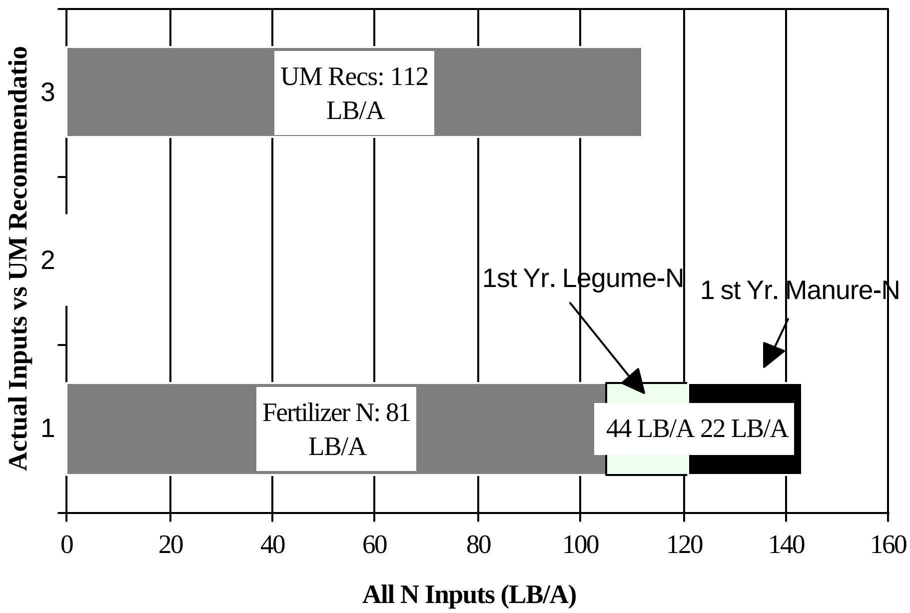

Figure E.1.13. Comparison of University of MN recommendations to N inputs (fertilizer, legumes and manure) across all corn acres. Total corn area in this analysis was 4,924 acres.

Balances were examined in more detail by lumping the **corn acreage** into five different scenarios:

Scenario 1: N from fertilizer only; no manure or legume credits;
Scenario 2: Previously alfalfa; no manure applied;
Scenario 3: Previously soybeans; no manure applied;
Scenario 4: Previously a non-legume crop, manure applied;
Scenario 5: Previously a legume crop, manure applied.

Nitrogen balances for all corn acres are broken down into these scenarios in Table E.1.8. Fertilizer N rates specific to each scenario is illustrated in Figure E.1.13. Rates in scenario 1 (no legumes, no manure) averaged 127 lb/A. Producers were clearly reducing N fertilizer by 20 lb/A for the soybean credit (N rate averaged 107 lb/A). Producers also significantly reduced fertilizer inputs on manured fields. Fertilizer N rates in scenario 4 (non-legume, manure applied) and scenario 5 (legume, manure applied) were reduced to 52 lb/A and 66 lb/A, respectively. These translate into reduction of 59 and 48%, respectively, in comparison to acres receiving commercial N rates.

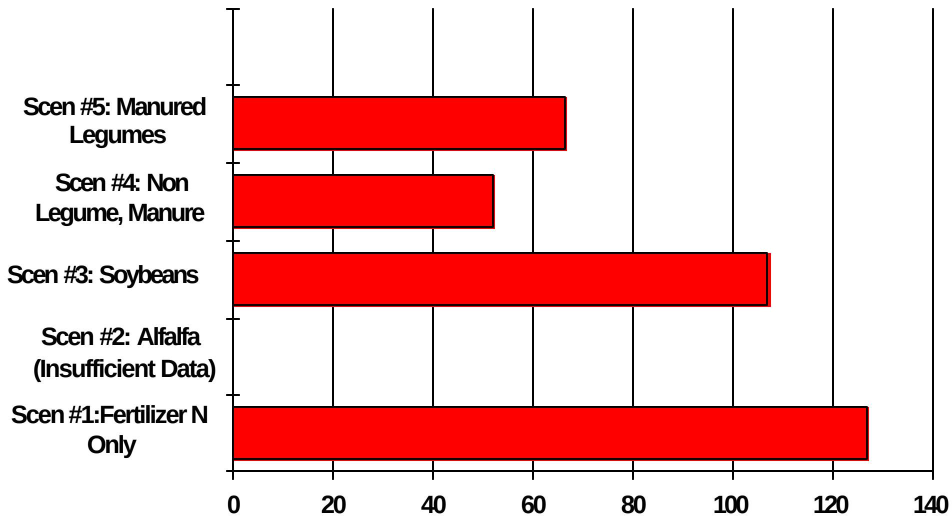

Figure E.1.14. Commercial fertilizer N rates on corn by management scenario.

Factoring in legume and manure credits into the process, the amounts in excess of University of MN recommendations are illustrated in Figure E.1.15. Excess amounts for scenarios 1, 3 and 4 are quite similar; the acres in scenario 4 are insufficient to make any conclusions. Clearly, producers are not taking sufficient credits in scenario 5 (manured legumes); over-application rates averaged 130 lb/A (Table E.1.9A).

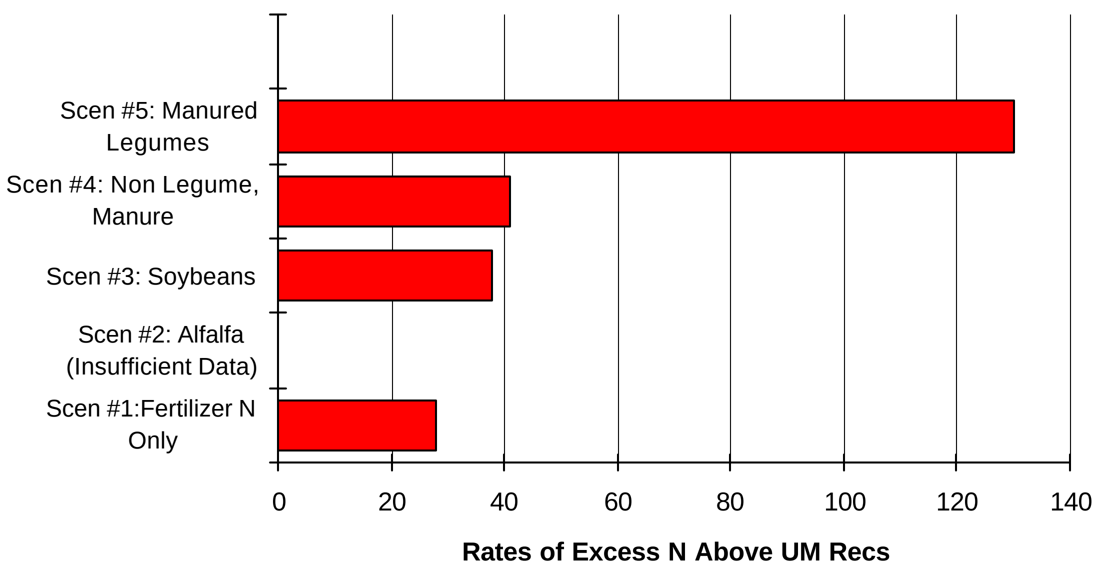

Figure E.1.15. Amounts of N in excess of University of Minnesota recommendations across the different management scenarios. Analysis includes all 4,924 acres.

Acreage distributions and N balances were then divided into two additional categories; ABOVE and BELOW UM recommendations. Data are given in Tables E.1.9B and E.1.9C respectively.

Seventy-eight (78%) of the total corn acres were classified into the ABOVE category. Excess amounts of N average 55 lb/Acre. The remaining acres (22%) were classified as BELOW UM recommendations. Shortage amounts of N average 27 lb/A.Viewing the distribution of excess N from a water quality perspective, a helpful indicator is the cumulative excess N values found in Table E.1.8. These figures factor in both the total acres of any given scenario as well as the rate of excess (shortage) of N. Although the over-application rates (130 lb/A) of scenario 5 (manured legume crop) are much higher than the others, the total acres are relatively small. In contrast, the over-application rates on scenario 3 (previously soybeans, no manure) were relatively low (38 lb/A), however the acreage is high. Figure E.1.16 captures this concept by illustrating the relative excess N by the various management scenarios.

These results from the West Central producers is somewhat unique from the stand point that no one particular scenario dominates the direction where educational focus should be directed. Based on this graphic, educators will have to remain diverse in dealing with proper N fertilizer rates and proper crediting of both manures and legumes.

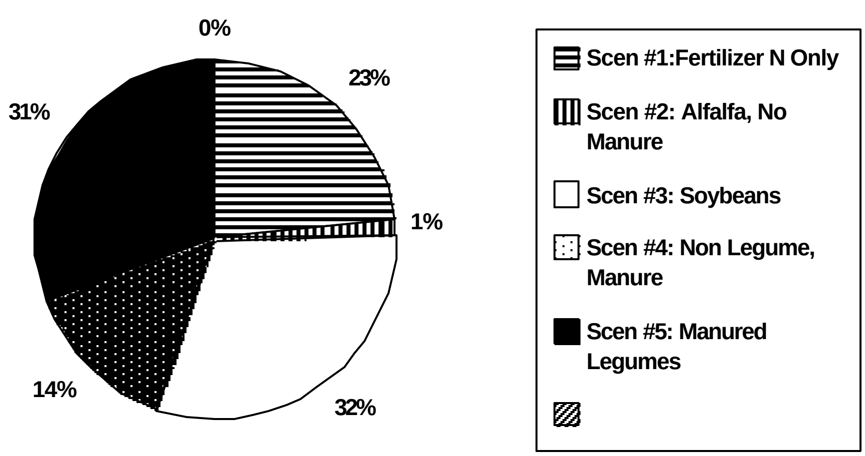

Figure E.1.16. Total excess N by the different management scenarios across all corn acres.

Table E.1.9A. **Nitrogen Inputs and Balances Across All Corn Acres**										
			PCN	**Manure**	**Manure**		**Fert N**		**N Rec.**	**Excess or**	**Excess or**

Scenario Number	Total Acres	PCN (LBS/A)	Cumulative (LBS)	N (LBS/A)	Cumulative (LBS)	Fert N (LBS/A)	Cumulative (LBS)	N Rec. (LBS/A)	Cumulative (LBS)	Shortage (LBS/A)	Shortage (LBS)
1	1,809	0	0	0	0	127	230,039	112	202,279	28	50,934
2	31	100	3,100	0	0	96	2,961	0	0	96	2,961
3	1,758	30	52,740	0	0	107	188,943	78	137,760	38	66,648
4	768	0	0	67	51,706	52	39,798	89	68,447	41	31,150
5	509	46	23,541	89	45,373	66	33,527	26	13,320	130	66,017
TOTALS FOR ALL SCENARIOS	**4,875**	**16**	**79,381**	**20**	**97,080**	**102**	**495,267**	**87**	**421,806**	**45**	**217,709**

Table E.1.9B.
Nitrogen Inputs and Balances Across Only Corn Acres
Above University of Minnesota Recommendations

Scenario Number	Total Acres	PCN (LBS/A)	PCN Cumulative (LBS)	Manure N (LBS/A)	Manure Cumulative (LBS)	Fert N (LBS/A)	Fert N Cumulative (LBS)	N Rec. (LBS/A)	N Rec. Cumulative (LBS)	Excess or Shortage (LBS/A)	Excess or Shortage (LBS)
1	1,607	0	0	0	0	144	231,991	111	179,150	33	52,806
2	31	100	3,100	0	0	96	2,961	0	0	96	2,961
3	1,327	30	39,810	0	0	117	154,910	70	92,486	47	62,476
4	357	0	0	75	26,678	90	31,956	91	32,536	73	26,205
5	486	46	22,391	89	43,187	69	33,680	22	10,904	136	65,963
TOTALS FOR ALL SCENARIOS	**3,808**	**17**	**65,301**	**18**	**69,865**	**120**	**455,497**	**83**	**315,076**	**55**	**210,409**

Table E.1.9C.
Nitrogen Inputs and Balances Across Only Corn Acres
Below University of Minnesota Recommendations

Scenario Number	Total Acres	PCN (LBS/A)	PCN Cumulative (LBS)	Manure N (LBS/A)	Manure Cumulative (LBS)	Fert N (LBS/A)	Fert N Cumulative (LBS)	N Rec. (LBS/A)	N Rec. Cumulative (LBS)	Excess or Shortage (LBS/A)	Excess or Shortage (LBS)
1	202	0	0	0	0	99	20,022	152	30,652	34	6,880
2	0	0	0	0	0	0	0	0	0	0	0
3	431	30	12,930	0	0	82	35,146	111	48,027	30	12,865
4	411	0	0	55	22,780	9	3,817	84	34,590	20	8,199
5	23	50	1,150	1	23	0	0	20	460	19	439
TOTALS FOR ALL SCENARIOS	**1,067**	**13**	**14,080**	**21**	**22,803**	**55**	**58,985**	**107**	**113,729**	**27**	**28,383**

Scenario Representative:

Scenario 1 = Acres receiving only fertilizer N; no PCN or manure applied.
Scenario 2 = Acres previously in alfalfa; no manure applied.
Scenario 3 = Acres previously in soybeans; no manure applied.
Scenario 4 = Acres receiving manure with no previous PCN.
Scenario 5 = Acres receiving manure with PCN.

Conclusions and Summary of the Current Nutrient Management Practices in West Central Minnesota

Twenty-three farms, covering over 13,000 acres, participated in the **FA**rm **N**utrient **M**anagement **A**ssessment **P**rogram (**FANMAP**) with staff from the Minnesota Department of Agriculture. Producers volunteered 2-4 hours of their time to share information about their farming operation. Producers were carefully selected to represent a wide diversity of management skills and farm characteristics. The overall purpose of the program was to develop a clear understanding of current farm practices regarding agricultural nutrients and utilize this knowledge for future water quality educational programs.

Producers in this study appeared to be using the correct timing of N fertilizer for fall and spring applications. Although just based on one year of information, fall-applied N was applied correctly based on long-term soil temperature data. Nitrogen sources were dominated by ammonium-based products which is particularly important in fall applications. Use of the soil nitrate test was limited only covering 16% of the corn acres, however, the previous wet season may have limited the usefulness of the test. Manure testing was very limited.

Manure accounts for approximately 15% of the 'first year available' N; legumes account for another 11%. Organic contributions are less than other regions of the state where FANMAP was used. Obviously proper crediting of both of these sources is needed to successfully manage N in any cropping system. On corn acres where no previous manure or legume credits existed to confound the rate selection process, producers appear to be in agreement with recommendations that were made by UM/MES **four to five years ago**. Recommended rates have been reduced a minimum of 20 lb/A. Consequently due to the development of more conservative recommendations, producers are over-applying fertilizer inputs by 28 lb/N/A. Roughly 89% of the acreage in this particular scenario were above UM recommendations.

Producers were reducing N fertilizer inputs following soybeans by 20 lb/A. Soybean crediting may have been less than normal due to the poor 1993 crop. Using the one pound N credit per bushel, which is typical in western Minnesota, producers were taking the appropriate credits. Statewide recommendations give soybeans a 40 lb/A credit.

Producers were basically reducing commercial N inputs by 75 lb/A in scenarios where previous manure applications were made to non-legume crops such as corn. Producers were under-estimating the value of the manure by approximately 40 lb/A. A common practice is to apply manure to soybean acres which are followed by corn in the rotation. In this scenario, producers were found to reduce their commercial inputs by approximately 60 lb/A. However the combination of legume and manure credits, coupled with the fertilizer (average of 66 lb/A), creates a situation where over-applications in excess of 130 lb/A develops. In these situations, only a starter N application should be applied and would trim 40 lb/N/A from the N budget. Producers could capture a much higher percentage of the "fertilizer replacement value" by applying the manure into other corn rotations. Although over 70% of the "first year" available N was applied to corn in this study, only 25% of the corn acres received annual applications of manure. For a water quality perspective, the most significant impacts could be made by improving the N crediting process in this particular cropping scenario.

The process of manure crediting is greatly simplified with manure storage systems that allow for a minimal number of land application events. In general, most of the storage facilities of the selected farms in West Central Minnesota allowed some flexibility in storage capabilities and thus timing of application. Approximately 75% of the N retained after storage originated from a variety of systems that allowed for some storage benefits. Scrape and haul collection systems, a type of system which demands frequent applications, accounted for 25% of the N available for land application. In previously studies by the MN Extension Service, the nutrient value from manure has been found to be highly variable. Manure testing needs continual promotion as a fundamental part of a nutrient management plan. None of the producers had tested their manure previously to this project.

There were some very positive findings from this study. There is strong evidence that producers are voluntarily adopting the educational materials and strategies developed by the University of Minnesota/MN Extension Service. Producers can make significant reductions by using the most recent recommendations. Producers have made significant progress in the crediting of organic contributions although there are certain cropping sequences where large improvements need to be made.