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Report 4

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Contents

Dairy 2014

Nutrient Management Practices on U.S. Dairy Operations, 2014



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USDA-APHIS-VS-CEAH-NAHMS
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
<http://www.aphis.usda.gov/nahms>

#755.0818

Cover photograph courtesy of Dr. Jason Lombard.

Items of Note

More than 97 percent of dairy operations housed weaned and pregnant heifers in 2013. The highest percentage of operations (32.7 percent) primarily used multiple-animal inside area/barn to house weaned heifers. The highest percentage of operations (27.8 percent) primarily used an open/dry lot with barn or shed to house pregnant heifers. Overall, 58.0 percent of operations allowed weaned heifers on pasture, and 74.1 percent allowed pregnant heifers on pasture.

For operations that housed weaned heifers, 34.3 percent primarily used bedded packs to handle manure in weaned-heifer housing areas. Gutter cleaners were the primary manure handling method used for cows on 34.3 percent of all operations, and alley scrapers were primarily used on 27.6 percent of all operations.

Overall, 92.8 percent of operations stored and/or treated solid manure; 41.6 percent of operations stored, but did not treat, solid manure on a manure spreader.

Overall, 59.3 percent of operations stored and/or treated liquid/slurry manure; 23.7 percent of operations stored liquid/slurry manure in an earthen basin but did not treat it.

On average, all operations could store any manure for 161.2 days before having to remove it. Overall, 90 percent of operations applied manure to land either owned or rented. More than one-third of operations that applied manure to land (~36 percent) analyzed the nutrient content of the manure for nitrogen, phosphorous, or potassium. The highest percentages of operations applied manure to land based on manure volume/acreage available (70.0 percent) and soil quality improvement (65.7 percent).

The majority of operations (87.2 percent) applied manure/slurry using a broadcast/solid spreader. Overall, 21.3 percent of operations always or almost always incorporated manure into the soil within 24 hours of application. On average, manure was applied 3,688 feet (0.7 miles) from any surface water.

Of the 50.8 percent of operations with a written nutrient management plan, 80.0 percent developed the plan in conjunction with USDA's Natural Resource Conservation Service or with a local conservation district. Almost one-half of all operations (43.7 percent) contacted an agronomist/crop consultant regarding nutrient management.

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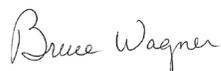
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Bruce A. Wagner
Director,
Center for Epidemiology and Animal Health

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Contacts for further information:

Questions or comments on data analysis: Dr. Jason Lombard (970) 494-7000

Information on reprints or other reports: Ms. Abby Zehr (970) 494-7000

For questions about this report or for additional copies, please contact:

USDA-APHIS-VS-CEAH-NAHMS
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970-494-7000

Introduction

The National Animal Health Monitoring System (NAHMS) is a nonregulatory program of the USDA's Animal and Plant Health Inspection Service. NAHMS is designed to help meet the Nation's animal health information needs and has collected data on dairy health and management practices through four previous studies:

The 1991–92 National Dairy Heifer Evaluation Project (NDHEP) provided the dairy industry's first national information on the health and management of dairy cattle in the United States. Just months after the study's first results were released in 1993, cases of acute bovine viral diarrhea surfaced in the United States (following a 1993 outbreak in Canada). Information from NDHEP on vaccination and biosecurity practices helped officials address the risk of disease spread and target educational efforts on vaccination protocols. In addition, an outbreak of human illness was reported in 1993 in the Pacific Northwest related to *Escherichia coli* O157:H7. NDHEP data on the prevalence of *E. coli* O157:H7 in dairy cattle helped officials define public health risks as well as research needs. This baseline picture of the industry also helped identify additional research and educational efforts in various production areas, such as feed management and weaning practices.

Dairy 1996 helped the U.S. dairy industry identify educational needs and prioritize research efforts on such topics as antimicrobial use and Johne's disease, as well as digital dermatitis, bovine leukosis virus, and potential foodborne pathogens, including *E. coli*, *Salmonella*, and *Campylobacter*.

Dairy 2002 described management strategies that prevent and reduce Johne's disease and determined management factors associated with *Mycoplasma* and *Listeria* in bulk-tank milk. Additionally, levels of participation in quality assurance programs, the incidence of digital dermatitis, a profile of animal-waste handling systems used on U.S. dairy operations, and industry changes since the NDHEP 1991–92 and Dairy 1996 studies were examined in Dairy 2002.

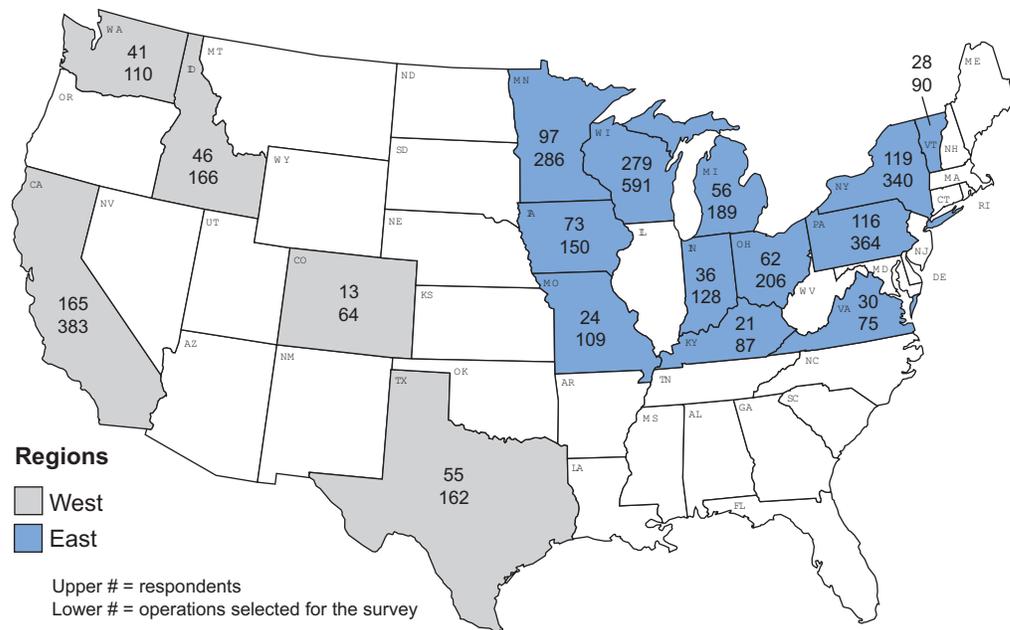
Dairy 2007 evaluated cow comfort using an on-farm assessment tool and evaluated passive transfer (maternal antibody) and growth for preweaned heifer calves. In addition, the study estimated the prevalence of multiple diseases, including bovine viral diarrhea virus, contagious mastitis pathogens such as Johne's disease, and food safety pathogens such as *Salmonella* and *Listeria*. The implementation of biosecurity practices was also evaluated, as has been done in every NAHMS dairy study. Additionally, industry changes since the NDHEP 1991–92, Dairy 1996, and Dairy 2002 studies were examined.

Dairy 2014 is the latest NAHMS dairy study and provides valuable information to participants, stakeholders, and the dairy industry as a whole. The study was conducted in 17 of the Nation's major dairy States (see map p 3). These States represented 80.5 percent of U.S. dairy operations and 81.3 percent of U.S. dairy cows. Results from the study are presented in a variety of publications, including the following reports:

- "Dairy Cattle Management Practices in the United States, 2014" contains national information collected from 1,261 dairy operations that participated in the NAHMS Dairy 2014 study.
- "Milk Quality, Milking Procedures, and Mastitis on U.S. Dairy Operations, 2014," contains information from 265 operations with 30 or more dairy cows, a subset of the 1,261 operations described in "Dairy Cattle Management Practices in the United States, 2014."
- "Health and Management Practices on U.S. Dairy Operations, 2014" contains information from 265 operations with 30 or more dairy cows, a subset of the 1,261 operations described in "Dairy Cattle Management Practices in the United States, 2014."
- "Nutrient Management Practices on U.S. Dairy Operations, 2014" is the fourth in a series of reports from the NAHMS Dairy 2014 study. The majority of this report presents national information from 1,261 operations described in the NAHMS report, "Dairy Cattle Management Practices in the United States, 2014." NASS data collectors conducted questionnaire interviews with producers during January 2014. Operations with fewer than 30 cows were administered an abbreviated questionnaire and, therefore, are not included in some tables in this report.

All NAHMS Dairy reports are available at: <http://www.aphis.usda.gov/nahms>

NAHMS Dairy 2014 Participating States



Methods used, definitions for phase I and phase II of the study, and the number of respondents can be found in the Methodology section of this report on page 47.

Terms Used in This Report

Cattle types:

Cow—Female dairy bovine that has calved at least once.

Heifer—Female dairy bovine of any age that has not yet calved.

Pregnant heifer—Female dairy bovine that is pregnant for the first time.

Weaned heifer—Female dairy bovine that is no longer on liquid feed (i.e., milk or milk replacer) and is not pregnant.

Herd size: Herd size is based on an operation's January 1, 2014, dairy cow inventory. Very small operations had fewer than 30 head; small operations had 30 to 99 head; medium operations had 100 to 499 head; and large operations had 500 or more head. Very small operations were administered an abbreviated questionnaire with a subset of questions administered to operations with 30 or more cows.

Housing types:

Freestall—Housing consisting of resting stalls or "beds" in which dairy cows are free to enter and leave at will.

Multiple-animal area—Housing other than freestall or open dry lot where cows are able to move from one area to another, such as in a bedded-pack barn.

Open dry lot—An open, dirt lot with no vegetative cover used for housing cows in arid and semi-arid climates.

Pasture—An area with vegetation suitable for grazing.

Stanchion—Housing in which a cow is restrained in an individual stall in a device with two rails that close around the cow's neck after she enters the stall. Cows are not able to enter and leave stalls at will.

Tie stall—Housing in which a cow is restrained by a neck collar attached to an individual stall by a chain. Cows are not able to enter and leave tie stalls at will.

Manure: The waste product from cattle. Fertilizing land by spreading manure, which occurs frequently, is part of a nutrient management plan. There are three common types of manure: solid, slurry, and liquid. Solid manure usually contains more than 15 percent solids and is typically found in areas where dirt, pasture, or bedding absorb moisture from the manure. Slurry manure usually contains from 5 to 15 percent solids and is generated when there is limited or no material to absorb moisture from manure. Liquid manure contains less than 5 percent solids and is generated when waste water or rain water is mixed with manure. *For the purposes of this report, liquid and slurry manure are combined.*

Manure-handling methods:

Alley flush with recycled water—System in which lagoon water is used to flush manure from alleyways. Lagoon water and manure are collected, and the solids are usually separated with mechanical or gravity systems before the waste water is recycled and used again.

Alley scraper (mechanical or tractor)—System used to clean cow alleyways using either a scraper blade, which is moved with a chain or cable, or a tractor equipped with a bucket or blade.

Bedded pack (manure pack)—Manure accumulates in a pack that is frequently bedded. The pack is completely removed during cleaning.

Gutter cleaner—Conveyor with paddles that moves manure from a trough behind the cows to another handling method or storage area.

Manure left on pasture—Manure is not handled, although the pasture might be harrowed to break up and spread manure.

Manure vacuum—Equipment is used to suck slurry manure from a concrete surface and into a tank.

Open/dry lot scraped—Manure from a dry lot which is usually scraped using a tractor with a bucket or blade.

Slotted floor—Floor with perforations or slots that allows manure to fall into a collection pit below.

Manure storage and treatment systems:

Below-floor slurry or deep pit—Concrete or earthen-lined pit (located below cow areas) where manure accumulates and is stored.

Collected methane/biogas—A method for capturing gas produced when manure is stored in an anaerobic environment.

Composted (actively managed to produce a composted material)—Manure is monitored for temperature and regularly turned/mixed to aerate.

Liquid/slurry manure stored in earthen basin and not treated—Manure is stored in a basin without treating.

Manure pack (bedded pack – inside barn)—Accumulated manure is stored in a pack that is frequently bedded. The pack is completely removed during cleaning.

Manure spreader (spread on a daily or almost daily basis)—Short-term manure storage in equipment used to scatter manure in a field.

Outside storage for solid manure not in dry lot or pen—Manure is stored in a pile where cattle do not have access.

Outside storage for solid manure within dry lot or pen—Manure is stored in a pile with a pen of cattle.

Slurry stored in tank (either above or below ground)—Storage system where liquid manure is captured in a tank.

Solid manure stored in a building without cattle access—Collection of solid manure in areas with a solid separator or with other means of reducing manure moisture content.

Solid manure stored with a picket dam—Pit or lagoon that has a permeable barrier, usually a wooden fence that allows excess water from rainfall or other sources to drain away from the manure.

Solid separator—Device that physically separates liquids from manure, usually through pressure.

Treatment lagoon (mechanically aerated)—Structure similar to a pond where manure and other waste water accumulate and manure decomposes. Aerators are used to provide oxygen to support aerobic bacteria.

Treatment lagoon (not mechanically aerated)—Structure similar to a pond engineered and designed to allow manure and other waste water to accumulate and decompose in an aerobic environment.

Operation: Premises with at least one dairy cow on January 1, 2014.

Operation average: The average value for all operations. A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, the operation average number of days operations could store manure before reaching capacity and having to remove it (table A.3.d) is calculated by summing reported average storage days for each operation divided by the number of operations.

Population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. An estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). When estimates are reported as being “higher” or “lower,” a statistical difference is implied but not tested. Not all statistically different estimates are mentioned in the text of this report. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported as (0.0). If there were no reports of the event (0.0 percent) or if all operations reported the event (100.0 percent), no standard error was reported (—).

Regions:

West: California, Colorado, Idaho, Texas, Washington

East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, Wisconsin.

Sample profile: Information that describes characteristics of the operations from which Dairy 2014 data were collected.

Section I: Population Estimates

Note: Data in all tables refer to calendar year 2013, unless otherwise noted.

Where applicable, column or row totals are shown as 100.0 to aid in interpretation. However, estimates may not sum to 100.0 due to rounding.

A. Nutrient Management

1. Housing

The majority of operations housed weaned and pregnant heifers in 2013.

A.1.a. Percentage of operations that housed or reared weaned or pregnant heifers on the operation, by herd size:

Percent Operations										
Herd Size (number of cows)										
Heifer class	Very small (<30)		Small (30–99)		Medium (100–499)		Large (500+)		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Weaned	96.5	(2.1)	98.1	(0.7)	98.1	(0.7)	90.5	(1.3)	97.1	(0.5)
Pregnant	93.7	(3.3)	99.0	(0.5)	99.7	(0.3)	98.5	(0.5)	98.4	(0.5)
Either	97.9	(1.5)	99.6	(0.3)	99.7	(0.3)	98.9	(0.4)	99.3	(0.3)

The highest percentage of operations (32.7 percent) primarily used multiple-animal inside area/barn to house weaned heifers, followed by open/dry lot with barn or shed (21.9 percent). Generally, the percentage of operations that housed weaned heifers in tie stalls or stanchions decreased as herd size increased. Large operations accounted for the highest percentage of operations that housed weaned heifers in an open/dry lot without barn or shed (14.5 percent).

A.1.b. Percentage of operations by primary housing type used for weaned heifers, and by herd size:

Primary housing type	Percent Operations									
	Herd Size (number of cows)									
	Very small (<30)		Small (30–99)		Medium (100–499)		Large (500+)		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Multiple-animal inside area/barn	19.7	(4.9)	35.8	(2.5)	37.9	(2.7)	22.3	(1.9)	32.7	(1.6)
Open/dry lot with barn or shed	18.9	(5.2)	21.3	(2.1)	24.5	(2.3)	22.8	(1.9)	21.9	(1.4)
Individual inside hutch/pen, cold	17.7	(5.3)	9.9	(1.6)	6.9	(1.4)	3.0	(0.7)	9.6	(1.2)
Freestall with access to open/dry lot	5.6	(2.9)	7.2	(1.3)	5.8	(1.3)	11.4	(1.4)	7.0	(0.9)
Pasture	12.3	(4.0)	4.4	(1.0)	7.1	(1.4)	1.9	(0.8)	6.0	(0.9)
Tie stall or stanchion	13.1	(3.8)	6.5	(1.2)	1.8	(0.8)	0.0	(—)	5.7	(0.9)
Open/dry lot without barn or shed*	3.9	(2.9)	4.7	(1.1)	4.8	(1.2)	14.5	(1.5)	5.6	(0.8)
Freestall with no access to open/dry lot	4.0	(2.2)	4.9	(1.2)	5.7	(1.2)	10.5	(1.7)	5.5	(0.8)
Individual inside hutch/pen, warm	0.0	(—)	1.7	(0.7)	3.0	(0.9)	1.2	(0.4)	1.7	(0.4)
Individual outside hutch/pen	1.4	(1.4)	1.5	(0.6)	0.6	(0.4)	2.9	(0.7)	1.4	(0.4)
Not housed on this operation	3.5	(2.1)	1.9	(0.7)	1.9	(0.7)	9.5	(1.3)	2.9	(0.5)
Total	100.0		100.0		100.0		100.0		100.0	

*With or without shade structures.

The highest percentage of operations (27.8 percent) primarily used an open/dry lot with barn or shed to house pregnant heifers, followed by a freestall with access to open/dry lot (18.5 percent), multiple-animal inside area/barn (15.0 percent), and pasture (12.6 percent).

A.1.c. Percentage of operations by primary housing type used for pregnant heifers, and by herd size:

Percent Operations										
Herd Size (number of cows)										
Primary housing type	Very small (<30)		Small (30–99)		Medium (100–499)		Large (500+)		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Open/dry lot with barn or shed	23.0	(5.8)	29.5	(2.3)	30.2	(2.5)	18.8	(1.9)	27.8	(1.6)
Freestall with access to open/dry lot	14.1	(5.1)	18.6	(2.1)	19.5	(2.2)	21.3	(1.8)	18.5	(1.4)
Multiple-animal inside area/barn	13.3	(4.6)	17.8	(2.0)	14.0	(2.0)	5.6	(1.1)	15.0	(1.3)
Pasture	17.5	(4.9)	11.8	(1.5)	14.1	(1.9)	6.4	(1.3)	12.6	(1.1)
Open/dry lot without barn or shed*	4.6	(2.6)	6.3	(1.3)	9.7	(1.5)	20.7	(1.6)	8.3	(0.8)
Tie stall or stanchion	21.2	(5.1)	9.7	(1.6)	0.9	(0.5)	0.0	(—)	8.1	(1.1)
Freestall with no access to open/dry lot	0.0	(—)	5.2	(1.2)	11.3	(1.7)	25.7	(1.8)	8.1	(0.8)
Not housed on this operation	6.3	(3.3)	1.0	(0.5)	0.3	(0.3)	1.5	(0.5)	1.6	(0.5)
Total	100.0		100.0		100.0		100.0		100.0	

*With or without shade structures.

The percentage of operations that allowed weaned or pregnant heifers on pasture generally decreased as herd size increased. More than three-fourths of very small operations allowed weaned or pregnant heifers on pasture (77.0 and 85.9 percent of operations, respectively), compared with less than one-third of large operations (20.1 and 30.3 percent, respectively). Overall, 58.0 percent of operations allowed weaned heifers on pasture, and 74.1 percent allowed pregnant heifers on pasture.

A.1.d. For the 97.1 percent of operations that housed weaned heifers (table A.1.a), and for the 98.4 percent of operations that housed pregnant heifers (table A.1.a), percentage of operations that allowed heifers access to pasture, by heifer class and by herd size:

Percent Operations										
Herd Size (number of cows)										
	Very small (<30)		Small (30–99)		Medium (100–499)		Large (500+)		All operations	
Heifer class	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Weaned	77.0	(5.4)	65.7	(2.5)	44.8	(2.8)	20.1	(2.1)	58.0	(1.7)
Pregnant	85.9	(4.8)	83.3	(1.9)	65.3	(2.6)	30.3	(2.3)	74.1	(1.4)

2. Manure handling

The methods used for handling manure in weaned-heifer housing areas differed by herd size, in some cases. More than one-half of very small, small, and medium operations left manure on pasture. Over one-half of medium and large operations scraped manure from an open/dry lot, and about two-thirds of small and medium operations handled manure using a bedded pack. In general, the use of gutter cleaners decreased as herd size increased, while the use of alley scrapers increased as herd size increased.

A.2.a. For the 97.1 percent of operations that housed weaned heifers (table A.1.a), percentage of operations by method(s) used to handle manure in weaned-heifer housing areas, and by herd size:

Method	Percent Operations									
	Herd Size (number of cows)									
	Very small (<30)		Small (30–99)		Medium (100–499)		Large (500+)		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Manure left on pasture	58.8	(6.7)	88.3	(1.7)	70.3	(2.5)	39.4	(2.5)	75.5	(1.5)
Bedded pack (manure pack)	30.2	(6.5)	67.5	(2.4)	68.1	(2.5)	41.3	(2.4)	60.3	(1.7)
Open/dry lot scraped	33.9	(6.4)	55.4	(2.6)	53.5	(2.7)	62.9	(2.3)	52.6	(1.8)
Alley scraper (mechanical or tractor)	19.5	(5.6)	23.6	(2.2)	42.7	(2.8)	44.2	(2.4)	29.7	(1.6)
Gutter cleaner	23.9	(5.9)	23.0	(2.1)	8.9	(1.6)	5.5	(1.0)	18.0	(1.4)
Alley flush with recycled water	0.0	(—)	0.1	(0.1)	2.2	(0.6)	30.7	(1.8)	3.3	(0.2)
Slotted floor	0.0	(—)	3.5	(1.0)	2.6	(0.9)	4.8	(1.1)	2.9	(0.6)
Manure vacuum	0.0	(—)	0.3	(0.3)	0.8	(0.6)	5.2	(0.9)	0.8	(0.2)
Other	6.9	(4.0)	3.0	(0.9)	1.8	(0.9)	1.2	(0.5)	3.1	(0.8)

For operations that housed weaned heifers, 34.3 percent primarily used bedded packs to handle manure in weaned-heifer housing areas. Bedded packs were primarily used for handling manure in weaned-heifer housing areas by the highest percentage of small and medium operations (37.8 and 40.7 percent, respectively). Scraping an open/dry lot or using an alley scraper were the two primary methods used by large operations (35.3 and 26.6 percent of operations, respectively).

A.2.b. For the 97.1 percent of operations that housed weaned heifers (table A.1.a), percentage of operations by primary method used to handle manure in weaned-heifer housing areas, and by herd size:

Primary method	Percent Operations									
	Herd Size (number of cows)									
	Very small (<30)		Small (30–99)		Medium (100–499)		Large (500+)		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Bedded pack (manure pack)	21.4	(5.6)	37.8	(2.5)	40.7	(2.7)	15.3	(1.9)	34.3	(1.7)
Open/dry lot scraped	12.8	(4.0)	17.8	(2.0)	19.2	(2.2)	35.3	(2.3)	19.0	(1.3)
Manure left on pasture	36.5	(6.6)	15.9	(1.8)	13.3	(1.9)	5.2	(1.3)	17.1	(1.4)
Alley scraper (mechanical or tractor)	14.9	(5.2)	11.2	(1.6)	21.3	(2.2)	26.6	(2.1)	15.6	(1.3)
Gutter cleaner	10.5	(3.7)	13.4	(1.7)	2.0	(0.7)	0.6	(0.4)	9.0	(1.0)
Alley flush with recycled water	0.0	(—)	0.0	(—)	1.4	(0.5)	15.4	(1.6)	1.7	(0.2)
Slotted floor	0.0	(—)	2.2	(0.8)	1.3	(0.7)	0.8	(0.4)	1.6	(0.5)
Manure vacuum	0.0	(—)	0.3	(0.3)	0.0	(—)	0.4	(0.3)	0.2	(0.2)
Other	3.8	(2.8)	1.3	(0.6)	0.7	(0.5)	0.4	(0.2)	1.4	(0.5)
Total	100.0		100.0		100.0		100.0		100.0	

For operations that housed weaned heifers, a higher percentage in the East region than in the West region (36.9 and 4.1 percent, respectively) primarily used bedded packs to handle manure. Alternatively, a higher percentage of operations in the West region than in the East region (40.9 and 17.2 percent, respectively) handled manure in weaned-heifer housing areas by scraping open/dry lots.

A.2.c. For the 91.7 percent of operations that housed weaned heifers (table A.1.a), percentage of operations by primary method used to handle manure in weaned-heifer housing areas, and by region:

Primary method	Percent Operations			
	West		East	
	Percent	Std. error	Percent	Std. error
Bedded pack (manure pack)	4.1	(2.0)	36.9	(1.8)
Open/dry lot scraped	40.9	(3.6)	17.2	(1.4)
Manure left on pasture	18.5	(3.4)	17.0	(1.5)
Alley scraper (mechanical or tractor)	16.7	(3.3)	15.6	(1.3)
Gutter cleaner	0.0	(—)	9.8	(1.1)
Alley flush with recycled water	19.6	(2.1)	0.2	(0.1)
Slotted floor	0.0	(—)	1.7	(0.5)
Manure vacuum	0.2	(0.2)	0.2	(0.2)
Other	0.0	(—)	1.5	(0.6)
Total	100.0		100.0	

Cow manure was left on pasture on more than 60 percent of very small, small, medium, and all operations. About 60 percent of small, medium, and large operations scraped an open/dry lot. In general, the use of a gutter cleaner for handling manure decreased as herd size increased. A lower percentage of very small and small operations used an alley scraper compared with medium and large operations.

A.2.d. Percentage of operations by method(s) used to handle manure in cow housing areas, and by herd size:

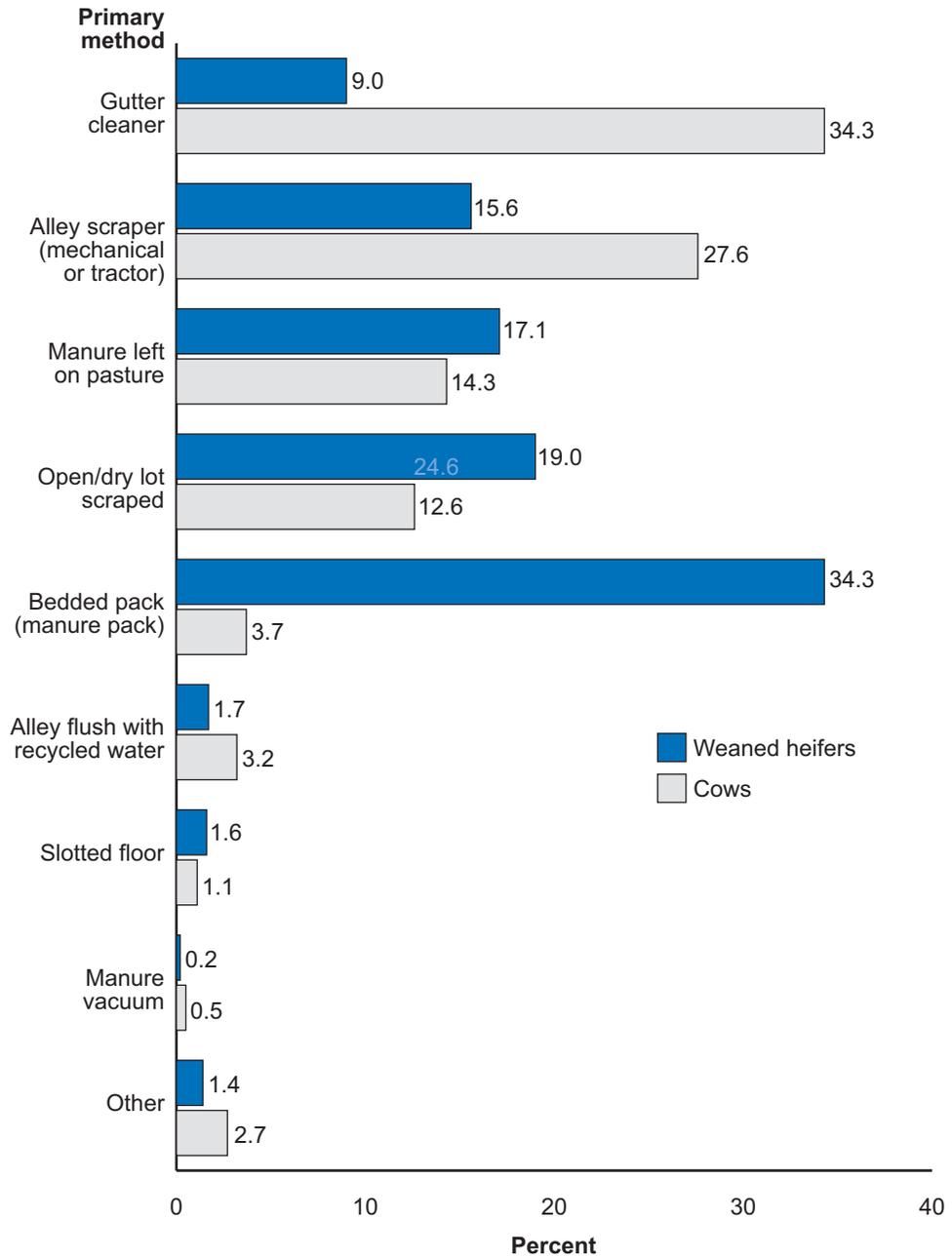
Method	Percent Operations									
	Herd Size (number of cows)									
	Very small (<30)		Small (30–99)		Medium (100–499)		Large (500+)		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Manure left on pasture	71.8	(5.9)	88.3	(1.6)	65.9	(2.6)	26.2	(2.1)	74.3	(1.4)
Open/dry lot scraped	35.8	(6.1)	65.2	(2.4)	60.4	(2.7)	57.9	(2.0)	59.0	(1.7)
Gutter cleaner	48.0	(6.4)	65.6	(2.2)	26.6	(2.6)	9.6	(1.3)	47.9	(1.6)
Alley scraper (mechanical or tractor)	22.0	(5.4)	33.4	(2.4)	69.6	(2.6)	65.7	(1.9)	43.9	(1.6)
Bedded pack (manure pack)	23.0	(5.4)	30.3	(2.3)	36.1	(2.7)	31.3	(2.2)	30.8	(1.6)
Alley flush with recycled water	0.0	(—)	1.9	(0.7)	4.4	(0.9)	39.4	(1.8)	5.8	(0.5)
Slotted floor	0.0	(—)	3.9	(1.0)	6.4	(1.3)	10.1	(1.5)	4.5	(0.6)
Manure vacuum	4.0	(2.9)	0.9	(0.5)	0.3	(0.3)	8.7	(1.0)	2.0	(0.5)
Other	7.3	(3.7)	5.5	(1.3)	4.1	(1.2)	1.6	(0.5)	5.1	(0.9)

Gutter cleaners were used as the primary method of handling manure on 34.3 percent of all operations, and alley scrapers were the primary method used by 27.6 percent. Leaving manure on pasture was the primary method of handling manure in cow housing areas on 41.0 percent of very small operations. The majority of small operations (53.9 percent) primarily used a gutter cleaner. About 50 percent of medium and large operations (51.4 and 45.2 percent, respectively) primarily used an alley scraper in cow housing areas.

A.2.e. Percentage of operations by primary method used to handle manure in cow housing areas, and by herd size:

Percent Operations										
Herd Size (number of cows)										
	Very small (<30)		Small (30–99)		Medium (100–499)		Large (500+)		All operations	
Primary method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Gutter cleaner	25.2	(5.2)	53.9	(2.4)	12.5	(2.0)	0.4	(0.3)	34.3	(1.6)
Alley scraper (mechanical or tractor)	16.1	(4.9)	15.9	(1.8)	51.4	(2.8)	45.2	(1.9)	27.6	(1.4)
Manure left on pasture	41.0	(6.3)	11.2	(1.6)	9.6	(1.7)	2.2	(0.8)	14.3	(1.4)
Open/dry lot scraped	8.0	(3.0)	9.8	(1.4)	15.5	(2.0)	27.1	(1.8)	12.6	(1.0)
Bedded pack (manure pack)	6.3	(3.3)	3.1	(0.8)	4.5	(1.3)	1.2	(0.4)	3.7	(0.7)
Alley flush with recycled water	0.0	(—)	1.3	(0.6)	2.5	(0.7)	19.8	(1.6)	3.2	(0.4)
Slotted floor	0.0	(—)	0.6	(0.4)	2.8	(0.9)	0.6	(0.3)	1.1	(0.3)
Manure vacuum	0.0	(—)	0.5	(0.4)	0.0	(¾)	2.6	(0.6)	0.5	(0.2)
Other	3.4	(2.4)	3.6	(1.0)	1.3	(0.7)	0.7	(0.4)	2.7	(0.7)
Total	100.0		100.0		100.0		100.0		100.0	

Percentage of operations by primary method used to handle manure in weaned-heifer housing areas and in cow housing areas



Higher percentages of operations in the West region than in the East region scraped an open/dry lot or used an alley flush with recycled water as their primary method for handling manure in cow housing areas. No operations in the West region used a gutter cleaner or slotted floor for handling manure from cows.

A.2.f. Percentage of operations by primary method used to handle manure in cow housing areas, and by region:

Primary method	Percent Operations			
	West		East	
	Percent	Std. error	Percent	Std. error
Gutter cleaner	0.0	(—)	37.4	(1.7)
Alley scraper (mechanical or tractor)	17.1	(3.1)	28.6	(1.5)
Manure left on pasture	18.7	(3.8)	13.9	(1.4)
Open/dry lot scraped	33.6	(3.1)	10.7	(1.1)
Bedded pack (manure pack)	2.6	(1.6)	3.8	(0.8)
Alley flush with recycled water	23.4	(2.2)	1.3	(0.4)
Slotted floor	0.0	(—)	1.2	(0.3)
Manure vacuum	2.1	(0.5)	0.4	(0.2)
Other	2.4	(1.7)	2.7	(0.7)
Total	100.0		100.0	

Multiple manure handling methods for cows were used for each primary housing type.

A.2.g. Percentage of operations by manure handling method(s) used for cows and by housing type for lactating cows:

Method	Percent Operations															
	Primary Housing Type															
	Tie stall or stanchion	Pasture		Freestall with no access to open/dry lot		Freestall with access to open/dry lot		Open/dry lot without barn or shed*		Open/dry lot with barn or shed*		Other	All operations			
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error		
Left on pasture	85.1	(2.3)	95.6	(4.2)	47.9	(3.1)	71.9	(3.1)	43.4	(9.2)	74.7	(5.5)	82.8	(4.9)	74.3	(1.4)
Lot scraped	57.4	(3.1)	49.6	(6.9)	47.1	(3.1)	71.5	(3.7)	92.9	(6.6)	71.4	(8.0)	60.3	(7.5)	59.2	(1.7)
Gutter cleaner	89.0	(2.1)	26.2	(6.5)	12.7	(2.4)	22.8	(3.2)	30.5	(9.0)	29.6	(6.7)	25.9	(6.6)	47.5	(1.6)
Alley scraper	16.8	(2.3)	29.6	(5.8)	85.4	(2.1)	65.3	(3.5)	43.8	(8.7)	36.2	(7.0)	45.6	(7.3)	44.5	(1.7)
Alley flush	1.5	(0.7)	4.6	(2.0)	7.6	(1.1)	11.2	(1.4)	25.0	(5.9)	10.9	(2.5)	2.9	(1.4)	6.0	(0.5)
Slotted floor	3.2	(1.1)	0.8	(0.6)	6.5	(1.3)	7.5	(1.8)	5.1	(2.0)	2.7	(1.3)	5.0	(2.2)	4.7	(0.6)
Bedded pack	27.2	(2.8)	16.4	(4.7)	33.3	(2.9)	30.8	(3.4)	28.1	(7.5)	43.9	(7.5)	57.6	(7.4)	31.1	(1.6)
Vacuum	1.2	(0.7)	3.1	(2.0)	1.2	(0.3)	3.1	(1.9)	10.8	(2.9)	4.9	(2.4)	0.3	(0.3)	2.0	(0.5)
Other	7.8	(1.8)	2.2	(2.0)	1.3	(0.6)	1.6	(0.7)	0.9	(0.8)	5.8	(3.7)	17.2	(7.0)	5.2	(0.9)

*With or without shade structures.

Primary manure-handling methods used for cows varied by housing type. For instance, gutter cleaners were used by 76.8 percent of tie stall/stanchion operations, while alley scrapers were used by 73.9 and 45.7 percent of freestalls without and with outside access, respectively.

A.2.h. Percentage of operations by primary manure handling method used for cows and by primary housing type:

Primary method	Percent Operations							
	Primary Housing							
	Tie stall or stanchion	Pasture	Freestall with no access to open/dry lot	Freestall with access to open/dry lot	Open/dry lot without barn or shed*	Open/dry lot with barn or shed*	Other	All operations
	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error
Gutter cleaner	76.8 (2.7)	10.9 (5.3)	1.5 (0.9)	7.4 (2.2)	7.1 (6.6)	14.3 (5.5)	19.1 (6.0)	34.6 (1.6)
Alley scraper	3.7 (1.1)	6.6 (3.4)	73.9 (2.8)	45.7 (3.8)	20.0 (8.2)	7.2 (3.5)	22.3 (5.4)	28.0 (1.4)
Left on pasture	8.2 (1.9)	69.1 (6.7)	2.3 (1.2)	8.3 (2.2)	8.8 (5.9)	26.8 (8.1)	21.4 (7.3)	13.4 (1.3)
Lot scraped	2.5 (1.0)	9.8 (3.9)	14.3 (2.3)	25.8 (3.1)	56.1 (9.2)	27.5 (5.1)	9.3 (4.0)	12.9 (1.0)
Bedded pack	1.1 (0.7)	1.9 (1.8)	0.4 (0.4)	2.8 (1.1)	0.0 (—)	18.3 (5.8)	19.1 (5.6)	3.4 (0.6)
Alley flush	1.3 (0.7)	0.3 (0.3)	4.3 (0.9)	7.7 (1.2)	4.8 (2.5)	3.1 (1.4)	0.9 (0.4)	3.2 (0.4)
Slotted floor	0.5 (0.5)	0.0 (—)	2.6 (0.9)	1.7 (0.8)	0.0 (—)	0.0 (—)	1.2 (1.2)	1.1 (0.3)
Vacuum	0.4 (0.4)	1.5 (1.5)	0.6 (0.2)	0.3 (0.1)	2.3 (1.2)	0.0 (—)	0.3 (0.3)	0.5 (0.2)
Other	5.4 (1.6)	0.0 (—)	0.3 (0.2)	0.3 (0.2)	0.9 (0.8)	2.7 (2.6)	6.4 (3.9)	2.8 (0.7)
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*With or without shade structures.

3. Waste storage or treatment systems

More than one-half of all operations used a spreader or pack as a manure storage system (61.3 and 57.6 percent, respectively). A higher percentage of operations in the East region than in the West region used these two systems. The highest percentages of large operations stored liquid/slurry manure in an untreated earthen basin (51.6 percent) or stored solid manure outside not in dry lot or pen (46.2 percent). About one-half of operations in the West region used outside storage for solid manure not in a dry lot or pen (52.0 percent) or a treatment lagoon that was not mechanically aerated (45.8 percent).

A.3.a. Percentage of operations by manure storage or treatment system(s) used, and by herd size and region:

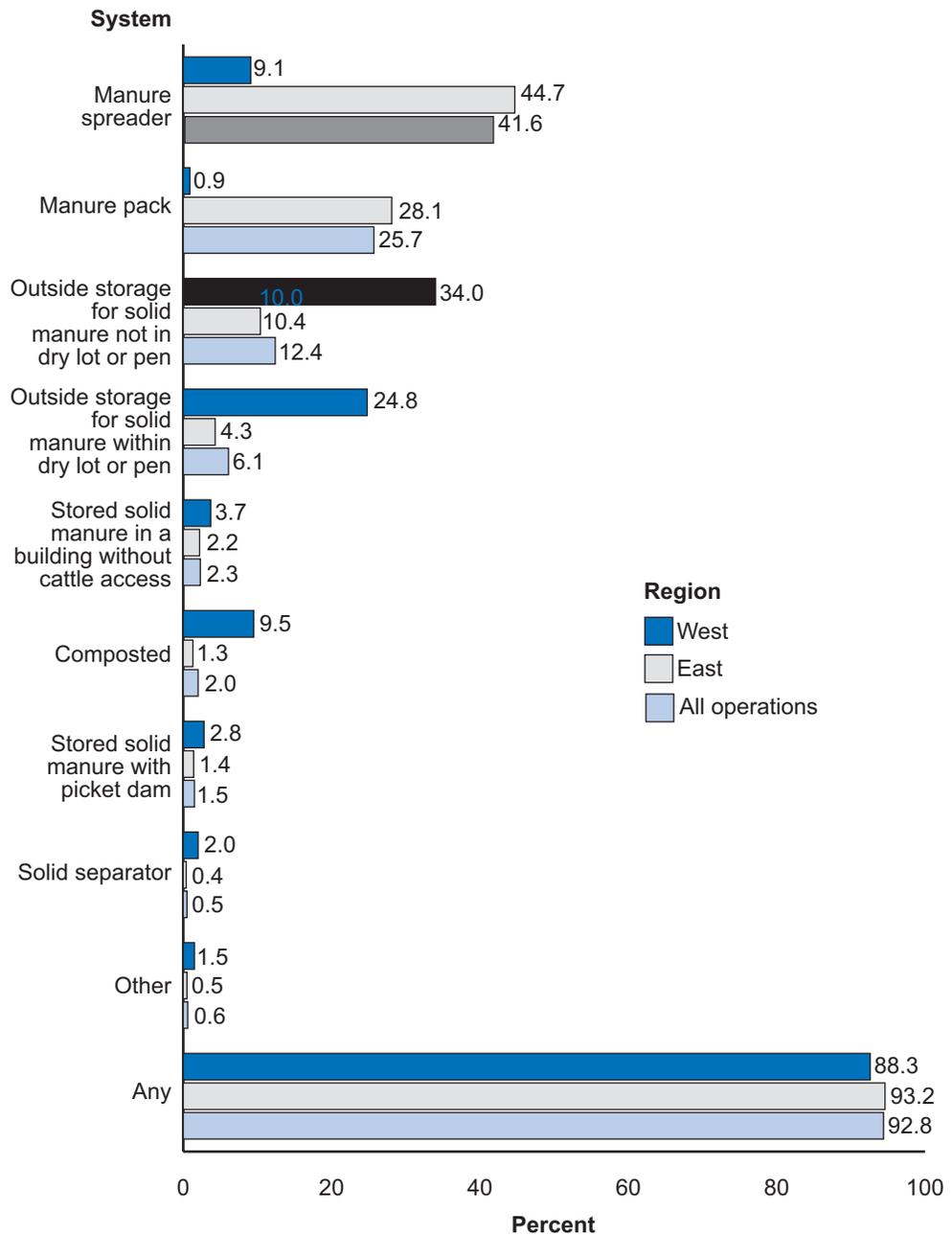
System	Percent Operations											
	Herd Size (number of cows)						Region				All operations	
	Small (30–99)		Medium (100–499)		Large (500+)		West		East			
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Manure spreader	67.0	(2.4)	57.6	(2.6)	40.4	(2.2)	41.2	(3.2)	63.2	(1.8)	61.3	(1.6)
Manure pack	59.4	(2.4)	63.2	(2.6)	32.9	(1.9)	9.4	(2.4)	62.3	(1.8)	57.6	(1.7)
Outside storage for solid manure not in dry lot or pen	28.8	(2.3)	33.1	(2.6)	46.2	(2.3)	52.0	(3.4)	30.0	(1.7)	32.0	(1.6)
Liquid/slurry manure stored in earthen basin and not treated	16.4	(1.9)	37.0	(2.6)	51.6	(2.3)	39.8	(3.2)	25.0	(1.5)	26.3	(1.4)
Liquid/slurry stored in tank	13.9	(1.8)	20.2	(2.1)	15.7	(1.6)	9.8	(1.7)	16.6	(1.4)	16.0	(1.3)
Below-floor slurry or deep pit	14.3	(1.8)	17.1	(2.0)	17.3	(2.0)	11.8	(2.0)	15.8	(1.3)	15.4	(1.2)
Outside storage for solid manure within dry lot or pen	12.3	(1.6)	18.2	(2.0)	24.2	(1.8)	39.5	(3.1)	12.9	(1.2)	15.3	(1.2)
Treatment lagoon—not mechanically aerated	4.1	(1.0)	10.1	(1.5)	33.8	(2.0)	45.8	(3.3)	5.6	(0.8)	9.2	(0.8)
Composted	5.2	(1.1)	9.3	(1.6)	24.1	(1.9)	27.1	(2.4)	6.7	(0.9)	8.5	(0.8)
Stored solid manure in a building without cattle access	3.9	(1.0)	4.3	(1.0)	7.3	(1.1)	6.7	(1.5)	4.1	(0.7)	4.4	(0.7)
Solid separator	0.6	(0.4)	2.7	(0.8)	26.7	(2.0)	20.5	(1.9)	2.5	(0.4)	4.1	(0.4)
Treatment lagoon—mechanically aerated	0.9	(0.5)	4.5	(1.1)	16.8	(1.6)	24.8	(3.0)	1.7	(0.4)	3.7	(0.5)
Stored solid manure with picket dam	2.3	(0.8)	5.2	(1.3)	2.5	(0.6)	4.8	(1.3)	3.0	(0.7)	3.2	(0.6)
Collected methane/biogas	0.0	(—)	0.3	(0.3)	6.7	(1.3)	1.3	(0.5)	0.8	(0.2)	0.8	(0.2)
Other	1.4	(0.6)	2.4	(0.8)	4.6	(0.9)	4.0	(0.8)	1.9	(0.5)	2.1	(0.4)

Solid manure was stored and/or treated on 92.8 percent of operations. A higher percentage of small operations (95.3 percent) stored and/or treated solid manure compared with large operations (87.8 percent). The use of a manure spreader decreased as herd size increased. Manure packs were used by a higher percentage of small and medium operations (25.0 and 30.9 percent, respectively) compared with large operations (14.1 percent). A higher percentage of operations in the East region than in the West region used a manure spreader or manure pack to handle the majority of solid manure. In general, the percentages of operations that used outside storage for solid manure not in a dry lot, or that used outside storage for solid manure within a dry lot or pen, increased as herd size increased. A higher percentage of operations in the West region than in the East region used composting, outside storage for solid manure not in a dry lot or pen, or outside storage for solid manure within a dry lot or pen.

A.3.b. Percentage of operations by manure storage or treatment system(s) used for the majority of solid manure, and by herd size and region:

System	Percent Operations											
	Herd Size (number of cows)						Region				All operations	
	Small (30–99)		Medium (100–499)		Large (500+)		West		East			
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Manure spreader	52.9	(2.5)	28.8	(2.6)	14.1	(1.9)	9.1	(1.8)	44.7	(1.8)	41.6	(1.7)
Manure pack	25.0	(2.2)	30.9	(2.5)	15.2	(1.6)	0.9	(0.7)	28.1	(1.7)	25.7	(1.5)
Outside storage for solid manure not in dry lot or pen	9.0	(1.4)	13.5	(1.9)	28.0	(2.1)	34.0	(3.2)	10.4	(1.1)	12.4	(1.0)
Outside storage for solid manure within dry lot or pen	4.0	(1.0)	7.5	(1.4)	13.6	(1.5)	24.8	(3.0)	4.3	(0.7)	6.1	(0.7)
Stored solid manure in a building without cattle access	2.1	(0.7)	2.4	(0.8)	3.3	(0.8)	3.7	(1.1)	2.2	(0.5)	2.3	(0.5)
Composted	0.5	(0.3)	3.1	(0.9)	7.6	(1.1)	9.5	(1.6)	1.3	(0.3)	2.0	(0.3)
Stored solid manure with picket dam	1.5	(0.7)	1.7	(0.8)	1.4	(0.5)	2.8	(1.1)	1.4	(0.5)	1.5	(0.5)
Solid separator	0.0	(0.0)	0.7	(0.5)	3.0	(0.8)	2.0	(0.7)	0.4	(0.2)	0.5	(0.2)
Other	0.3	(0.3)	0.8	(0.5)	1.4	(0.5)	1.5	(0.6)	0.5	(0.3)	0.6	(0.2)
Any storage or treatment	95.3	(1.1)	89.5	(1.7)	87.8	(1.6)	88.3	(2.6)	93.2	(0.9)	92.8	(0.8)
No solid manure	4.7	(1.1)	10.5	(1.7)	12.2	(1.6)	11.7	(2.6)	6.8	(0.9)	7.2	(0.8)

Percentage of operations by manure storage or treatment system(s) used for the majority of solid manure, and by region

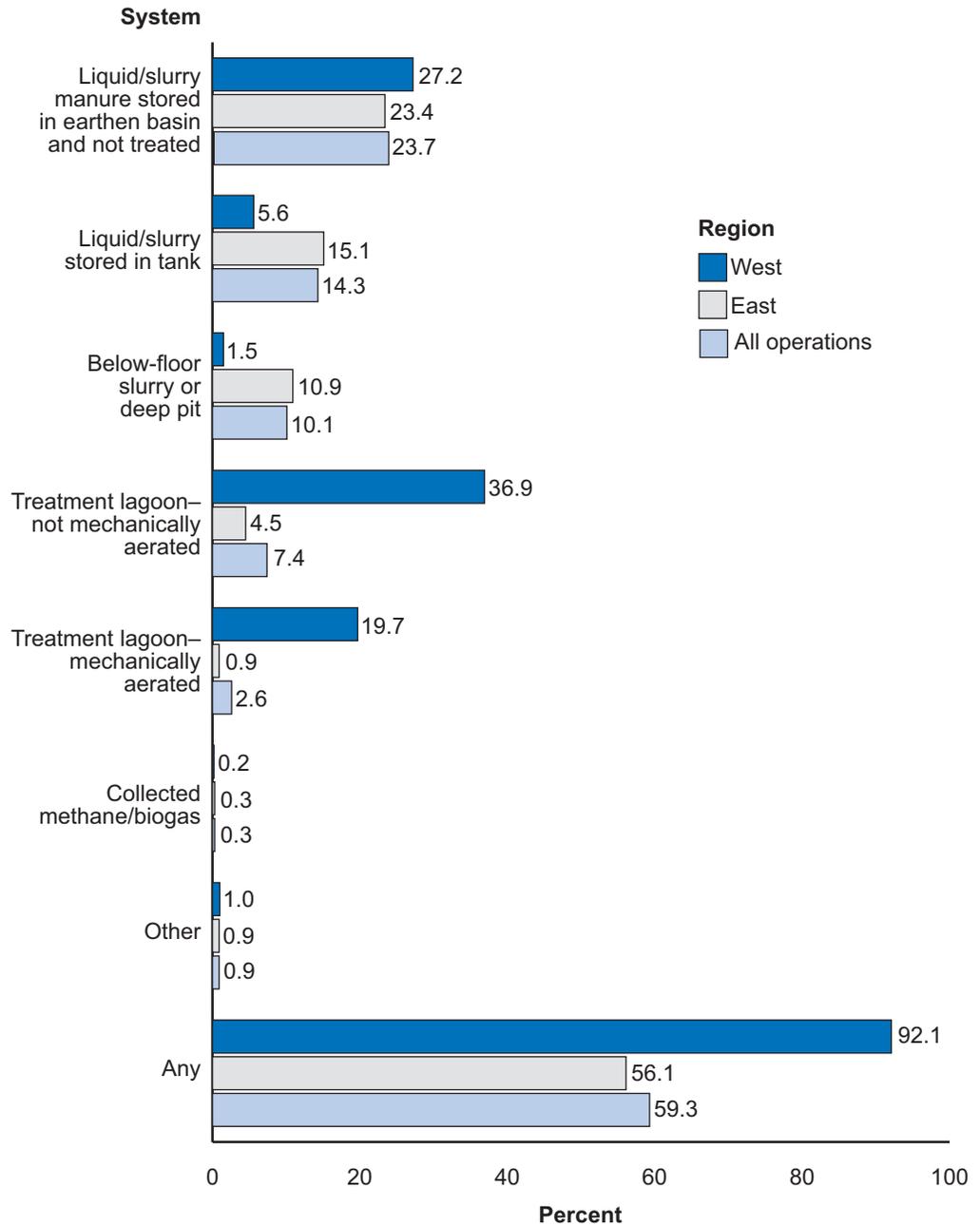


Liquid/slurry manure was stored or treated on 59.3 percent of operations. The percentage of operations that stored or treated liquid/slurry manure increased as herd size increased. A lower percentage of small operations (15.4 percent) stored liquid/slurry manure in an untreated earthen basin compared with medium and large operations (34.1 and 40.1 percent, respectively).

A.3.c. Percentage of operations by manure storage or treatment system(s) used for the majority of liquid/slurry manure, and by herd size and region:

System	Percent Operations											
	Herd Size (number of cows)						Region					
	Small (30–99)		Medium (100–499)		Large (500+)		West		East		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Liquid/slurry stored in earthen basin and not treated	15.4	(1.8)	34.1	(2.6)	40.1	(2.3)	27.2	(3.1)	23.4	(1.5)	23.7	(1.4)
Liquid/slurry stored in tank	13.8	(1.8)	17.6	(2.0)	7.7	(1.2)	5.6	(1.4)	15.1	(1.4)	14.3	(1.2)
Below-floor slurry or deep pit	10.6	(1.6)	11.2	(1.7)	4.5	(1.3)	1.5	(0.7)	10.9	(1.2)	10.1	(1.1)
Treatment lagoon—not mechanically aerated	3.6	(0.9)	7.2	(1.2)	27.9	(1.9)	36.9	(2.7)	4.5	(0.7)	7.4	(0.7)
Treatment lagoon—mechanically aerated	0.0	(0.0)	4.0	(1.0)	12.5	(1.4)	19.7	(2.9)	0.9	(0.2)	2.6	(0.3)
Collected methane/biogas	0.0	(0.0)	0.0	(0.0)	2.8	(1.0)	0.2	(0.2)	0.3	(0.1)	0.3	(0.1)
Other	0.9	(0.5)	0.9	(0.5)	1.1	(0.4)	1.0	(0.4)	0.9	(0.3)	0.9	(0.3)
Any	44.3	(2.5)	75.1	(2.6)	96.7	(0.7)	92.1	(2.3)	56.1	(1.8)	59.3	(1.7)
No liquid/slurry manure	55.7	(2.5)	24.9	(2.6)	3.3	(0.7)	7.9	(2.3)	43.9	(1.8)	40.7	(1.7)

Percentage of operations by manure storage or treatment system(s) used for the majority of liquid/slurry manure, and by region



The average number of days operations could store any manure before having to remove it from the storage facility increased as herd size increased. On average, all operations could store manure for 161.2 days before having to remove it. Operations in the West region could store manure for more days than operations in the East region (399.3 and 138.3 days, respectively).

A.3.d. Operation average number of days operations could store any manure before having to remove it from the storage facility, by herd size and by region:

Operation Average Number of Days											
Herd Size (number of cows)						Region					
Small (30–99)		Medium (100–499)		Large (500+)		West		East		All operations	
Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
116.8	(7.1)	170.4	(11.2)	369.7	(111.9)	399.3	(143.0)	138.3	(5.9)	161.2	(13.7)

Although almost 25 percent of operations could store any manure for fewer than 7 days, more than 60 percent could store it for 90 days or more. Less than 15 percent of operations of any herd size or from any region could store manure for 365 days or more.

A.3.e. Percentage of operations by maximum manure storage capacity (in days), and by herd size and region:

Capacity (days)	Percent Operations											
	Herd Size (number of cows)			Region		All operations						
	Small (30–99)	Medium (100–499)	Large (500+)	West	East							
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error				
Fewer than 7	30.9	(2.4)	13.8	(2.1)	1.9	(0.9)	1.3	(0.8)	24.6	(1.7)	22.5	(1.5)
7–29	5.7	(1.2)	6.1	(1.3)	3.0	(1.0)	1.1	(0.4)	5.9	(0.9)	5.5	(0.8)
30–59	7.1	(1.4)	5.0	(1.2)	1.6	(0.6)	2.1	(1.0)	6.2	(1.0)	5.9	(0.9)
60–89	4.8	(1.2)	2.5	(0.8)	2.3	(0.6)	3.5	(1.5)	3.8	(0.8)	3.8	(0.7)
90–179	17.8	(2.0)	22.9	(2.4)	19.6	(1.9)	23.1	(3.1)	19.2	(1.5)	19.5	(1.4)
180–364	30.7	(2.4)	44.7	(2.7)	58.8	(2.4)	61.6	(3.4)	35.8	(1.8)	38.0	(1.7)
365 or more	3.0	(0.9)	5.0	(1.3)	12.8	(1.5)	7.3	(1.4)	4.4	(0.7)	4.7	(0.7)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

4. Manure use and application

Over 90 percent of all operations applied solid or liquid/slurry manure to land either owned or rented, while 11.9 percent gave away manure. A higher percentage of large operations than medium or small operations gave away manure and/or sold or used manure as composted bedding. With the exception of applying manure to land, a higher percentage of operations in the West region than in the East region used manure in these fashions.

A.4.a. Percentage of operations by how any manure was used, and by herd size and region:

Use	Percent Operations											
	Herd Size (number of cows)						Region					
	Small (30–99)		Medium (100–499)		Large (500+)		West		East	All operations		
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Applied to land either owned or rented	98.9	(0.5)	98.6	(0.6)	94.4	(0.9)	91.5	(1.5)	99.0	(0.4)	98.3	(0.4)
Gave away	9.3	(1.5)	9.1	(1.4)	33.3	(2.0)	30.0	(2.4)	10.1	(1.1)	11.9	(1.0)
Sold or received other compensation	2.6	(0.8)	7.1	(1.3)	34.1	(2.1)	29.5	(2.3)	5.3	(0.7)	7.4	(0.7)
Used composted manure for bedding	1.4	(0.6)	3.1	(0.9)	26.5	(2.0)	26.0	(2.2)	2.6	(0.5)	4.7	(0.5)
Other	0.5	(0.3)	1.0	(0.6)	1.9	(0.6)	3.6	(1.8)	0.5	(0.2)	0.8	(0.3)

Almost all operations (94.4 percent) used solid manure in 2013. The majority of operations (89.3 percent) applied the majority of solid manure to land either owned or rented. A higher percentage of small and medium operations (94.6 and 89.2 percent, respectively) applied the majority of solid manure to land compared with large operations (61.2 percent). A higher percentage of large operations than small and medium operations used composted manure for bedding, sold manure or received other compensation, or gave away the majority solid manure. A higher percentage of operations in the East region (92.2 percent) than in the West region (59.4 percent) applied the majority of manure to land.

A.4.b. Percentage of operations by how the majority of solid manure was used, and by herd size and region:

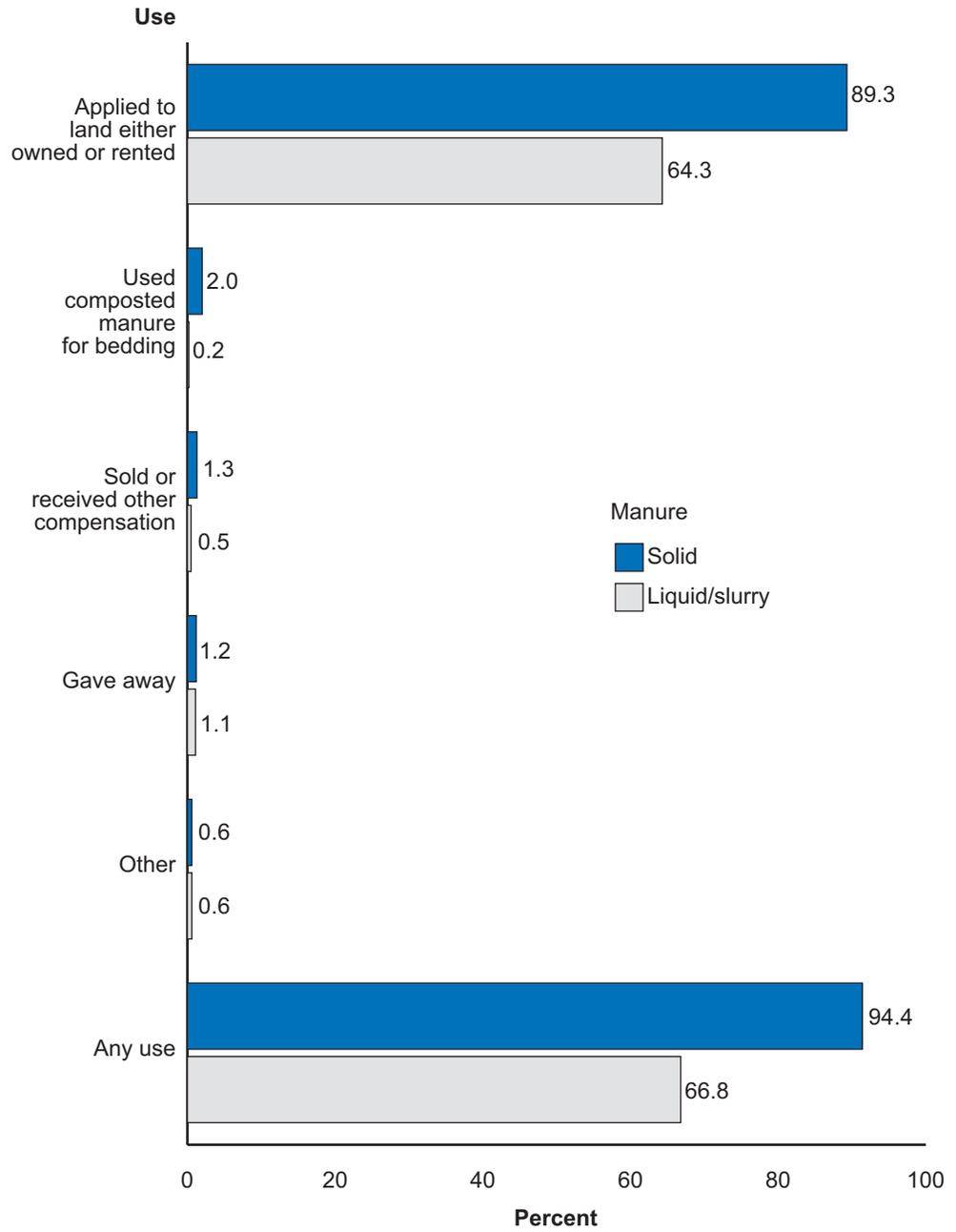
Use	Percent Operations											
	Herd Size (number of cows)			Region		All operations						
	Small (30–99)	Medium (100–499)	Large (500+)	West	East							
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error					
Applied to land either owned or rented	94.6	(1.2)	89.2	(1.7)	61.2	(2.2)	59.4	(3.1)	92.2	(0.9)	89.3	(0.9)
Used composted manure for bedding	0.6	(0.5)	1.0	(0.5)	11.9	(1.5)	12.7	(1.8)	1.0	(0.3)	2.0	(0.4)
Sold or received other compensation	0.0	(—)	0.8	(0.4)	9.2	(1.2)	10.7	(1.5)	0.4	(0.1)	1.3	(0.2)
Gave away	0.5	(0.3)	1.0	(0.5)	5.8	(1.0)	8.2	(1.4)	0.5	(0.2)	1.2	(0.3)
Other	0.8	(0.4)	0.1	(0.1)	1.2	(0.4)	1.5	(0.6)	0.6	(0.3)	0.6	(0.3)
Any use	96.5	(1.0)	92.2	(1.5)	89.3	(1.5)	92.6	(2.2)	94.6	(0.8)	94.4	(0.7)
No solid manure	3.5	(1.0)	7.8	(1.5)	10.7	(1.5)	7.4	(2.2)	5.4	(0.8)	5.6	(0.7)

The percentage of operations that used liquid/slurry manure increased as herd size increased. Overall, 66.8 percent of operations used liquid/slurry manure in 2013. The percentage of operations that applied liquid/slurry manure to land either owned or rented was higher on medium and large operations (81.0 and 87.6 percent, respectively) than on small operations (51.4 percent). A higher percentage of operations in the West region than in the East region used liquid/slurry manure (94.8 and 64.1 percent, respectively).

A.4.c. Percentage of operations by how the majority of liquid/slurry manure was used, and by herd size and region:

Use	Percent Operations					
	Herd Size (number of cows)			Region		All operations
	Small (30–99)	Medium (100–499)	Large (500+)	West	East	
Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	
Applied to land either owned or rented	51.4 (2.6)	81.0 (2.4)	87.6 (1.4)	83.4 (2.7)	62.4 (1.8)	64.3 (1.7)
Used composted manure for bedding	0.0 (—)	0.4 (0.4)	1.0 (0.4)	0.7 (0.3)	0.2 (0.1)	0.2 (0.1)
Sold or received other compensation	0.0 (—)	0.0 (—)	4.8 (1.0)	2.7 (0.8)	0.3 (0.1)	0.5 (0.1)
Gave away	0.7 (0.5)	1.0 (0.4)	3.7 (0.8)	6.5 (1.4)	0.6 (0.3)	1.1 (0.3)
Other	0.6 (0.4)	0.5 (0.4)	0.8 (0.3)	1.4 (0.7)	0.5 (0.3)	0.6 (0.3)
Any use	52.9 (2.5)	82.8 (2.3)	97.9 (0.6)	94.8 (2.1)	64.1 (1.8)	66.8 (1.7)
No liquid/slurry manure	47.1 (2.5)	17.2 (2.3)	2.1 (0.6)	5.2 (2.1)	35.9 (1.8)	33.2 (1.7)

Percentage of operations by how the majority of manure was used, by type of manure



More than one-third of operations that applied manure to land (~36 percent) analyzed the nutrient content of the manure for nitrogen, phosphorous, or potassium. The percentages of operations that analyzed the nutrient content of manure for these three elements increased as herd size increased and were higher in the West region than in the East region.

A.4.d. For the 98.3 percent of operations that applied any manure to owned or rented land (table A.4.a), percentage of operations that analyzed the nutrient content of manure, by element analyzed, herd size, and region:

Percent Operations												
Element	Herd Size (number of cows)						Region					
	Small (30–99)		Medium (100–499)		Large (500+)		West		East		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Nitrogen	20.4	(2.1)	49.7	(2.8)	88.6	(1.6)	73.1	(3.2)	33.0	(1.6)	36.3	(1.5)
Phosphorus	20.0	(2.1)	50.5	(2.8)	88.4	(1.6)	72.5	(3.2)	33.0	(1.6)	36.3	(1.5)
Potassium	20.4	(2.1)	50.5	(2.8)	87.9	(1.6)	71.9	(3.2)	33.3	(1.6)	36.5	(1.5)

The highest percentages of operations applied any manure to land based on manure volume/acreage available (70.0 percent) and soil quality improvement (65.7 percent). In general, the percentage of operations that used a specific criterion for manure use increased as herd size increased and was higher on operations in the West region than in the East region.

A.4.e. For the 98.3 percent of operations that applied any manure to owned or rented land (table A.4.a), percentage of operations that used the following criteria to determine how much or how often manure was applied, by herd size and region:

Percent Operations								
Criterion	Herd Size (number of cows)			Region			All operations	
	Small (30–99)	Medium (100–499)	Large (500+)	West		East		
	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error		Std. Pct. error
Manure volume/acreage available	65.4 (2.4)	74.9 (2.4)	82.4 (1.8)	77.8 (3.1)	69.3 (1.8)	70.0 (1.6)		
Soil quality improvement	58.5 (2.6)	73.4 (2.5)	84.9 (1.9)	80.4 (2.6)	64.4 (1.9)	65.7 (1.7)		
Crop nitrogen requirement	48.7 (2.5)	66.3 (2.7)	86.9 (1.9)	75.1 (3.6)	56.4 (1.9)	58.0 (1.7)		
Crop phosphorus requirement	41.1 (2.5)	60.4 (2.8)	80.6 (2.0)	67.6 (3.6)	49.5 (1.9)	51.0 (1.7)		
Other	3.1 (0.9)	4.0 (1.1)	2.9 (0.7)	1.9 (0.6)	3.5 (0.7)	3.3 (0.6)		

Higher percentages of operations spread solid manure daily in spring, fall, and winter than in summer, and higher percentages of operations spread solid manure weekly in spring and fall than in summer and winter. Between 20 and 30 percent of operations spread solid manure monthly or less often.

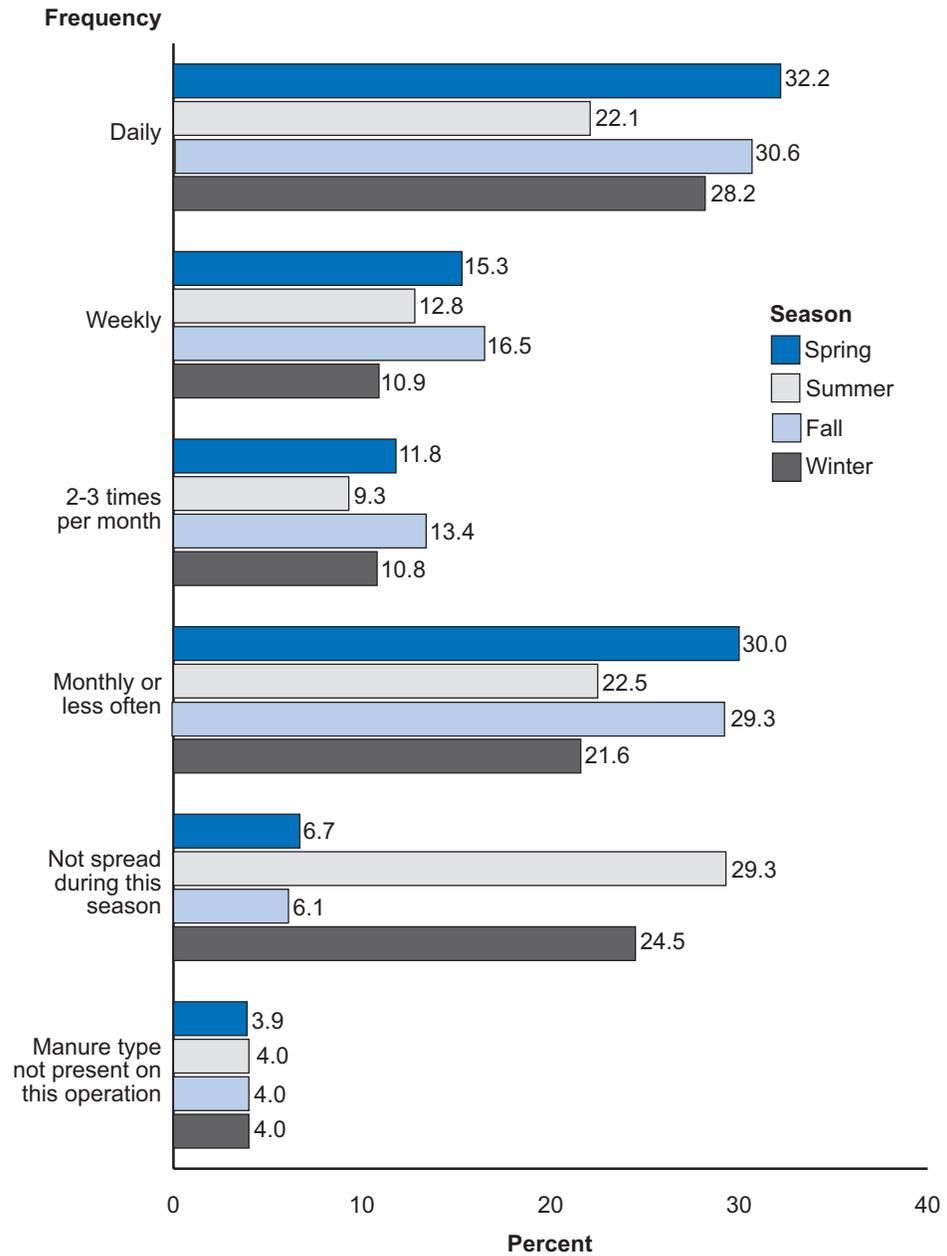
In general, liquid/slurry manure was spread less frequently than solid manure. A higher percentage of operations spread liquid/slurry manure monthly or less often in spring and fall (33.0 and 37.0 percent, respectively) than in summer and winter (22.9 and 18.1 percent, respectively). Similar to solid manure, liquid/slurry manure was spread by a higher percentage of operations in spring and fall than in summer and winter.

A.4.f. For the 98.3 percent of operations that applied any manure to owned or rented land (table A.4.a), percentage of operations by frequency solid and liquid/slurry manure was applied, and by season:

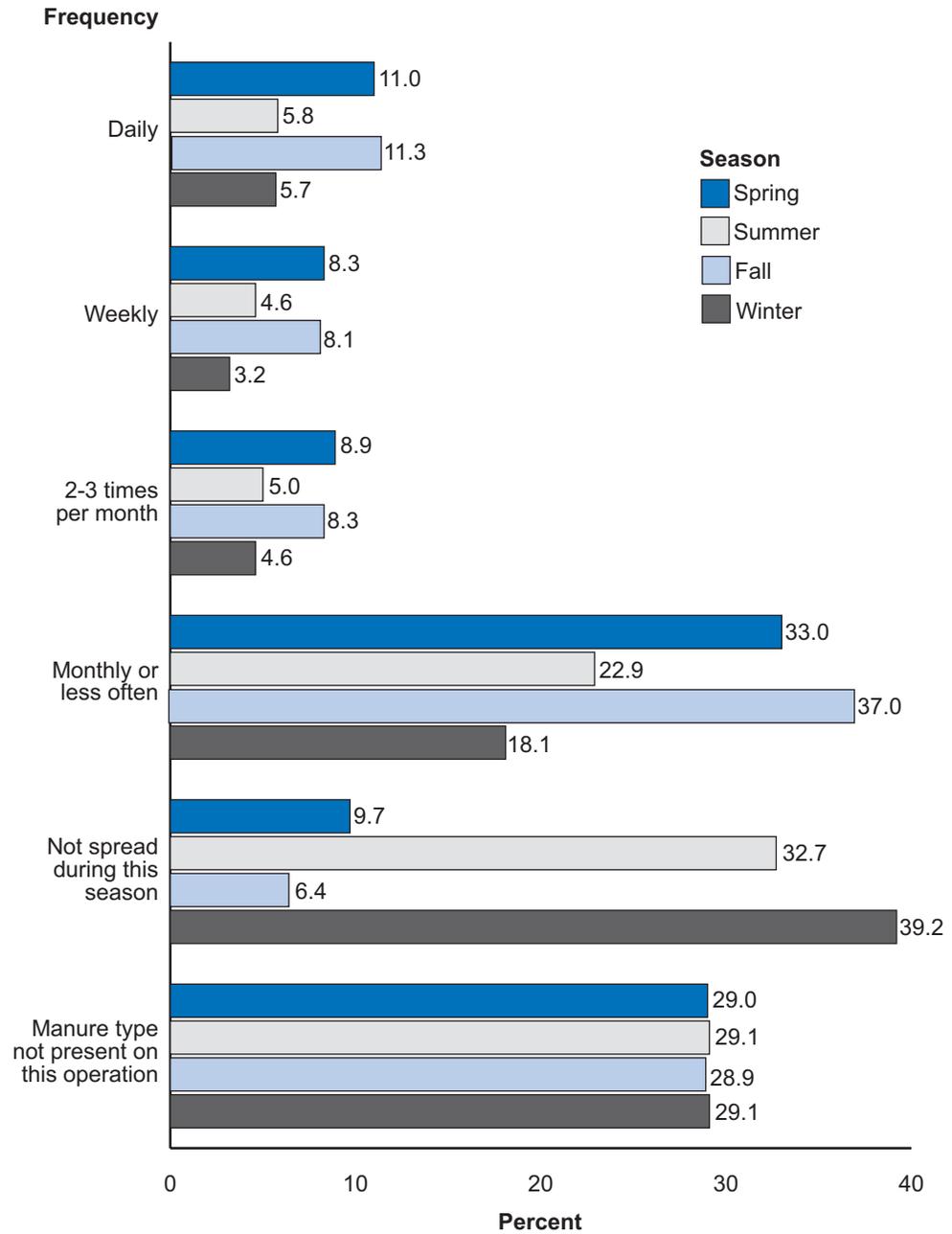
Percent Operations*								
Season								
Frequency	Spring		Summer		Fall		Winter	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Solid								
Daily	32.2	(1.6)	22.1	(1.5)	30.6	(1.6)	28.2	(1.6)
Weekly	15.3	(1.3)	12.8	(1.2)	16.5	(1.3)	10.9	(1.1)
2–3 times per month	11.8	(1.1)	9.3	(1.0)	13.4	(1.2)	10.8	(1.1)
Monthly or less often	30.0	(1.6)	22.5	(1.5)	29.3	(1.6)	21.6	(1.4)
Not spread during this season	6.7	(0.8)	29.3	(1.6)	6.1	(0.8)	24.5	(1.4)
Manure type not present on this operation	3.9	(0.6)	4.0	(0.6)	4.0	(0.6)	4.0	(0.6)
Total	100.0		100.0		100.0		100.0	
Liquid/slurry								
Daily	11.0	(1.1)	5.8	(0.9)	11.3	(1.1)	5.7	(0.9)
Weekly	8.3	(0.9)	4.6	(0.6)	8.1	(0.9)	3.2	(0.6)
2–3 times per month	8.9	(1.0)	5.0	(0.7)	8.3	(0.9)	4.6	(0.7)
Monthly or less often	33.0	(1.6)	22.9	(1.4)	37.0	(1.7)	18.1	(1.3)
Not spread during this season	9.7	(1.0)	32.7	(1.7)	6.4	(0.8)	39.2	(1.7)
Manure type not present on this operation	29.0	(1.6)	29.1	(1.6)	28.9	(1.6)	29.1	(1.6)
Total	100.0		100.0		100.0		100.0	

*Excludes very small operations (<30 cows).

For the 98.3 percent of operations that applied any manure to owned or rented land, percentage of operations by frequency solid manure was applied, and by season



For the 98.3 percent of operations that applied any manure to owned or rented land, percentage of operations by frequency liquid/slurry manure was applied, and by season



The majority of operations (87.2 percent) applied manure/slurry using a broadcast/solid spreader, while 41.6 percent used a surface application by tank wagon or tank truck. A higher percentage of small and medium operations used a broadcast/solid spreader compared with large operations. A higher percentage of medium and large operations used surface application by tank wagon or tank truck than small operations. A lower percentage of small than medium or large operations used surface application by tank wagon or tank truck. A higher percentage of large operations (43.5 percent) than small or medium operations (1.7 and 6.8 percent, respectively) used irrigation/sprinklers to apply manure. About two-thirds of operations in the West region (65.5 percent) used an irrigation/sprinkler compared with operations in the East region (2.4 percent).

A.4.g. For the 98.3 percent of operations that applied manure to owned or rented land (table A.4.a), percentage of operations by method(s) used to apply any manure, and by herd size and region:

Method	Percent Operations					
	Herd Size (number of cows)			Region		All operations
	Small (30–99)	Medium (100–499)	Large (500+)	West	East	
Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	
Broadcast/ solid spreader	90.2 (1.5)	85.4 (1.8)	75.2 (2.1)	76.1 (2.6)	88.2 (1.2)	87.2 (1.1)
Surface application by tank wagon or tank truck	32.3 (2.4)	56.8 (2.7)	51.9 (2.1)	33.6 (3.5)	42.3 (1.8)	41.6 (1.6)
Subsurface injection by tank wagon, tank truck, or tractor	2.7 (0.8)	18.5 (1.9)	29.5 (1.8)	5.8 (1.3)	10.6 (0.8)	10.2 (0.8)
Irrigation/ sprinkler	1.7 (0.6)	6.8 (1.1)	43.5 (1.9)	65.5 (2.7)	2.4 (0.5)	7.7 (0.6)
Other	0.2 (0.2)	1.1 (0.6)	2.7 (0.8)	1.0 (0.4)	0.7 (0.2)	0.8 (0.2)

The percentage of operations that incorporated any manure into the soil within 24 hours of application increased as herd size increased. Overall, 21.3 percent of operations always or almost always incorporated manure into the soil within 24 hours of application. Conversely, about one-third of operations (35.9 percent) never incorporated manure into the soil within 24 hours. A higher percentage of operations in the West region (35.7 percent) than in the East region (20.0 percent) always or almost always incorporated manure into the soil within 24 hours.

A.4.h. For the 98.3 percent of operations that applied any manure to owned or rented land (table A.4.a), percentage of operations by frequency that manure was incorporated into the soil within 24 hours after application, and by herd size and region:

Frequency	Herd Size (number of cows)			Region		
	Small (30–99)	Medium (100–499)	Large (500+)	West	East	All operations
	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error
Always or almost always	12.5 (1.7)	28.5 (2.4)	51.3 (2.3)	35.7 (3.4)	20.0 (1.3)	21.3 (1.3)
Sometimes	43.9 (2.6)	43.8 (2.8)	33.8 (2.4)	31.9 (3.5)	43.8 (1.9)	42.8 (1.8)
Never	43.6 (2.6)	27.7 (2.4)	14.9 (1.6)	32.4 (3.7)	36.2 (1.8)	35.9 (1.7)
Total	100.0	100.0	100.0	100.0	100.0	100.0

Almost three-fourths of operations that applied any manure to land (72.0 percent) applied it to actively growing crops. The highest percentage of operations (60.5 percent) applied manure to actively growing pastures or hay crops. Manure was applied to forage to be ensiled or to other forage crops on a lower percentage of small and medium operations than on large operations. Manure was applied to forage to be ensiled or to other forage crops on a higher percentage of operations in the West region than in the East region.

A.4.i. For the 98.3 percent of operations that applied any manure to owned or rented land (table A.4.a), percentage of operations that applied manure to the following actively growing crops, by herd size and by region:

Crop	Percent Operations											
	Herd Size (number of cows)						Region					
	Small (30–99)		Medium (100–499)		Large (500+)		West		East		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Pasture or hay crop	64.8	(2.5)	56.0	(2.7)	49.2	(2.4)	46.5	(3.4)	61.8	(1.8)	60.5	(1.7)
Forage to be ensiled	23.0	(2.2)	30.9	(2.6)	44.9	(2.3)	48.2	(3.4)	25.8	(1.7)	27.7	(1.5)
Other forage crops	14.9	(1.9)	11.4	(1.7)	34.7	(2.2)	38.3	(2.6)	13.9	(1.4)	16.0	(1.3)
Grain or oilseed crops	11.4	(1.7)	12.5	(2.0)	7.0	(1.3)	7.7	(2.4)	11.6	(1.3)	11.2	(1.2)
Other	1.6	(0.7)	1.8	(0.7)	0.4	(0.3)	0.6	(0.4)	1.6	(0.5)	1.5	(0.5)
Any crops	72.5	(2.3)	68.4	(2.5)	78.8	(1.7)	81.4	(2.7)	71.1	(1.7)	72.0	(1.6)

Overall, any manure was applied a minimum average distance of 3,688 feet (0.7 miles) from any surface water. The average minimum distance was lower for small and medium operations (2,158 and 3,293 feet, respectively) than for large operations (13,739 feet). Operations in the West region reported a greater minimum distance than operations in the East region (18,320 and 2,403 feet, respectively).

A.4.j. For the 98.3 percent of operations that applied any manure to owned or rented land (table A.4.a), average minimum distance (in feet) between areas where manure was applied and any surface water, such as a lake, pond, stream, or river, by herd size and by region:

Average Minimum Distance (feet)											
Herd Size (number of cows)						Region					
Small (30–99)		Medium (100–499)		Large (500+)		West		East		All operations	
Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
2,158	(250)	3,293	(426)	13,739	(1,553)	18,320	(1,951)	2,403	(220)	3,688	(259)

On 20.4 percent of operations, any manure was applied less than 100 feet from surface water, compared with 1,000 feet or more on 34.1 percent of operations. A higher percentage of operations in the West region than in the East region applied manure 1,000 feet or more from surface water (59.9 and 31.8 percent, respectively). Alternatively, a higher percentage of operations in the East region than in the West region applied manure 200 to 499 feet from surface water (20.3 and 8.8 percent, respectively).

A.4.k. For the 98.3 percent of operations that applied any manure to owned or rented land (table A.4.a), percentage of operations by minimum distance between manure and any surface water, and by herd size and region:

Minimum distance (ft)	Percent Operations											
	Herd Size (number of cows)			Region								
	Small (30–99)	Medium (100–499)	Large (500+)	West	East	All operations						
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error		
Less than 100	21.9	(2.2)	19.0	(2.2)	15.5	(2.0)	14.6	(2.9)	20.9	(1.6)	20.4	(1.5)
100–199	16.2	(2.0)	18.5	(2.2)	15.8	(1.8)	13.4	(2.8)	17.1	(1.5)	16.8	(1.4)
200–499	18.6	(2.1)	21.7	(2.4)	16.7	(1.7)	8.8	(1.9)	20.3	(1.6)	19.3	(1.5)
500–999	9.9	(1.6)	9.3	(1.6)	6.9	(1.4)	3.3	(1.2)	9.9	(1.1)	9.4	(1.1)
1,000 or more	33.5	(2.4)	31.6	(2.6)	45.1	(2.4)	59.9	(3.9)	31.8	(1.8)	34.1	(1.7)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

5. Nutrient management plans

One-half of all operations (50.8 percent) had a written nutrient management plan. The percentage of operations with a plan increased as herd size increased and was higher for operations in the West region than in the East region.

A.5.a. Percentage of operations with a written plan that addressed nutrient management (e.g., land treatment practices, manure storage structures), by herd size and by region:

Percent Operations											
Herd Size (number of cows)						Region					
Small (30–99)		Medium (100–499)		Large (500+)		West		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
37.1	(2.4)	66.7	(2.5)	82.2	(1.5)	71.9	(2.4)	48.7	(1.8)	50.8	(1.7)

Of the 50.8 percent of operations with a written nutrient management plan, 80.0 percent developed the plan in conjunction with USDA’s Natural Resource Conservation Service or with a local conservation district. Two-thirds of operations (66.0 percent) developed a plan to satisfy a State or local regulatory requirement.

A.5.b. For the 50.8 percent of operations with a written nutrient management plan (table A.5.a), percentage of operations that developed or implemented a plan in conjunction with the following agencies, by herd size and by region:

Agencies	Percent Operations											
	Herd Size (number of cows)						Region				All operations	
	Small (30–99)		Medium (100–499)		Large (500+)		West		East		Pct.	Std. error
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Developed in cooperation with the USDA Natural Resource Conservation Service or a local conservation district	80.3	(3.5)	81.6	(2.7)	76.0	(2.2)	73.3	(3.8)	81.0	(2.1)	80.0	(1.9)
Implemented to help satisfy a State or local regulatory requirement	60.5	(4.3)	64.7	(3.4)	81.9	(2.0)	83.7	(3.5)	63.4	(2.6)	66.0	(2.3)
Part of USDA voluntary cost share program	33.5	(4.1)	46.2	(3.5)	30.7	(2.4)	31.8	(3.8)	38.8	(2.6)	37.9	(2.3)

Almost one-half of all operations (43.7 percent) contacted an agronomist/crop consultant regarding nutrient management. Other resources consulted included personnel from the Natural Resource Conservation Service (31.0 percent of operations) and private nutrient management consultant (29.4 percent). In general, the use of many of the resources was lower for small operations than for large operations.

A.5.c. Percentage of operations by resource(s) consulted about nutrient management, and by herd size and region:

Resource	Percent Operations											
	Herd Size (number of cows)						Region					
	Small (30–99)		Medium (100–499)		Large (500+)		West		East		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Agronomist/crop consultant	36.9	(2.5)	50.8	(2.7)	61.3	(2.1)	37.8	(3.3)	44.3	(1.8)	43.7	(1.7)
Natural Resource Conservation Service personnel	25.0	(2.3)	38.2	(2.7)	43.8	(2.3)	31.0	(3.0)	31.0	(1.7)	31.0	(1.6)
Private nutrient management consultant	19.6	(2.1)	35.9	(2.7)	64.8	(2.3)	47.7	(3.2)	27.6	(1.6)	29.4	(1.5)
Consulting nutritionist	14.0	(1.8)	19.6	(2.2)	40.2	(2.3)	32.4	(2.9)	17.2	(1.4)	18.6	(1.3)
University/extension personnel	11.9	(1.7)	20.7	(2.2)	20.9	(1.9)	12.0	(1.9)	15.8	(1.3)	15.5	(1.2)
Private veterinary practitioner	6.0	(1.2)	9.1	(1.6)	27.2	(1.9)	28.9	(2.2)	7.4	(0.9)	9.3	(0.9)
State or local department of agriculture personnel	4.9	(1.1)	11.2	(1.7)	24.3	(1.9)	20.8	(3.0)	7.7	(0.9)	8.9	(0.9)
State or local department of natural resources personnel	4.0	(1.0)	9.7	(1.6)	25.8	(2.0)	13.1	(2.3)	7.6	(0.8)	8.1	(0.8)
Environmental engineering consultant	2.0	(0.7)	4.6	(1.2)	28.9	(2.1)	21.0	(2.6)	4.2	(0.6)	5.7	(0.6)
Other	2.3	(0.8)	1.1	(0.5)	0.9	(0.4)	1.3	(0.7)	1.8	(0.6)	1.8	(0.5)

6. Concentrated animal feeding operations

An animal feeding operation (AFO) is defined as an agricultural enterprise on which animals are kept and raised in confined situations. The Environmental Protection Agency (EPA) has guidelines to determine if an AFO should be classified as a concentrated animal feeding operation (CAFO). By definition, CAFOs have more than 700 mature dairy cows confined on-site for more than 45 days in a year. Additionally, operations not classified as a CAFO by herd size can be designated a CAFO by the permitting authority, if the operation is a significant contributor of pollutants in surface water. CAFOs are regulated by the EPA under the Clean Water Act, but the EPA can designate the enforcement authority to States. States can have different definitions for CAFOs, which are subject to regulation, including the need for a nutrient management plan. For more information on regulatory definitions of CAFO's please visit: https://www3.epa.gov/npdes/pubs/sector_table.pdf

Operators on about one-third of all operations (32.1 percent) had not heard of a CAFO. Almost two-thirds of operations (58.1 percent) were not CAFOs, while one-tenth of operations (9.8 percent) were. A higher percentage of small and medium operations were not CAFOs (60.5 and 64.1 percent, respectively) compared with large operations (29.4 percent). The percentage of operations reported to be a CAFO increased as herd size increased. Almost two-thirds of operations in the East region (60.4 percent) reported **not** being a CAFO compared with one-third of operations in the West region (35.1 percent).

A.6.a. Percentage of operations by classification regarding Concentrated Animal Feeding Operations (CAFOs) under current Federal EPA guidelines, and by herd size and region:

Classification	Percent Operations					
	Herd Size (number of cows)			Region		All operations
	Small (30–99)	Medium (100–499)	Large (500+)	West	East	
Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	Std. Pct. error	
Never heard of CAFO	36.9 (2.4)	26.5 (2.3)	20.8 (1.9)	30.7 (2.6)	32.2 (1.7)	32.1 (1.6)
Heard of CAFO but this operation is not a CAFO	60.5 (2.4)	64.1 (2.6)	29.4 (2.1)	35.1 (3.4)	60.4 (1.8)	58.1 (1.7)
Heard of CAFO and this operation is a CAFO	2.6 (0.8)	9.4 (1.5)	49.8 (2.1)	34.2 (3.2)	7.4 (0.7)	9.8 (0.7)
Total	100.0	100.0	100.0	100.0	100.0	100.0

Section II: Methodology

A. Needs Assessment

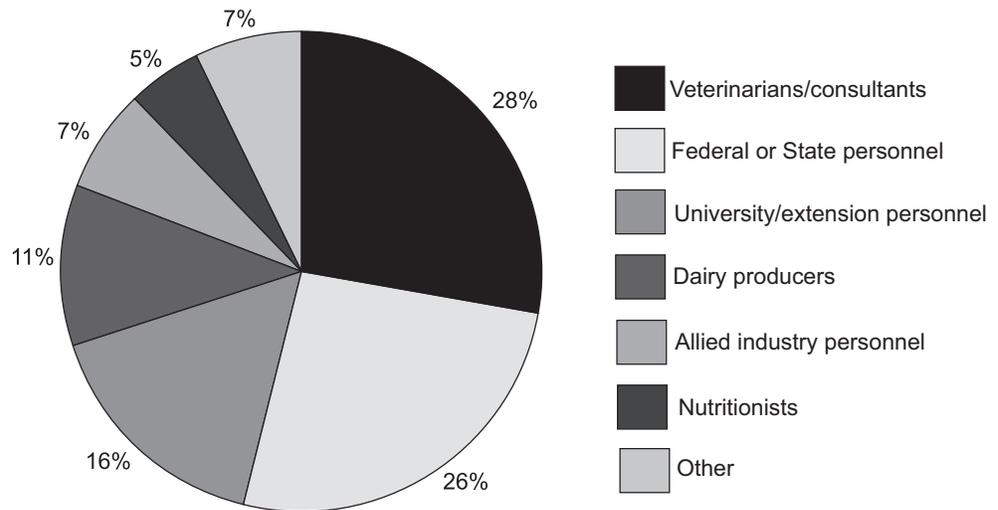
NAHMS develops study objectives by exploring existing literature and contacting industry members about their informational needs and priorities during a needs assessment phase. The objective of the needs assessment for the NAHMS Dairy 2014 study was to collect information from U.S. dairy producers and other dairy specialists about what they perceived to be the most important dairy health and productivity issues. A driving force of the needs assessment was the desire of NAHMS to receive as much input as possible from a variety of producers, as well as from industry experts and representatives, veterinarians, extension specialists, university personnel, and dairy organizations. Information was collected via focus groups and through a needs assessment survey.

In addition, the needs assessment survey targeted producers, veterinarians, extension personnel, university researchers, and allied industry groups and was designed to determine the top three management issues, diseases/disorders, and producer incentives. The survey, created in SurveyMonkey, was available online from late October through the end of December 2012. The survey was promoted via industry-related electronic newsletters, magazines, and Web sites. Organizations and magazines promoting the study included Vance Publishing's "Dairy Herd Management, Dairy Alert," "Dairy Today," Hoard's "Dairyman," National Mastitis Council, "Journal of the American Veterinary Medical Association," and the American Association of Bovine Practitioners. Email messages promoting the study—asking for input and providing identification of the online site—were also sent to cooperative members of the National Milk Producers Federation and to State and Federal personnel. A total of 218 people completed the study questionnaire.

Respondents to the needs assessment represented the following affiliations:

- Veterinarians/consultants—28 percent
- Federal or State government personnel—26 percent
- University/extension personnel—16 percent
- Dairy producers—11 percent
- Allied industry personnel—7 percent
- Nutritionists—5 percent.

Percentage of survey respondents, by affiliation



A Dairy 2014 needs assessment focus group session was held on January 7, 2013, with the goal of setting objectives for the study. These objectives are on p 56 of this report.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done in February 2013 using data from the USDA's National Agricultural Statistics Service (NASS) February 1, 2013, Cattle Report. A goal for NAHMS national studies is to include States that account for at least 70 percent of the animals and operations in the United States. The initial review identified 17 major States representing 80.3 percent of the U.S. milk cow inventory and 76.7 percent of the operations with milk cows (dairy herds). The States were California, Colorado, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Washington, and Wisconsin.

A memo identifying these 17 States was provided in March 2013 to the USDA–APHIS–VS–CEAH director and, in turn, to VS regional directors. Each regional director sought input from the respective States about being included or excluded from the study.

2. Operation selection

The list sampling frame was provided by NASS. Within each State, a stratified random sample was selected in which strata were defined by size categories. The size indicator was the number of milk cows for each operation. Producers on NASS' list frame in the 17 States who had reported 1 or more milk cows on January 1, 2013, were eligible to be included in the sample for contact in January 2014. Among producers reporting fewer than 30 cows, 500 operations were selected for phase 1a. For operations reporting 30 or more cows, 3,000 operations were selected for contact during phase 1b, with a total of 3,500 operations selected for the study.

3. Population inferences

a. Phases 1a and 1b

Inferences cover the population of dairy producers with at least 1 milk cow in the 17 participating States. These States accounted for 80.3 percent (7,390,000 head) of milk cows and 76.7 percent (49,145) of operations with milk cows in the United States (2012 Census of Agriculture). See appendix II for respective data on individual States. All respondent data were statistically weighted to reflect the population from which the sample was selected. The inverse of the probability of selection for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected. Operations with 500 cows or more and organic operations were overrepresented in the sample to ensure valid estimates could be generated for these operations.

C. Data Collection

1. Data collectors and data collection period

a. Phases Ia and Ib

All data were collected from January 1 through January 31, 2014. Producers with fewer than 30 cows were mailed an abbreviated questionnaire. Producers that did not respond to the mailed questionnaire were contacted for a telephone interview. Telephone interviews were conducted via computer-assisted interview software from a single NASS phone center. The questionnaire took approximately 30 minutes to complete. For operations with 30 or more cows, NASS enumerators administered the general dairy management questionnaire via an in-person interview, which took an average of 1.5 hours to complete. All data were entered into a SAS data set.

D. Data Analysis

1. Phases Ia and Ib: Validation

Individual State data files were combined and sent to NAHMS national staff, which performed additional data validation on the entire data set.

2. Phases Ia and Ib: Estimation

Estimation was done with SUDAAN® software (RTI, version 11.0.1). SUDAAN uses a Taylor series expansion to estimate appropriate variances, which accounts for the stratified sample design.

E. Sample Evaluation

The purpose of this section is to provide respondent and nonrespondent information. Historically, the term “response rate” was used as a catch-all parameter, but there are many ways to define and calculate response rates. Therefore, the following table below presents an evaluation based on a number of measurement parameters, which are defined with an “x” in categories that contribute to the measurement.

1. Phase Ia: National Agricultural Statistics Service—fewer than 30 cows

A total of 500 operations were selected for the survey of operations with fewer than 30 cows. Of these operations, 14.0 percent completed the questionnaire.

Response category	Number operations	Percent operations	Measurement parameter		
			Contacts	Usable ¹	Complete ²
Completed survey	70 ³	14.0		x	x
Refused survey or inaccessible	430	86.0			
Total	500	100.0		70	70
Percent of total operations				14.0	14.0
Percent of total operations weighted ⁴				13.2	13.2

¹Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).

²Survey complete operation—respondent provided answers to all or nearly all questions for at least one site.

³One operation with more than 300 cows was recategorized as a medium-sized operation for data analysis.

⁴Weighted response—the rate was calculated using the initial selection weights.

2. Phase I_b: National Agricultural Statistics Service—30 or more cows

A total of 3,000 operations were selected for the survey of operations with 30 or more cows. Of these operations, 2,605 (86.8 percent) were contacted; 1,580 operations provided usable inventory information (52.7 percent of the total selected and 60.7 percent of those contacted). In addition, 1,191 operations (39.7 percent) provided “complete” information for the questionnaire. Of operations that provided complete information and were eligible to participate in the VS phase of the study (1,191 operations), 526 (44.2 percent) consented to be contacted for consideration/discussion about further participation.

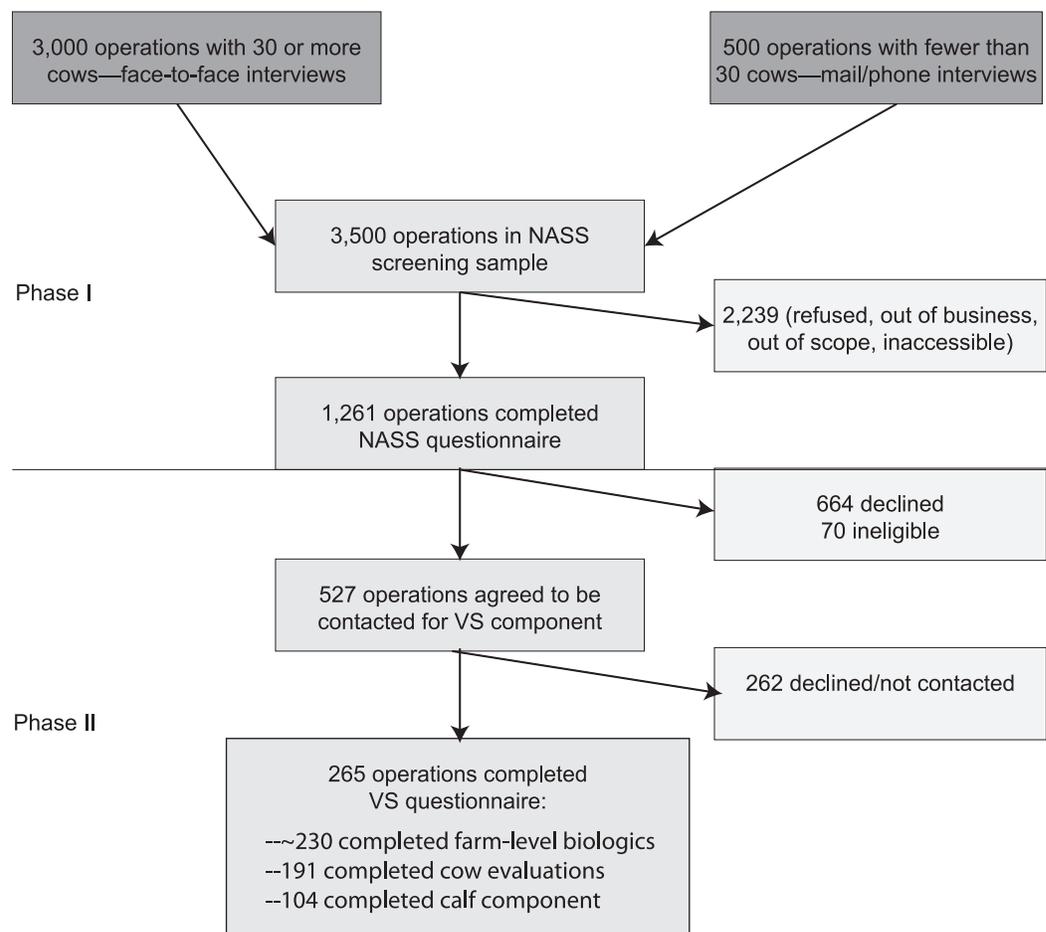
Response category	Number operations	Percent operations	Measurement parameter		
			Contacts	Usable ¹	Complete ²
Survey complete and VS consent	526	17.5	x	x	x
Survey complete, refused VS consent	665	22.2	x	x	x
No dairy cows on January 1, 2014	320	10.7	x	x	
Out of business	69	2.3	x	x	
Out of scope	8	0.3			
Refusal of NASS survey	1,025	34.2	x		
Office hold (NASS elected not to contact)	113	3.8			
Inaccessible	274	9.1			
Total	3,000	100.0	2,605	1,580	1,191
Percent of total operations			86.8	52.7	39.7
Percent of total operations weighted ³			87.3	57.0	38.5

¹Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).

²Survey complete operation—respondent provided answers to all or nearly all questions.

³Weighted response—the rate was calculated using the initial selection weights.

Flowchart of respondents



NASS = National Agricultural Statistics Service
 VS = Veterinary Services

Appendix I: Sample Profile

A. Responding Operations Phases 1a and 1b

1. Number of responding operations, by herd size and by region

Region ¹	Number of Responding Operations				
	Herd Size (number of cows)				
	Very small (<30)	Small (30–99)	Medium (100–499)	Large (500+)	All operations
West	5	12	47	256	320
East	64	385	296	196	941
Total	69 ²	397	343	452	1,261

¹Regions:

West: California, Colorado, Idaho, Texas, Washington.

East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, Wisconsin.

²One operation from Phase 1a with more than 300 cows was re-categorized into the medium herd size category.

Appendix II: U.S. Milk Cow Population and Operations

Number of milk cows, number of operations, and average herd size for participating States

Region	State	Number of milk cows (thousand head)		Number of operations		Average herd size	
		Milk cows on operations with 1 or more head ¹	Milk cows on operations with 30 or more head ²	Operations with 1 or more head ¹	Operations with 30 or more head ²	Operations with 1 or more head	Operations with 30 or more head
West	California	1,815.7	1,814.1	1,931	1,436	940.3	1,263.3
	Colorado	130.7	129.6	517	115	252.8	1,127.0
	Idaho	578.8	577.5	934	540	619.7	1,069.4
	Texas	434.9	431.9	985	512	441.5	843.6
	Washington	267.0	265.4	798	353	334.6	751.8
	Total	3,227.1	3,218.5	5,165	2,956	624.8	1,088.8
East	Indiana	174.1	161.7	2,401	1,010	72.5	160.1
	Iowa	204.8	199.4	1,810	1,230	113.1	162.1
	Kentucky	71.8	67.0	1,564	746	45.9	89.8
	Michigan	376.3	369.2	2,409	1,500	156.2	246.1
	Minnesota	463.3	448.6	4,746	3,720	97.6	120.6
	Missouri	93.0	99.8	2,451	960	37.9	104.0
	New York	610.7	594.6	5,427	3,968	112.5	149.8
	Ohio	267.9	246.4	4,008	2,084	66.8	118.2
	Pennsylvania	532.3	515.3	7,829	6,025	68.0	85.5
	Vermont	134.1	131.7	1,075	769	124.7	171.3
	Virginia	94.1	91.2	1,168	628	80.6	145.2
	Wisconsin	1,270.1	1,241.5	11,543	9,541	110.0	130.1
	Total	4,292.5	4,166.4	46,431	32,181	92.4	129.5
Total (17 States)		7,519.6	7,384.9	51,596	35,137	145.7	210.2
Percentage of U.S.		81.3	81.4	80.5	87.8		
Total U.S. (50 States)		9,252.3	9,067.8	64,098	40,017	144.3	226.6

¹Source: NASS 2012 Census of Agriculture.

²Source: NASS 2012 Census of Agriculture Special Tabulation.

Appendix III: Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
 - “Changes in Milking Procedures on U.S. Dairy Operations,” info sheet
 - **“Nutrient Management Practices on U.S. Dairy Operations, 2014”**
 - “Changes in the U.S. Dairy Cattle Industry 1991–2014”
2. Describe management practices and production measures related to animal welfare
 - “Dairy Cattle Management Practices in the United States, 2014
 - “Cattle Welfare on U.S. Dairy Operations, 2014,” interpretive report
 - “Management of Nonambulatory Dairy Cows on U.S. Dairy Operations”
3. Estimate within-herd prevalence of lameness and evaluate housing and management factors associated with lameness
 - “Associations Between Housing and Management Practices on the Prevalence of Lameness, Hock Lesions, and Thin Cows on U.S. Dairy Operations,” info sheet
4. Evaluate heifer calf health from birth to weaning
 - “Dairy Cattle Management Practices in the United States, 2014”
 - “Colostrum Feeding and Management on U.S. Dairy Operations, 1991–2014,” info sheet
 - “Morbidity and Mortality of Prewaned Dairy Heifer Calves,” info sheet
 - “Evaluation of Colostrum Quality and Passive Transfer Status of Dairy Heifer Calves on U.S. Dairy Operations, 2014,” info sheet
 - “Prevalence of *Giardia* and *Cryptosporidium* in Prewaned Dairy Heifer Calves, 2014,” info sheet
 - “Evaluation of Average Daily Gain in Prewaned Dairy Heifer Calves, 2014,” info sheet
5. Describe antimicrobial use and residue-prevention methods used to ensure milk and meat quality
 - “Milk Quality, Milking Procedures and Mastitis on U.S. Dairy Operations, 2014”
 - “Health and Management Practices on U.S. Dairy Operations, 2014”
 - “Antimicrobial Use on U.S. Dairy Operations, 2002–14,” info sheet

6. Estimate the prevalence and describe antimicrobial resistance patterns of select foodborne pathogens

- “*Listeria* and *Salmonella* in Bulk Tank Milk on U.S. Dairy Operations, 2002–14,” info sheet
- “Prevalence of *Campylobacter* spp. in Bulk-tank Milk and Filters from U.S. Dairies, 2014,” info sheet
- “*Salmonella* Dublin Antibodies in Bulk-tank Milk on U.S. Dairy Operations, 2014,” info sheet
- “*Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002–14,” info sheet

Additional informational sheets

- “Dairy Cattle Identification Practices in the United States, 2014,” info sheet
- “Reproduction Practices on U.S. Dairy Operations, 2014,” info sheet
- “Dairy Cattle Injection Practices in the United States, 2014,” info sheet
- “Off-Site Heifer Raising on U.S. Dairy Operations, 2014,” info sheet
- “Dry-off Procedures on U.S. Dairy Operations, 2014,” info sheet