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# Waste Assessment of Agricultural Chemicals, Petroleum Products and Maintenance Residuals on Farmsteads

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# WASTE ASSESSMENT OF AGRICULTURAL CHEMICALS, PETROLEUM PRODUCTS AND MAINTENANCE RESIDUALS ON FARMSTEADS

S. D. Reed, R. D. Grisso, W. E. Woldt, S. M. Niemeyer

**ABSTRACT.** *The purpose of this study was to evaluate waste management practices of purchasing, handling, storage, and disposal of agricultural chemicals, petroleum products, and maintenance residuals. One-hundred surveys were returned by agricultural producers from three Nebraska counties selected based on unique environmental and waste management issues. Twenty-four questions concerning agricultural chemicals and 16 questions directed to petroleum products and maintenance residuals are discussed. A follow-up interview with 45 respondents was conducted "on-site" to gain insight into their reported practices, perceptions, and actual practices. Most farmers (66%) tended to purchase pesticides in 3.8 to 10 L (1-2.5 gal) containers and most (79%) were willing to participate in a recycling program for pesticide containers. Most of the respondents burned soft/hard plastic and paper pesticide containers, or returned the metal containers to the supplier. Few farmers took pesticide containers to landfills, or buried or stored containers in their field. Most farmers (76%) applied left-over diluted chemical residues or rinsates evenly on the field just sprayed. Eighty-one percent of the farmers stored pesticides and 89% stored fertilizers at locations greater than 31 m (101 ft) from a water source. Only 9% of the respondents indicated they had containment barriers for stationary bulk pesticides, fertilizer storage tanks, or transportable nurse tanks. Seventy-nine percent of the respondents and 84% of the interviewed farmers did not record or monitor volumes of petroleum storage. Farmers tended to have trash dumps (62%) and junk piles (57%) on their farmsteads. Geographic location within the state and size of the farmstead had an effect on whether the farms had dumps. Most farmers (94%) felt they used appropriate recycling methods to deal with waste products. However, over half of the farmers were unaware of the location of the petroleum (oil) recycling station. Most farmers (94%) indicated they felt they purchased replacement items based on long life instead of lowest price.*

**Keywords.** *Waste management, Pollution, Agricultural chemicals, Petroleum products, Farmsteads.*

**W**aste reduction has emerged as one of the major topics of outreach education in many states due to increased concern about proper waste management cost and environmental pollution. In 1990, the U.S. produced approximately 180 000 000 metric tons (195,000,000 tons) of solid waste (U.S. Environmental Protection Agency, 1990). Nebraska generated approximately 1 764 500 metric tons (1,900,000 tons) of solid waste in 1990 (SCS Engineers, 1991).

Waste management is defined as the controlling act of using proper methods of managing waste and preventing degradation of air, water, soil, and plant resources (Nebraska-Field Office Tech Guide, 1983). Waste

management can also be described as the elimination, reduction, reuse, and/or treatment of waste so it becomes permanently harmless to the environment (Wentz, 1989).

Pollution prevention is a preferred approach to waste management. It is defined as any practice, plan, or habit that reduces the generation of pollutants/wastes at the source rather than controlling them once created. It focuses on ways to avoid producing air emissions or soil and water discharge of pollutants.

## LITERATURE REVIEW

Environmental concerns are very important aspects of agricultural society. These concerns provide a background for decisions made in agricultural operations.

## AGRICULTURAL CHEMICALS

Pesticides are chemicals used to control pests, including weeds, diseases, and insects. It is estimated that approximately 13 590 000 kg (30,000,000 lbs) of pesticides are used annually in Nebraska (Exner and Spaulding, 1990; Nelson and Vitzthum, 1984). Nebraska ranked seventh in the nation for pesticide volume used in 1987 (Exner and Spaulding, 1990; Waddell and Bower, 1988).

The EPA reported that pesticide use has stabilized because of new herbicides, more efficient pesticides, and lower farm income. They also reported that use of pesticides (by mass of active ingredients) stabilized in 1982 and has remained stable over the past 10 years. Agriculture accounts for an estimated 75% of pesticide usage in the

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U.S. There are 1.3 million trained and certified pesticide applicators in the U.S. and most are associated with agriculture (Anonymous, 1993).

Previous waste management studies in Missouri, Nebraska, and Ohio, indicated farmers and chemical dealers across the United States are trying to use environmentally sensitive practices. Management practices along with farmers' attitudes toward regulations and public perception of these regulations were expressed in these studies. Pesticide application rates within the three areas were very similar. Most farmers in Missouri (95%), Nebraska (85%), and in Ohio (94%) applied agricultural chemicals themselves (Constance et al., 1992; Rockwell et al., 1992; Ozkan, 1992).

Twenty-one percent of Nebraska farmers (Rockwell et al., 1992) hired a commercial applicator for all pesticide applications compared to 25% for Missouri and 9% for Ohio. Fifty-four percent of the Nebraska farmers did both, while 33% in Missouri and Ohio did so.

Ninety-three percent of Nebraska farmers measured, diluted and mixed pesticides in the field with nurse tanks, or at water hydrants away from the well source. Of the farmers with leftover concentrates, 89% stored some or all for later use and 33% returned some or all to the dealer. Four percent buried the remaining concentrates, 6% sold to neighbors, friends, relatives, and 0.9% took it to landfill (Rockwell et al., 1992).

Recycling of empty pesticide containers is a popular disposal method for the agricultural community. In 1993, a record 2.4 million pesticide containers were returned for recycling (Anonymous, 1996). Nebraska has approximately 41 plastic pesticide container collection and recycling sites.

Forty percent of Nebraska farmers burned their pesticide containers, while 52% of Ohio, and 53% (hard/plastic) and 72% (soft plastic/paper) of Missouri farmers did so. The Missouri survey showed that 33% of the respondents left custom applicators responsible for container disposal, and 30% of the farmers returned the container to a dealership. Ohio and Nebraska's methods of container disposal also included: burying, taking them to landfills, and disposing them in farm junk piles (Constance et al., 1992; Johnson, 1992; Ozkan, 1992; Rockwell et al., 1992).

Ohio survey results showed that 52% of the respondents stored left over chemicals on their farmsteads. Thirteen percent of the Ohio farmers did not dispose of chemicals, 9% diluted chemicals with water and sprayed it on non-crop land, 5% followed instructions on the label, 1% poured on ground away from farm building/house, and 4% used some other methods (Ozkan, 1992).

## FERTILIZER

Fertilizers are products used as a nutrient for promoting plant growth. Buttermore (1993) conducted a study of fertilizer storage. The major objective was to assess the potential impact of these secondary containment regulations on small farms. Buttermore (1993) showed that 87% of farm fertilizer storage tanks were 18 906 L (5,000 gal) or less in size and approximately 12,620 fertilizer storage tanks were used on 4,260 Nebraska farms. Average annual storage time was approximately 2.5 months. Sixty-eight percent of storage tanks were reported to be located near a water source and

more than 77% of the storage tanks were 7580 L (2,000 gal) or smaller (Buttermore, 1993). Buttermore (1993) concluded the cost of secondary containment facilities would be an economic burden on farms with small fertilizer storage capabilities.

## FARMER PERSPECTIVES CONCERNING PESTICIDES

Farmers from Missouri (Constance et al., 1992) expressed concerns and interest in environmental impacts that affect them. Missouri farmers' largest concern was the public perception of their pesticide usage. Farmers felt that town and city residents were using too much pesticide on their lawns. Urban citizens' general use of pesticides on their lawns were considered more hazardous to ground water than crop land receiving pesticide. Farmers felt they were more conservative in the use of pesticides, because the land, water, and air were their natural resources. They feared that the negative impact of public perception would result in increased restrictive pesticide regulations. Economically, Missouri farmers felt that banning potentially harmful pesticides will decrease food production and result in higher prices for consumers.

Ohio farmers (Ozkan, 1992) expressed concerns about landfills, government regulations, and environmental issues. They were willing to support container recycling attempts. They suggested deposits on containers, returnable containers, buy-back plans, and recycling programs.

Ohio farmers felt that landfills were not the ideal solution for disposal of pesticide containers. Farmers stated that landfill regulations were confusing, and that traveling distance, operation hours, liability, and added cost of landfill usage were barriers for their effective use. Instead of using the landfill as a disposal method, burning the containers was the most common practice. Opinions were voiced against public perception of pesticide use and that farmers needed pesticides to control weeds. Farmers questioned why non-farmers escaped governmental regulation and felt anyone who applied chemicals, should receive educational training. Some farmers stated if they could not burn, bury or take pesticide containers to a landfill, they will ignore the law and do what is necessary. Others felt that stricter laws should be placed on companies that generate the chemicals.

## PETROLEUM

Aboveground and underground storage of petroleum products can harm public health and the environment. Tanks 20 years and older are at a high risk of leaking (Javid et al., 1991). It is estimated that one out of four underground storage tanks leak.

Forty farmers were surveyed (Wertz et al., 1990) in Lancaster County, Nebraska, concerning their tractor maintenance record keeping practices. An average of 15 L (4 gal) of engine oil and 106 L (28 gal) of hydraulic fluid was maintained for on-farm inventory. Wertz et al. (1990) showed that 38% of the farmers had "on-farm" diesel fuel storage tanks. An average of 5100 L (1,344 gal) of diesel fuel could be stored "on-farm" with a maximum of 41 800 L (11,000 gal) and a minimum of 1140 L (300 gal) of storage. Ninety-two percent (Wertz et al., 1990) of the tanks were aboveground with 48% of the tanks shaded for more than half of the day. Wertz et al. (1990) showed that most owners (88%) purchased oil and lubricants from an

oil supplier, and only 10% purchased oil from an equipment dealer. Equipment dealers were shown to supply most of the oil filters, fuel filters, and most replaceable parts and supplies.

According to Wertz et al. (1990), most of the farmers (63%) disposed of used oil on their farmstead. Twenty-five percent took their drained oil to the recycler, and 12% used it for burning in shop heaters. Johnson (1992) reported that 75% of agricultural chemical dealers in Nebraska disposed used oil filters as follows: 9% were burned at dumps, 11% recycled, 2% were burned "on-site", 24% used "other" methods, and 2% did not answer.

#### **MISCELLANEOUS RESIDUALS**

For many years, agricultural producers have disposed of many solid waste products on their farmsteads. Some of these disposal practices could have been harmful to the environment. Changes in licensed landfills and regulations have left many communities with limited disposal options.

In Nebraska, as well as many other states, it is illegal to dispose of solid waste in any location other than a licensed disposal facility. This includes both residential and production operation solid waste. Some exceptions are the use of clean dirt, brick, stone, tires/posts for blow out stabilization and accumulation of agricultural junk that is agricultural in character. However, home owners have reduced accessibility to a licensed facility (Woldt, 1994).

#### **WASTE REDUCTION METHODS**

Johnson (1992) conducted an assessment of agricultural chemical dealers' waste management practices in Nebraska. Forty-six cooperatives responded that they sold tires. Seventy-four percent of these respondents accepted worn-out tires. Thirty-two percent of the cooperatives charged customers for disposing of worn tires, and 56% allowed free disposal of worn tires that were exchanged. Twelve percent of the cooperatives did not accept worn-out tires. Fees for disposing tires at licensed landfills ranged from \$1.00 to \$3.50 per tire. Johnson (1992) stated that tires disposed at the cooperatives were: 77% of the tires were reused by farmers, 31% were sent to private companies, 28% sent to licensed landfill, 2% sent to city dump, 2% burned, 2% suppliers picked up, 2% county picked up, and 28% had no disposal option. The total is more than 100% because some cooperatives used more than one disposal method.

Fifty-one cooperatives responded that lead acid battery disposal were managed by them. Eighty-two percent of the lead acid batteries were picked up for recycling by battery suppliers, and 24% were recycled by a local organization (Johnson, 1992).

#### **OBJECTIVE**

The objective of this study was to evaluate current management practices of purchasing, handling, storage, and disposal of chemicals, petroleum products, and maintenance residuals used by agricultural producers.

#### **METHODS AND PROCEDURES**

The survey tool consisted of 44 questions with some questions having multiple responses. The topics evaluated were agricultural chemicals, petroleum products, and

maintenance residuals from farm products and equipment. The questions from each area were prioritized based on the practices of product purchase, storage, handling, and disposal. The 44 questions were divided into 4 questions concerning demographics, 24 concerning agricultural chemicals, 11 on petroleum products, and 5 on maintenance residuals. The survey tool and responses are found in Reed (1995).

Custer, Merrick, and Sarpy Counties were selected because of their different geographical background and unique environmental settings. Custer County did not have a licensed landfill facility. Merrick County has environmental restrictions, because of its high nitrate levels and close proximity to a large aquifer. Sarpy County farms were located near two major metro areas (Lincoln and Omaha) and have access to licensed landfills. For additional information on the three counties and the respondents demographics see Reed et al. (1994).

Custer County has 6659 km<sup>2</sup> (2,571 mi<sup>2</sup>) of land. The total county population in 1992 was 12,300, and the average farm net income was \$61,148 (Bureau of Economic Analysis, U.S. Dept of Commerce, 1994). Per capita average income for the county was \$19,339. Within the county, 1,321 farms had an average size of 436 ha (1,079 acres). Five hundred and twenty-six farms had some irrigated land. Total irrigated land was 73 048 ha (180,812 acres). The ratio of livestock/crop in dollars was 5:17 (Census of Agriculture, 1992).

Merrick County has 1233 km<sup>2</sup> (478 mi<sup>2</sup>) of land. Total county population in 1992 was 8,100, and the average farm net income was \$27,820. Per capita average personal income was \$16,187 for the county. Six hundred and seventeen farms within the county had an average size of 190 ha (471 acres). Four hundred and seventy-four farms had some irrigated land. Total irrigated land was 66 494 ha (164,589 acres). The ratio of livestock/crop in dollars was 1:2 (Census of Agriculture, 1992).

Sarpy County has 616 km<sup>2</sup> (238 mi<sup>2</sup>) of land. Total county population in 1992 was 107,200, and the average farm net income was \$26,792. Per capita average personal income was \$16,518 for the county. Three hundred and sixty-two farms within the county had an average size of 117 ha (290 acres). Twenty-nine farms had some irrigated land. Total irrigated land was 1839 ha (4,552 acres). The ratio of livestock/crop in dollars was 5:12 (Census of Agriculture, 1992).

#### **SELECTION OF AGRICULTURAL PRODUCERS**

Three sets of mailing labels of agricultural producers were obtained whose major income came from agricultural production. The farmstead had to be a minimum of 101 ha (250 acres). A total of 450 labels (150 for each of the three counties) were included. Three mailings were sent: initial letters/survey tools, follow-up letters, and thank-you letters (Reed, 1995).

#### **"ON-SITE" FARM INTERVIEWS**

The follow-up interview compared the answers on the survey tool with agricultural producers' answers while "on-site". The interview consisted of 10 questions (Reed, 1995) and the farmers were selected at random. Farmers were also asked to comment about environmental

regulations and other issues they felt important in their waste management practices.

## RESULTS AND DISCUSSION

One hundred of the 450 agricultural producers receiving the survey cooperated in the study. Thirty-eight percent of the respondents were from Custer County. Twenty-seven percent of the respondents were from Merrick County and the remaining farmers (35%) were from Sarpy County.

The results section is divided into four parts; demographic information, pesticides and fertilizer, petroleum, and maintenance residuals of farm products and equipment. Each survey question was compared to responses by county, education level, income level, crop land and total farm size. The numerical findings of the survey and demographic questions are listed on separate tables. The findings are categorized by county, where Sarpy, Merrick, Custer, and "Over-all" were recognized as S, M, C, and O, respectively.

Questions with total percentages greater than 100 are recognized by an "\*" placed at the bottom of the table. This symbol indicated that the respondents selected more than one answer.

### PART I. DEMOGRAPHIC INFORMATION

The four questions concerning demographics are similar to the questions asked on other Nebraska surveys (Rockwell et al., 1992). This was helpful to determine if these responses were similar to the Nebraska farm population. Tables of demographic data will give background information of the farmers. Demographic information was sorted by county, and respondent's age, education level, income level, and farm size.

#### 1) How much education do you have?

Educational Level	% of 100 Respondents			
	O	S	M	C
Less than high school	4	3	3	5
High school graduate	42	61	40	28
Some college or vocational-technical training	25	13	33	28
College graduate	19	16	18	22
Post college credits	10	7	6	17
Total	100	100	100	100

The results indicated that overall, 4% of farmers had less than a high school education, 42% were high school graduates, 25% had some college or vocational technical training, 19% were college graduates, and 10% earned post college credits. Rockwell et al. (1992) showed that 10% of Nebraska farmers had less than a high school education, 49% had high school diploma, 28% some college or vocational technical college, and 19% were college graduates. Thus, the educational levels of survey respondents were very similar to Rockwell's findings. Responses of education level less than high school and high school were too small for accurate results, therefore the two responses were combined for further analysis.

#### 2) What range does your age fall in?

Age	% of 98 Respondents			
	O	S	M	C
Less than 20 years	0	0	0	0
20 to 40 years	27	23	22	33
41 to 64 years	66	67	71	58
65 or above	7	10	3	8
Total	100	100	96	99

Sixty-six percent of the farmers were between the ages of 41 and 64 years, while none were younger than 20 years old. Rockwell et al. (1992) had 18% of farmer's age ranging from 20 to 34 years; 20% between 35 to 44 years; 18% between 45 to 54 years; 27% between 55 to 64 years; and 17% were 65 or above. The age of those farmers surveyed were slightly different from those of Rockwell et al. (1992).

#### 3a) What is the gross income from your farming/ranching operation?

Income Level	% of 91 Respondents			
	O	S	M	C
Less than \$40,000	9	11	3	12
\$40,000 to \$99,000	24	26	23	23
\$100,000 to \$249,000	37	37	33	41
\$250,000 to \$999,999	23	19	33	18
\$1,000,000 or more	7	7	7	6
Total	100	100	99	100

A majority (37%) of the gross income fell in the range of \$100,000 to \$249,000. Rockwell et al. (1992) showed 29% of farmers earned less than \$40,000; 33% earned from \$40,000 to \$99,999; 29% earned from \$100,000 to \$249,000; 7% earned from \$250,000 to \$999,999 and 1% earned \$1,000,000 or more. Both surveys indicated that respondent's income levels were similar.

Income levels were collapsed into three categories for analysis. These new ranges were less than \$100,000, \$100,000-\$249,000, and greater than \$250,000 and using these ranges by county are:

#### 3b) What is the gross income from your farming/ranching operation?

Income Level	% of 91 respondents			
	O	S	M	C
< \$100,000	33	37	27	35
\$100-\$249,000	39	37	33	41
> \$250,000	29	26	40	24
Total	100	100	100	100

#### 4) How many acres are you farming or ranching in 1993?

Farm/Ranch Size	Average size, 82 Respondents			
	O	S	M	C
Dry land, ha (acre)	158.8 (393.1)	298.2 (738.1)	41.0 (102.0)	112.0 (277.1)
Farm/Ranch Size	Average size, 81 Respondents			
	O	S	M	C
Irrigated, ha (acre)	184.1 (455.7)	44.0 (109.0)	257.1 (636.4)	186.4 (461.4)
Farm/Ranch Size	Average size, 83 Respondents			
	O	S	M	C
Pasture/range land, ha (acre)	275.9 (682.9)	29.5 (73.1)	130.2 (322.4)	566.7 (1402.8)

Sarpy County had the greatest portion of dry land [24 452 ha (60,524 ac)] per total farm land [30 465 ha (75,420 ac)] and is located in eastern Nebraska where rainfall is higher. Merrick County is underlaid by an aquifer and the irrigated land [20 825 ha (51,548 ac)] per total farm land [34 994 ha (86,671 ac)] corresponded appropriately to this region. Custer County is not located near a licensed landfill. Custer County is near the edge of the sandhills, this area contains a large portion of pasture land [47 036 ha (116,432 ac)] when compared to total farm land [71 319 ha (176,528 ac)]. In Rockwell et al. (1992), the average farm size was 355 ha (877 ac) and the total farm land was 90 389 ha (223,737 ac).

Crop land size was defined as the sum of dry and irrigated land. Total farm size was defined as the sum of dry, irrigated, and pasture land. Both crop land and total farm size cells were listed as ranging from less than 242 ha (600 ac), 242 to 485 ha (600-1,200 ac) to greater than 485 ha (1,200 ac).

**Crop Land Size versus Income Level:**

Crop Land Size	% of 88 respondents		
	Income level		
	< \$100,000	\$100-\$249,000	> \$250,000
< 242 ha (< 600 ac)	15	6	1
242-485 ha (600-1200 ac)	14	17	10
> 485 ha (> 1,200 ac)	5	16	17
Total	34	39	28

**PART II. PESTICIDES AND FERTILIZER**

**1) Please estimate the volume used each year.**

Pesticide Volume	% of 87 Respondents			
	O	S	M	C
3.8 to 190 L (1-50 gal)	25	21	11	42
193.8 to 570 L (51-150 gal)	23	25	25	19
573.8 to 760 L (151-200 gal)	13	11	18	10
> 763.8 L (> 201 gal)	39	43	46	29
Total	100	100	100	100

Many farmers (39%) used volumes of pesticide greater than 763.8 L (>201 gal) annually. Farmers in Custer County purchased more pesticides in volumes between 3.8 to 190 L (1-50 gal) than volumes greater than 763.8 L (>201 gal). Since Custer County had more pasture land than crop land compared to the other two counties, it appears pesticides were purchased in smaller volumes.

**2) What type of containers do you purchase pesticides in?**

Container Size	% of 100 Respondents			
	O	S	M	C
3.8 to 10 L (1-2.5 gal)	66	81	42	75
Bulk returnable	42	48	55	25
Bulk non-returnable	12	16	3	17
Other**	18	26	15	13
Total*	138	171	115	131

\* Indicates more than one was checked.

\*\* Other methods include: sacks, plastic bags, dry flowable/dissolvable packets, and dry-paper bags.

In comparison with the previous question, 39% of the farmers used greater than 763.8 L (201 gal) of pesticides, while 66% used 3.8 to 10 L (1-2.5 gal) containers. Farmers that chose to use 3.8 to 10 L (1-2.5 gal) containers and purchased over 763.8 L (201 gal) of pesticides, will usually have more than 100 containers annually to dispose.

**3) How far are pesticides stored from a water source? (drinking well, farm pond, irrigation well, abandoned wells, etc.)**

Distance	% of 83 Respondents			
	O	S	M	C
0 to 6 m (0-20 ft)	2	0	0	7
7 to 15 m (21-50 ft)	5	0	7	7
16 to 30 m (51-100 ft)	12	15	7	14
> 31 m (> 101 ft) or greater	81	85	86	72
Total	100	100	100	100

**4) What is the longest time period that unused pesticides are stored on farm?**

Storage Period	% of 85 Respondents			
	O	S	M	C
Less than 1 year	58	61	64	48
1 to 2 years	34	31	28	42
3 to 5 years	3	4	4	3
6 years or greater	5	4	4	7
Total	100	100	100	100

A majority of farmers (92%) stored unused pesticides for two years or less, while 8% stored pesticides three years or more. Farmers with a high school education or less tended to keep unused pesticides for the shortest time period (one year or less) than those with additional education.

**5) How are farm chemicals (herbicides, insecticides, fungicides, and rodenticide) stored? (check all that apply)**

Storage Location	% of 100 Respondents			
	O	S	M	C
On wooden pallets	44	45	40	39
On shelves	29	29	18	39
Fire resistant structure	18	16	15	22
Chemical tanks	11	13	9	11
Temperature controlled building	9	19	0	8
Other**	17	16	21	14
Total*	128	138	103	133

\* Indicates more than one was checked.

\*\* Other storage methods include: stored at dealers or suppliers, in machinery sheds or small buildings, in a room of a barn, was picked up when needed, and stored in a tank at the field.

Most farmers stored farm chemicals on shelves or on wooden pallets. From the “on-site” interviews, most farmers stored their farm chemicals in a machinery shed. From observations during the interview, chemicals were typically stored in an open area on pallets, the floor, and/or on metal/wooden shelves.

**6) What do you do to protect your pesticides from accidental access, theft, and vandalism? (check all that apply)**

Protection Practices	% of 100 Respondents			
	O	S	M	C
Locked containers, cabinets or bldgs.	38	42	51	22
Warning signs	7	3	15	3
Fence	2	0	0	6
Alarms systems	2	3	0	0
Other**	8	3	12	8
None	36	36	22	50
<b>Total</b>	<b>93</b>	<b>87</b>	<b>100</b>	<b>89</b>

\*\* Other protection methods used: pesticides were not purchased until needed, pesticides were applied commercially, none of the unused pesticides were stored, and pesticides were stored in an isolated non-conspicuous location.

Although half of the farmers (49%) protected their pesticides, 36% of all farmers and 50% of Custer County farmers had no security for pesticide storage. Some farmers did not need security for pesticides because pesticides were picked up and used on the same day and unused pesticides were not stored on the farmstead. Only one-third of the “on-site” interviewed farmers used some type of security system. The remaining farmers did not because they never had any problems with theft, vandalism or accidental access. Constance et al. (1992) showed on the average 15% of the farmers stored their farm pesticides in a locked area, and 33% of the pesticides were handled by a custom applicator.

**7a) Does your stationary bulk storage tanks or transportable nurse tanks for pesticides and/or fertilizers include barriers around the tanks to contain any spillage which might occur?**

Containment	% of 91 Respondents			
	O	S	M	C
Yes	9	10	7	9
No	30	35	38	18
Does not apply	61	55	55	73
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**7b) If your storage tanks were to rupture, could you contain and recover a major portion of the losses?**

Recovery	% of 42 Respondents			
	O	S	M	C
Yes	29	24	31	33
No	71	76	69	67
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**7c) Does your farm have a pesticide mixing and washing pad that allows spillage and rinsates to be contained?**

Mixing/Wash Pad	% of 89 Respondents			
	O	S	M	C
Yes	3	7	4	0
No	97	93	96	100
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**8) In case of pesticide liquid spillage, do you have these items available? (check all that apply)**

Clean-up Materials	% of 100 Respondents			
	O	S	M	C
Saw dust	30	42	33	17
Pet litter	25	35	21	19
Absorptive clay	21	23	24	17
Vermiculite	2	0	0	6
Activated charcoal	0	0	0	0
Other**	5	0	9	6
None	33	16	27	53
<b>Total*</b>	<b>116</b>	<b>116</b>	<b>114</b>	<b>118</b>

\* Indicates more than one was chosen.

\*\* Other clean-up materials were: sand, floor dry, hired an applicator.

**9) When dealing with spills, please check the items that you keep readily available for neutralizing pesticides.**

Neutralizing Materials	% of 100 Respondents			
	O	S	M	C
Sodium hypochlorite (laundry bleach)	25	32	24	19
Hydrated lime	8	10	6	8
Ammonia	8	10	12	3
Lye	1	3	0	0
Other**	5	3	9	3
None	55	48	52	64
<b>Total*</b>	<b>102</b>	<b>206</b>	<b>163</b>	<b>97</b>

\* Indicates more than one was chosen.

\*\* Other materials were: adsorptive clay, water, or washed containers.

**10) Most (75%) or greater of the farm pesticides and nutrients are applied by: (check all that apply)**

Application Methods	% of 100 Respondents			
	O	S	M	C
Self-application	57	55	64	53
Commercial applicator	45	52	33	50
Hired hand	14	13	6	22
Do not use pesticides	7	7	12	3
<b>Total*</b>	<b>123</b>	<b>127</b>	<b>115</b>	<b>128</b>

\* Indicates more than one was checked.

From the “on-site” farm interviews, 49% of farmers self-applied, 40% used a commercial applicator, and 9% used both. Rockwell et al. (1992) showed 54% of farmers both self-applied and hired commercial applicators, 26% self-applied, and 21% hired a commercial applicator.

**11) How do you decide: application rates of pesticides per acre and the quantity of pesticides to purchase? (check all that apply)**

Decision-making Methods	% of 100 Respondents			
	O	S	M	C
Label	61	61	52	69
Commercial applicator	41	39	36	47
Crop consultant	33	26	33	39
Past experience	28	29	24	31
Local cooperative	23	39	12	19
UNL Cooperative Extension	8	16	18	19
Other**	2	3	0	3
<b>Total*</b>	<b>206</b>	<b>213</b>	<b>175</b>	<b>227</b>

\* Indicates more than one was checked.

\*\* Other decision making methods were: followed recommendations by chemical dealers and neighbors, or based on soil type.

Most farmers (61%) chose to follow the instructions on the pesticide label for deciding application rates. Almost all respondents used more than one method to determine application rates. Rockwell et al. (1992) showed that 79% of pesticide decision making methods were according to the farmer's own judgement and past experience. Other methods used by Rockwell et al. (1992) respondents were: crop consultants (18%), agricultural chemical dealers (14%), extension service (10%), commercial applicators (8%), and observations from neighbors (1%).

**12) I feel I make good, practical, safe, and responsible decisions related to pesticide use and management.**

Response	% of 91 Respondents			
	O	S	M	C
Strongly agree	59	59	76	46
Agree	39	41	24	48
No opinion	2	0	0	6
Disagree	0	0	0	0
Strongly disagree	0	0	0	0
Total	100	100	100	100

Ninety-eight percent of farmers either strongly agreed or agreed they made safe, practical, and responsible decisions related to pesticide use and management. None of the farmers either disagreed or strongly disagreed that they made practical and safe management decisions related to pesticides. Total farm size influenced the farmer's decisions related to pesticide use and management. Larger farms had a stronger positive response for making practical and safe decisions related to pesticides. Therefore, farmers must realize that good management is critical, because improper management could harm their natural resources and lower the value of the farmstead.

**13a) Have you maintained records of spraying rates and types of pesticides on fields from previous purchases?**

Maintain Records	% of 92 Respondents			
	O	S	M	C
Yes	73	76	76	68
No	27	24	24	32
Total	100	100	100	100

Seventy-three percent of farmers maintained records of spraying rates and type of pesticide used on their fields. The income level, crop land, and total farm size influenced farmers' methods of record keeping of spraying rates and type of pesticides purchased. When more land was farmed and more income generated, more farmers tended to keep records of chemicals purchased and applied.

**13b) If yes, how far back?**

Records Retained	% of 66 Respondents			
	O	S	M	C
1 to 2 years	49	55	41	50
3 to 5 years	36	32	46	32
6 years or above	15	13	13	18
Total	100	100	100	100

**14a) Have you maintained records of total volume of pesticides previously applied on fields?**

Maintain Records	% of 92 Respondents			
	O	S	M	C
Yes	52	45	62	50
No	48	55	38	50
Total	100	100	100	100

**14b) If yes, how far back?**

Records Retained	% of 48 Respondents			
	O	S	M	C
1 to 2 years	35	46	28	32
3 to 5 years	42	39	44	41
6 years or above	23	15	28	24
Total	100	100	100	97

Fifty-two percent of farmers maintained records of total volume of pesticides previously applied on their fields. Farmers were more likely to keep records on spray rates and pesticide purchases than the total volume applied on their field. From the "on-site" interviews, farmers that used commercial applicators stated the commercial applicator kept their records. Most of the farmers interviewed who self-applied chemicals did not keep any records. One farmer indicated he kept no records, since his chemical usage was small and he could keep the information in his head. However, he was aware of the new record-keeping law.

**15a) Are you aware of what procedures should take place if personal contamination occurs?**

Clothing	% of 88 Respondents			
	O	S	M	C
Yes	93	93	97	91
No	7	7	3	9
Total	100	100	100	100

Oral (Mouth)	% of 85 Respondents			
	O	S	M	C
Yes	85	78	93	83
No	15	22	7	17
Total	100	100	100	100

Skin (and Eyes)	% of 87 Respondents			
	O	S	M	C
Yes	90	85	96	87
No	10	15	4	13
Total	100	100	100	100

Inhalation (Lungs)	% of 86 Respondents			
	O	S	M	C
Yes	70	64	83	63
No	30	36	17	37
Total	100	100	100	100

A majority of the farmers were aware of safety procedures if personal contamination occurred. The only area that farmers were less aware of was the need for personal lung protection. This is understandable since most farmers do not use pesticides that result in inhalation concerns. Educational level influenced knowledge of safety procedures for inhalation contamination. Farmers with a high school degree or less used more safety precautions than farmers with additional education.



**15b) If yes, explain your method of personal decontamination:**

The responses for personal decontamination methods of clothing, oral, skin, and inhalation are listed in Reed (1995). Sixty farmers explained their methods of personal safety and decontamination. The most common response for clothing decontamination was to read the label, burn clothing, and wash clothing in soap and water. If taken orally, farmers said they would induce vomiting, call poison center, drink liquids and call a doctor, or read the label for instructions. For skin protection, farmers stated they would take off clothes and shower, wash skin with soap and water, read label, flush with water and call a doctor. For inhalation contamination they would read the label, get fresh air and seek medical attention.

**16) Do you have a designated area in each field for handling and mixing pesticides?**

Designated Area	% of 88 Respondents			
	O	S	M	C
Yes	17	18	24	10
No	53	54	45	61
Don't mix in field	30	28	31	29
Total	100	100	100	100

Seventeen percent of farmers had a designated area in each field for handling and mixing pesticides, while 30% did not mix in the field. Only 10% of Custer County farmers handled and mixed chemicals in designated areas compared to 24% in Merrick County and 18% in Sarpy County. As the crop land size increased, fewer farmers mixed/handled pesticides in designated areas.

**17a) Does the pesticide supplier offer return policy on unused chemical products?**

Return Policy	% of 90 Respondents			
	O	S	M	C
Yes	61	58	80	47
No	14	21	10	12
Not sure	25	21	10	41
Total	100	100	100	100

**17b) If yes, can the empty or remains in the container be returned if the seal is broken?**

Return Policy	% of 64 Respondents			
	O	S	M	C
Yes	30	33	37	16
No	44	53	42	37
Not sure	26	14	21	47
Total	100	100	100	100

**18) How do you dispose of leftover rinsates from a spray tank?**

Dispose of Rinsates	% of 80 Respondents			
	O	S	M	C
Evenly distribute on fields just sprayed	76	76	78	75
Stored for later use	10	12	7	11
Chemical manu. contacted	4	4	4	3
Other**	10	8	11	11
Total	100	100	100	100

\*\* Other methods listed: use on idle acres, spray on fence lines and ditches, and return to commercial applicator.

Most leftover rinsates (76%) were evenly distributed on fields just sprayed. Eighty-four percent of the “on-site” interviewed farmers felt that evenly distributing rinsates across the field just sprayed was a good practice. Rockwell et al. (1992) showed that 41% of Nebraska farmers did not have concentrates left over, while 59% did. Constance et al. (1992) showed that 30% of Missouri farmers disposed of leftover or out-of-date pesticides by leaving the custom applicator responsible, using up the pesticides (20%), storing pesticides (10%) or taking pesticides back to the dealer (10%). Ozkan (1992) showed 52% of Ohio farmers disposed of unused (leftover) chemicals by saving and spraying on fields the following year, 16% took it back to chemical dealer, 13% did not dispose, 9% diluted with water and sprayed on non-crop land, 5% followed label recommendation, 0.6% poured on ground away from building, and 3.5% used some “Other” method.

**19) What do you do with empty hard plastic or metal pesticide containers? (check all that apply)**

Pesticide Container Disposal	% of 100 Respondents			
	O	S	M	C
Burn them	46	55	42	42
Return to supplier	24	22	27	22
Reuse	18	10	15	28
Temporarily store/stack out of way on farmstead	15	13	15	17
Take to landfill	12	16	3	16
Bury them	8	10	3	11
Store/stock in field on farmstead in the open	0	0	0	0
Other**	11	6	24	3
Total*	134	132	129	139

\* Indicates more than one was checked.

\*\* Other disposal methods were: recycled pesticide containers, triple rinsed, or burned the containers.

Rockwell et al. (1992) discussed disposal methods of pesticide containers. Sixteen percent of farmers buried containers, 27% were hauled to a landfill, 15% were returned to dealer, 53% were burned, and 11% were temporarily stored in an out-of-the-way location (accumulated percentages are more than 100%, because more than one choice was selected). Ozkan (1992) showed that 52% of pesticide containers were burned, 13% rinsed and reused, 13% were taken to the landfill, 12% were collected by a garbage service, 4% were buried, 1% were piled in a junk pile, and 6% used “Other” methods of disposing pesticides containers.

**20) What do you do with empty soft plastic or paper pesticide containers? (check all that apply)**

Pesticide Container Disposal	% of 100 Respondents			
	O	S	M	C
Burn them	65	74	61	62
Return to supplier	13	13	15	11
Take to landfill	10	16	0	14
Temporarily store/stock out of way on farmstead	6	7	3	8
Reuse	4	0	0	8
Bury	1	3	0	0
Store/stock in field on farmstead in the open	1	3	0	0
Other**	7	3	12	6
Total*	107	118	91	109

\* Indicates more than one was checked.

\*\* Other disposal methods included the triple rinse procedure.

**21a) Do you know the location of the nearest permitted landfill that accepts unused pesticides and containers?**

Nearest Landfill	% of 91 Respondents			
	O	S	M	C
Yes	23	29	21	20
No	77	71	79	80
Total	100	100	100	100

A majority of the farmers (77%) did not know the location of the nearest licensed landfill that accepted unused pesticide and/or pesticide containers. Farmers with a high school education or less knew the location of the nearest licensed landfill more often than farmers with additional education.

**21b) Estimate the distance of the permitted landfill closest to me is:**

Distance	% of 91 Respondents			
	O	S	M	C
0 to 16 km (0-10 mi)	18	48	0	6
17 to 50 km (11-30 mi)	12	17	3	15
51 to 81 km (31-50 mi)	8	0	14	9
82 km (51 mi) or greater	12	0	21	15
Do not know	50	35	62	55
Total	100	100	100	100

Fifty percent of farmers did know the distance of the local licensed landfills. A majority of farmers from the “on-site” interview stated they did not know the location of the nearest licensed landfill that accepted unused pesticide and/or pesticide containers. Most farmers interviewed did not know the distances to the nearest licensed landfill. They claimed if they did know the distance, they felt it was not economical to take waste products to it.

Ozkan (1992) showed that only 8% of farmers strongly disagreed that a landfill was within convenient distance, while 23% disagreed, 48% agreed, and 11% strongly agreed. Ozkan (1992) also showed that 4% of farmers strongly disagreed they knew the location of nearest landfill, while 13% disagreed, 60% agreed, and 23% strongly agreed.

**22a) How do you get information about pesticide container disposal? (check all that apply)**

Information Source	% of 100 Respondents			
	O	S	M	C
Supplier	53	52	55	53
Labels	45	45	42	47
UNL Cooperative Extension	44	39	58	36
Newspapers or magazines	14	6	21	14
Manufacturer	14	13	21	8
Other	0	0	0	0
Unaware	8	0	12	11
Total*	178	155	209	169

\* Indicates more than one was chosen.

Most farmers got information on pesticide container disposal from suppliers, pesticide labels, or UNL Cooperative Extension. Eight percent indicated they were unaware of available information concerning pesticide container disposal. Eighty-seven percent of “on-site” interviewed farmers felt they received sufficient information about pesticide container disposal.

**22b) I am willing to participate in an empty pesticide container recycling program.**

To Participate	% of 91 Respondents			
	O	S	M	C
Strongly agree	32	14	59	24
Agree	47	59	27	55
No opinion	20	24	14	21
Disagree	1	3	0	0
Strongly disagree	0	0	0	0
Total	100	100	100	100

The geographical location influenced farmer’s willingness to participate in pesticide container recycling program. Merrick County farmers showed a stronger agreement to participating in a recycling program than the other two counties. However, producers in all counties felt the need for recycling. Ozkan (1992) showed that only 2% of farmers strongly disagreed to participating in a recycling program, 9% disagreed, 61% agreed, and 28% strongly agreed to such programs.

**23) How far are fertilizers stored from a water source? (drinking well, farm pond, irrigation well, abandoned well, etc.)**

Distances	% of 72 Respondents			
	O	S	M	C
0 to 6 m (0-20 ft)	1	0	0	5
7 to 15 m (21-50 ft)	4	0	7	5
16 to 30 m (51-100 ft)	6	9	4	4
>31 m (>101 ft)	89	91	89	86
Total	100	100	100	100

**24) How are fertilizers stored? (check all that apply)**

Storage Location	% of 100 Respondents			
	O	S	M	C
Chemical tanks	31	39	39	17
On wooden pallets	4	3	3	6
On shelves	2	0	0	6
Fire resistant structure	1	3	0	0
Temperature-controlled building	0	0	0	0
Other**	31	29	33	31
Total	70	75	75	59

\*\* Other methods were: at dealers, in large steel tanks with dikes and holding pits, and by fertilizer companies.

**PART III. PETROLEUM**

**1) Please estimate the volume of the following farm products used each year. (Petroleum: gas, diesel, oil)**

Petroleum Volume	% of 96 Respondents			
	O	S	M	C
1800 to 3785 L (500 to 999 gal)	6	10	3	6
3786 to 18 950 L (1,000 to 4,999 gal)	48	52	43	50
18 951 to 37 900 L (5,000 to 9,999 gal)	32	32	42	22
37 901 L or greater (10,000 gal or greater)	14	6	12	23
Total	100	100	100	100

**2) What type of petroleum storage tanks do you have on your farmsteads?**

Type of Storage	% of 98 Respondents			
	O	S	M	C
Aboveground	91	84	97	91
Both	6	13	3	3
Underground	2	3	0	3
None	1	0	0	3
Total	100	100	100	100

A majority of farmers (91%) had aboveground petroleum storage tanks, 6% had both aboveground and underground storage, and 1% did not have any petroleum storage. From the “on-site” interviews, the majority of farmers (93%) had aboveground tanks and a few farmers had both.

**3a) What is the total capacity of underground petroleum tanks?**

Underground Tanks Size	% of 21 Respondents			
	O	S	M	C
1895 to 3786 L (500-999 gal)	19	22	20	14
3790 to 18 946 L (1,000-4,999 gal)	24	22	40	15
18 949 to 37 896 L (5,000-9,999 gal)	10	11	0	14
37 900 L or greater (10,000 gal or more)	47	45	40	57
Total	100	100	100	100

**3b) What is the total capacity of aboveground petroleum tanks?**

Aboveground Tanks Size	% of 93 Respondents			
	O	S	M	C
1895 to 3786 L (500-999 gal)	53	62	42	55
3790 to 18 946 L (1,000-4,999 gal)	41	38	58	27
18 949 to 37 896 L (5,000-9,999 gal)	4	0	0	12
37 900 L or greater (10,000 gal or more)	2	0	0	6
Total	100	100	100	100

**4) Do you store oil in appropriate building (fire resistant and ventilated) structures that are locked?**

Appropriate Structure	% of 96 Respondents			
	O	S	M	C
Yes	37	48	54	21
No	61	52	43	76
Do not store oil	2	0	3	3
Total	100	100	100	100

Thirty-seven percent of the farmers stored oil in fire resistant and ventilated buildings. Forty-eight percent of Sarpy and 54% of Merrick County farmers stored oil in secured building structures, while only 21% of Custer County farmers did so. The geographical location influenced the storage of oil in secured building structures. Farmers near the metro areas or townships stored oil in secured building structures.

**5) Do you store hydraulic fluid in an appropriate building (fire resistant and ventilated) structures that are locked?**

Appropriate Structure	% of 100 Respondents			
	O	S	M	C
Yes	35	45	46	17
No	60	48	51	77
Do not store hydraulic fluid	5	7	3	6
Total	100	100	100	100

Forty-five percent of Sarpy and 46% of Merrick County farmers stored hydraulic fluid in an appropriate building, while only 17% of Custer County farmers did so. The geographical location again influenced the storage of hydraulic fluid in secured building structures. Farmers near the metro areas or townships stored hydraulic fluid in secured building structures.

**6) For your petroleum storage tanks, do you have barriers built around them in case of spillage or leakage?**

Containment	% of 99 Respondents			
	O	S	M	C
Yes	2	3	0	3
No	98	97	100	97
Total	100	100	100	100

Ninety-eight percent of farmers did not have containment barriers built around petroleum storage tanks. Only 3% of the Sarpy and Custer County farmers had barriers, while Merrick respondents had none. Two farmers from the “on-site” interviews had contaminant barriers around petroleum storage tanks.

**7) Do you record and monitor the volumes of petroleum storage, usage, and fuel lost for all tanks?**

Record	% of 98 Respondents			
	O	S	M	C
Yes	21	27	18	19
No	79	73	82	81
Total	100	100	100	100

Twenty-one percent of farmers indicated they recorded and monitored the volume of petroleum stored and used. It was interesting the same percentage that monitored their tanks reflected the percent of underground storage tanks. In comparison, 73% of the farmers kept records of pesticide rates and types and total volume applied. Sixteen percent of the farmers from the “on-site” interviews maintained records of petroleum usage and loss. Since most petroleum storage tanks were aboveground, interviewed farmers reasoned they did not need to keep records because they could see if something malfunctioned with the tanks. They felt that record keeping was for major losses, such as large spills, leaks and not minor details (evaporated or stolen fuel).

**8) Do you do most of your refueling (of tractors, combines, trucks, etc.) in a designated area?**

Designated Area	% of 99 Respondents			
	O	S	M	C
Yes	92	90	97	89
No	8	10	3	11
Total	100	100	100	100

From “on-site” interviews, farmers were asked if they refueled at an appropriate distance from a water source. They indicated machinery/vehicles were refueled in designated areas and they were very cautious. These results indicated farmers were careful where they refueled equipment. Most farmers that farmed less than 242 ha (600 ac) refueled their equipment in designated areas more than those that farmed more.

**9) Do you keep maintenance and oil change records for all farm equipment?**

Records	% of 99 Respondents			
	O	S	M	C
Yes	82	81	85	80
No	18	19	15	20
Total	100	100	100	100

Eighty-two percent of farmers kept maintenance/oil service records, while 18% did not keep records. Wertz et al. (1990) showed that 40% of farmers kept a continuous record of all services for future reference, and 50% of farmers recorded tractor hours when the engine oil filter was serviced. These records were for a single service and were used only as a reference to perform the next service interval.

**10) When you discard used oils, do you...(select the following)**

Disposal Location	% of 100 Respondents			
	O	S	M	C
Reuse for farm use (lubricant, fuel source, fence line)	47	50	42	47
Store for recycle center	28	23	37	25
Reuse and store	9	7	9	11
Reuse and use other methods	6	10	3	6
Store and use other methods	1	3	0	0
Other**	9	7	9	11
Total	100	100	100	100

\*\* Other methods were: oil was used to burn trees, spread on road, used as a lubricant, given to garages, or picked up by a local person.

**11a) Are you aware of a petroleum (oil) recycling station nearby?**

Awareness	% of 100 Respondents			
	O	S	M	C
Yes	49	39	67	42
No	51	61	33	58
Total	100	100	100	100

Geographical location influenced whether farmers knew the location of the recycling station. Surprisingly, Sarpy County farmers were largely unaware (61%) of the local oil recycling stations, regardless of their close proximity to the metro areas. Ninety-three percent of the “on-site” interviewed farmers indicated they were unaware of the location of the recycling stations near them. However, they reported on surveys they knew the location, but when asked during the interview their response was not the same.

**11b) If you are aware of a recycling station nearby, do they charge for recycling used oils?**

Change	% of 58 Respondents			
	O	S	M	C
Yes	5	15	0	5
No	50	54	57	41
Not sure	45	31	43	54
Total	100	100	100	100

**PART IV. MAINTENANCE RESIDUALS OF FARM PRODUCTS AND EQUIPMENT**

**1) When you purchase farm products (tires, filters, tractor-car-truck batteries), are the products bought for their long life instead of shorter life and lower prices?**

Cost vs Quality	% of 100 Respondents			
	O	S	M	C
Yes	94	93	100	86
No	6	7	0	11
Total	100	100	100	97

**2a) Do you have junk piles of old machinery located on your property?**

Junk Piles	% of 100 Respondents			
	O	S	M	C
Yes	43	36	45	47
No	57	64	55	53
Total	100	100.0	100	100

Total farm size influenced whether junk piles were located on the farmsteads. Larger farms typically have more farm equipment, therefore, farmers retain old machinery for spare parts. From the “on-site” interviews, 95% of the Sarpy County, 40% of the Merrick County, and 53% of the Custer County farmsteads did not have junk piles. Also, farmers tended to keep junk piles for 20 to 40 years or more. The main reason was that the junk was used to repair other items or for sale. However, farmers did indicate that they cleaned up and hauled away unused parts. When farmers were asked what kind of items were stored in their trash dumps and junk pile, their responses were: trees, concrete, tin, wire, glass, used oil filters, used tires, and old machinery.

**2b) Do you have farmstead trash dumps located on your property?**

Trash Dumps	% of 100 Respondents			
	O	S	M	C
Yes	38	13	36	61
No	62	87	64	39
Total	100	100	100	100

Sarpy County farmsteads reported the lowest accumulation of trash dumps (13%) while Custer County farmsteads reported the greatest number of trash dumps (61%). Local landfills were less accessible in Custer County than Sarpy County, leaving Custer County farmers with little alternative but to dump trash on their farmsteads. These results were similar to responses from the “on-site” interviews in which 13% of the Sarpy County, 33% of the Merrick County, and 67% of the Custer County farmsteads had trash dumps. The geographic location influenced whether trash dumps were located on the farmstead. When local licensed landfills were not easily accessible, the waste residuals were more apt to be stored in farmstead dumps. Farmers also indicated that they did not have any full or empty pesticide containers in these trash piles.

**3) I recycle miscellaneous used farm equipment parts. (batteries, old tires, oil filters, etc.)**

Recycling Practices	% of 100 Respondents			
	O	S	M	C
Always	51	61	58	36
Often	23	19	33	17
Sometimes	20	20	6	33
Rarely	2	0	0	6
Never	4	0	3	8
Total	100.0	100	100	100

Geographic location influenced the recycling frequency of farmers. Custer County producers did not recycle as often as those in Merrick and Sarpy Counties. Custer county is isolated and less accessible to market areas for commercial recycling. Many recyclable products were reused for farm practices or stored on the property. These

results indicated farmers are aware and have positive attitudes toward reusing.

**4) How often is salvageable equipment (used tractors and implements and/or parts) taken or sold to nearby salvage yards?**

Recycling Practices	% of 97 Respondents			
	O	S	M	C
0 to 1 year	17	17	18	15
1 to 2 years	17	20	21	12
2 to 4 years	20	27	15	17
5 to 6 years	12	13	12	12
7 years or greater	18	13	15	23
Never	16	10	18	21
Total	100	100	100	100

Only 16% of the farmers “never” sold equipment to salvage yards, while 4% never recycled miscellaneous used farm equipment parts. Interestingly, farmers kept salvageable equipment more often than miscellaneous farm equipment. Probably because it was more valuable and could be retained for spare parts. The remaining farmers disposed of equipment over a period of time, their recycling practices were very consistent through the seven-year interval. This indicated most farmers did a fair job of removing salvageable equipment.

**5a) How do you generally dispose of used oil filters? (check only one)**

Disposal Location	% of 100 Respondents			
	O	S	M	C
Permitted landfill	38	55	43	19
On property	29	13	27	44
To retailer, distributor or trader	4	6	3	3
Nearby recycling center	3	7	0	3
Take to town incinerator	2	0	3	3
Stored in building	1	3	0	0
Other**	23	16	24	28
Total	100	100	100	100

\*\* Other methods were: the oil was burned out, and the tin was sent to an approved dump.

**5b) How do you generally dispose of old tires? (check only one)**

Disposal Location	% of 97 Respondents			
	O	S	M	C
To retailer, distributor or trader	40	37	58	26
On property	25	17	18	38
Permitted landfill	10	30	0	3
Stored in building	3	3	3	3
Take to town incinerator	2	3	0	3
Nearby recycling center	1	0	3	0
Other**	19	10	18	27
Total	100	100	100	100

\*\* Other methods were: used for silage piles, bank stabilization, and used as holders for salt and mineral blocks.

**5c) How do you generally dispose of old batteries (car, tractor, truck)? (check only one)**

Disposal Location	% of 98 Respondents			
	O	S	M	C
To retailer, distributor or trader	65	68	70	59
Nearby recycling center	27	29	27	23
On property	2	0	0	6
Permitted landfill	0	0	0	0
Take to town incinerator	0	0	0	0
Stored in building	0	0	0	0
Other**	6	8	3	12
Total	100	105	100	100

\*\* Other methods were: sold to junk dealers or salvage yards.

**SUMMARY**

A survey tool was developed to evaluate, compare, and contrast the agricultural producer’s current methods of agricultural waste management. One hundred surveys from Sarpy, Merrick, and Custer counties in Nebraska were returned. From the mail surveys and “on-site” interviews, it was apparent that different geographical locations in Nebraska affected some of the farmers waste management practices.

Most farmers (66%) purchased pesticides in 3.8 to 10 L (1-2.5 gal) containers. Purchasing pesticides in bulk returnable containers or dissolvable packages could help reduce excess build-up of small empty containers on the farmsteads. Seventy-nine percent of the farmers showed a willingness to participate in a recycling program for empty pesticide containers. Ninety-eight percent of farmers felt they made practical and safe decisions concerning pesticide application. Most leftover rinsates (76%) were evenly distributed on fields just sprayed.

The disposal methods of empty hard plastic/metal pesticide containers verses the soft/paper pesticide containers on farmsteads were similar. Forty-six percent of farmers burned empty hard plastic pesticide containers, 24% returned them to suppliers, and none were stored in the field. Most of the farmers (65%) burned soft plastic or paper containers or returned them to the supplier (13%). Few farmers (10-12%) that did not take pesticide containers to landfills, buried or stored containers in their fields. Sarpy and Merrick county farmers did not reuse the pesticide containers.

Seventy-three percent of farmers kept records of spraying rates and types of pesticides purchased compared to 52% who kept records of the total volume applied to each field. Consequently, farmers were becoming aware of the new regulation that restricted-use pesticide applicators must begin keeping records of their applications. When asked how far back records were kept, the results were similar between the two record keeping practices. Seventy-seven percent of farmers maintained records of total volume of pesticides for one to five years, while 85% kept records for spraying rates and types of pesticides purchased.

Thirty percent of farmers estimated the closest licensed landfill was within 50 km (30 mi), while 20% estimated 51 km or greater (31 mi or greater). Seventy-seven percent of the farmers did not know if local licensed landfills accepted unused pesticide containers and 50% did not know the location of a licensed landfill near them. A majority of the farmers interviewed “on-site” did not know the distance and claimed if they did know the distance, it was not economical to take waste products to the licensed landfill.

In case of pesticide spills, farmers tended to have several materials available for clean-up: saw dust (30%), pet litter (25%), and absorptive clay (21%). The most popular method to neutralize (25%) pesticide spills was with sodium hypochlorite (laundry bleach), then hydrated lime and ammonia (8%) followed. Thirty-three percent of the farmers did not keep any materials available for pesticide spills, compared to 55% of the farmers that kept no neutralization materials.

Pesticide and fertilizer storage distances from a water source were similar. Two percent of the farmers stored pesticides 0 to 6 m (0-20 ft) from a water source, while only 1% stored fertilizers the same distance. Twelve percent of the farmers stored pesticides 16 to 30 m (51-100 ft) from a water source, while 6% stored fertilizers the same distance. Eighty-one percent of the farmers stored pesticides and 89% stored fertilizers greater than 31 m (>101 ft) from a water source.

Out of 91 farmers, 30% indicated they had no containment barriers for pesticide or fertilizer stationary tanks or transportable nurse tanks, while 61% felt the question did not apply to their situation. While 12 farmers claimed they could contain and recover a major portion of loss if the storage tanks ruptured, only 8 farmers had containment barriers.

The average farmer frequently used between 3786 to 18 950 L (1,000-4,999 gal) of fuel annually. Seventy-nine percent of farmers from the mail survey and 84% from "on-site" interviews did not record or monitor volumes of petroleum storage, usage, and fuel loss from petroleum storage tanks. Since most petroleum tanks were above ground, farmers felt little need to monitor or record fuel usage or loss. There was a low response for having containment barriers for petroleum storage tanks (2%).

Refueling of vehicles (92%) was done in designated areas in the field. The number of farmers that kept maintenance records of equipment/oil services (82%) on a regular basis were much greater than those farmers that kept records (21%) on petroleum storage tank volumes. Most farmers did not store their oil and hydraulic fluid in secured building structures. Instead most of the oil and hydraulic fluids were stored in an open area of the machine shed. Over 76% of Custer County farmers did not secure their petroleum products in a locked structure.

Farmers tended to have trash dumps (62%) and junk piles (57%) on farmsteads. Their reasons for having them were due to lack of easily accessible disposal or recycling facilities and mechanical use. Farmers (94%) felt they did a good job of recycling. This was reflected in their disposal practices of used oil, tires, and batteries. However, knowledge of the location of licensed landfills and recycling centers was unknown by most respondents indicating that a local directory of these centers should be developed.

There were strong similarities between trash dumps and junk piles on farmsteads. Trash dumps and junk piles tended to increase by total farm size and remote locations. Custer County farmers had the most difficult problem of disposing trash and junk items. The majority of respondents (94%) frequently recycled miscellaneous used farm equipment parts. Seventy-nine percent of farmers sold or hauled away salvageable equipment. In addition, most farmers disposed of used oil filters (71%), used tires

(79%), and used batteries (93%) at the appropriate locations.

## CONCLUSIONS

Although most farmers had positive attitudes toward their waste management decisions, there were some management practices that needed improvement. For instance, knowledge of local licensed disposal facilities, and practices of storing petroleum away from water sources need to become top priority. Good management can decrease costs and the amount of left-over residuals, while preventing harm to the natural resources.

The "on-site" interviews indicated many farmers were concerned about not having access to licensed facilities to dispose of product residuals. Special programs need to be implemented for producers, especially those in isolated areas. These programs could encourage farmers to manage their agricultural waste in an economical, and yet environmentally sound manner. Though most farmers had positive attitudes toward their waste management decisions, there were some management practices that needed improvement. For instance, better record keeping of pesticides sprayed and total volume applied, knowledge of local licensed landfills, and practices of storing pesticides/fertilizers away from water sources need to become top priority. Good management can decrease cost and the amount of left-over residuals, while preventing harm to the natural resources.

Farmers for the most part utilize good pollution prevention and life-cycle practices. They purchased and disposed of miscellaneous residuals appropriately when given the opportunity. The majority of farmers (94%) felt they purchased farm products based on long life instead of lowest price. These pollution prevention practices eliminate the buildup of inexpensive products that have a tendency of wearing out quickly, accumulate, and generate potential waste disposal concerns. By purchasing products only when needed, farmers eliminate possible decay, dry rot, leakage, damage, and build-up of unused products in storage locations.

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