An Overview of Dairy Manure Nutrients

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Management of manure nutrients on any livestock enterprise is becoming a major issue. Operations are seeking ways to add value to the manure nutrients while minimizing the cost of handling manures. Table 1 shows the manure nutrients excreted for a lactating dairy cow based on daily milk production. The table was developed using a simplified equation being included in the revised manure excretion standard of the American Society of Agricultural Engineers. As milk production increases, manure excreted and manure nutrients increase linearly. As milk production approaches 0 lbs/cow/day, manure production still remains at 95 lbs/cow/day for a 1,400 lb cow or 68 lbs per 1,000 lbs live weight. This manure excretion is similar to beef cattle estimated at 60 lbs/day per 1,000 lbs live weight. Table 1 shows an increase in manure nutrients as milk production increases.

Table 1. Excreted manure characteristics based on daily milk production per cow.

Milk Production lbs/cow/day	Total Manure Production lbs/cow/day	Manure Nutrients Excreted (lbs/cow/dy)			Moisture Content (percent)
		Nitrogen	Phosphate	Potash	
50	127	0.83	0.32	0.16	87.5
60	134	0.88	0.34	0.18	87.4
70	140	0.92	0.36	0.19	87.3
80	147	0.96	0.38	0.21	87.2
90	153	1.00	0.40	0.23	87.1

Beef operations typically only consider the excreted manure waste stream on a daily basis. A dairy has two main waste streams – the excrete manure waste stream and the milk parlor wash water. Table 2 shows the influence of water usage in the milk parlor on the overall waste stream on a dairy with milk production at 70 lbs/cow/day. In Kansas, water allocations are based on 100 gallons per cow per day in the milk parlor. The total quantity of material that has to be handled increases from 140 lbs of excrete manure to 970 lbs when the parlor wash water is included. This reduces the solids content of the waste stream from 12.7 to 1.8 percent. Thus, the overall daily waste stream per 1,000 lbs live weight equals 700 lbs on a dairy as compared to 60 lbs on a beef operation. There are differences in lagoon volumes between dairies and feedlots for volume required to handle normal rainfall events. Feedlots are typically sized based on 150 to 250 sq ft per 1,000 lbs live weight and dairies are sized based on 350 to 500 sq ft per 1,000 lbs. These differences are not considered major in the High Plains region since evaporation handles

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most of the excrete urine and rainfall events. Evaporation results in the manure being harvested from a beef feedlot being relatively dry, i.e. less than 40 percent in most cases. Manure harvested from dry lot dairies will have a similar moisture content while manure separated from the waste stream on free stall dairies will generally have a moisture content of 80 percent or more. Thus the main waste streams from a beef feedlot are low moisture while the waste stream from a dairy is high moisture in nature.

Table 2. The influence of parlor water usage on waste stream on a dairy with lactating cows milking 70 lbs per cow per day.

Water Usage in Parlor gal/cow/day	Quantity of Waste Stream (lbs/cow/day)			Total Solids in Stream (percent)	Ratio of Waste to Milk
	Parlor Water	Excreted Manure	Total Weight		
Excreted	0	140	140	12.7	2
50	415	140	555	3.2	7.9
60	498	140	638	2.8	9.1
70	581	140	721	2.5	10.3
80	664	140	804	2.2	11.5
90	747	140	887	2.0	12.7
100	830	140	970	1.8	13.9
110	913	140	1,053	1.7	15.1
120	996	140	1,136	1.6	16.2
Beef (1,000 lbs)	0	60	60	12	NA

Figure 1 shows a comparison or nutrient values between dry lot and free stall dairies and beef lot operations. The data is based on limited sampling of dairies in Kansas with the beef feedlot information being obtained from Sevi-Tech Labs. The dry lot and free stall dairies were flushing the milk parlor. The table shows the nutrient value of the lagoon water ($/1,000 gallons) was much higher on free stall dairies as compared to dry lot dairies. In fact, there was little difference between nutrient value in the lagoons of dry lot dairies and beef feedlots. The data also shows the nutrient value of the solid waste stream ($/wet ton) was much higher for beef feedlots and lowest for free stall dairies. The recycled flush water absorbs nutrients from the solids each time an alley is flushed. This increases the nutrient content of the lagoon water. Other data shows even more differences in nutrient contents of the lagoons when comparing flush versus non flush milk parlors on dairies. The non flush parlor dairies have much lower nutrient content in the lagoon and high nutrient contents in the solids basins.

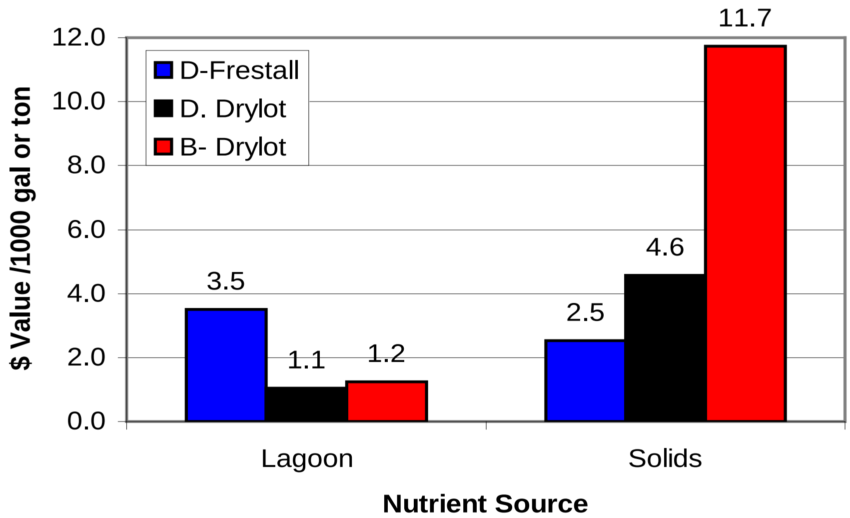

Figure 1. Comparison of economic value of waste stream from free stall and dry lot dairies and beef operations. Nitrogen was assumed to equal $0.25/lb, phosphate $0.16/lb and potash $0.14/lb.

Figure 2 shows the economic value of the manure if applied to cropland with high soil phosphorus levels. In this case, the value of the phosphorus nutrients in the manure steams is equal to zero since supplemental phosphate is not required. The value of the nutrients in the lagoon water is reduced by about 20 percent for the dairy operations but there is no change in the value of the nutrients from the beef feedlot lagoons. Phosphorus tends to be in the solids portion of the waste stream. The value of the nutrients in the solids portion of the waste streams reduces by nearly 25 percent for free stall dairies, 30 percent for dry lot dairies and nearly 40 percent for the beef feedlots when comparing Figures 1 and 2.

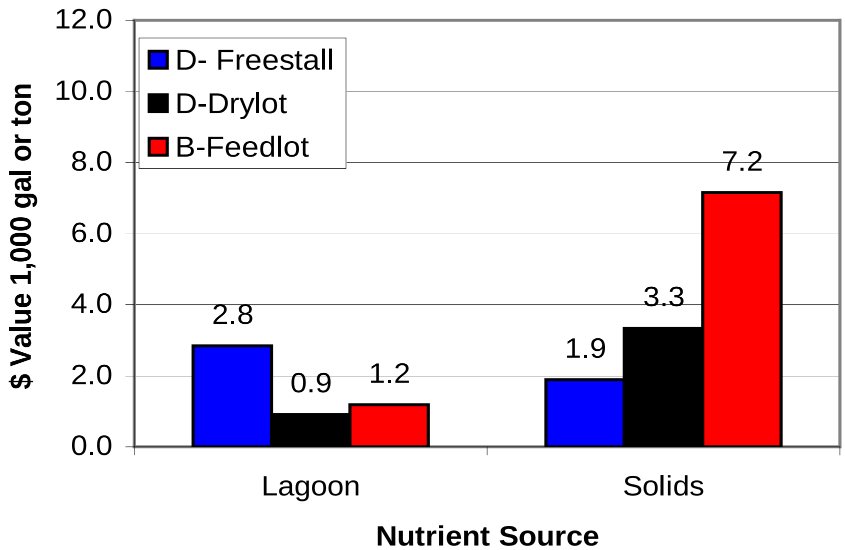

Figure 2. . Comparison of economic value of waste stream from free stall and dry lot dairies and beef operations assuming value of phosphate is zero. Nitrogen was assumed to equal $0.25/lb and potash $0.14/lb.

Using the data available, Figure 3 shows a nutrient's percent contribution to the overall nutrient value. For example, 40 percent of the value for the lagoon nutrients is derived from potash, 11 percent for phosphate and 49 percent from nitrogen on free stall dairies. This compares to beef feedlots where 70 percent of the value is derived from potash and only 27 percent from nitrogen.

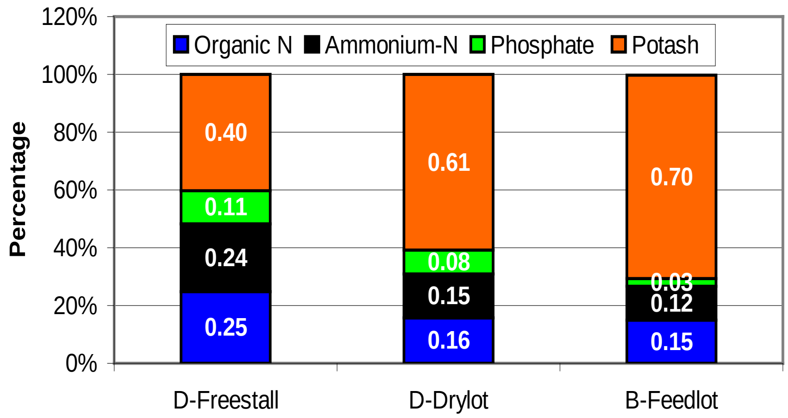

Figure 3. Comparison of percent nutrient value of different nutrients in the lagoon waste stream

Figure 4 shows a nutrient's percent contribution to value of the solids. For example, 17 percent of the value for the lagoon nutrients is derived from potash over 68 percent from nitrogen on free stall dairies. This compares to beef feedlots where 32 percent of the value is derived from potash and 39 percent from nitrogen. The dry lot dairy has similar percentage contribution to nutrient value to the beef feedlot.

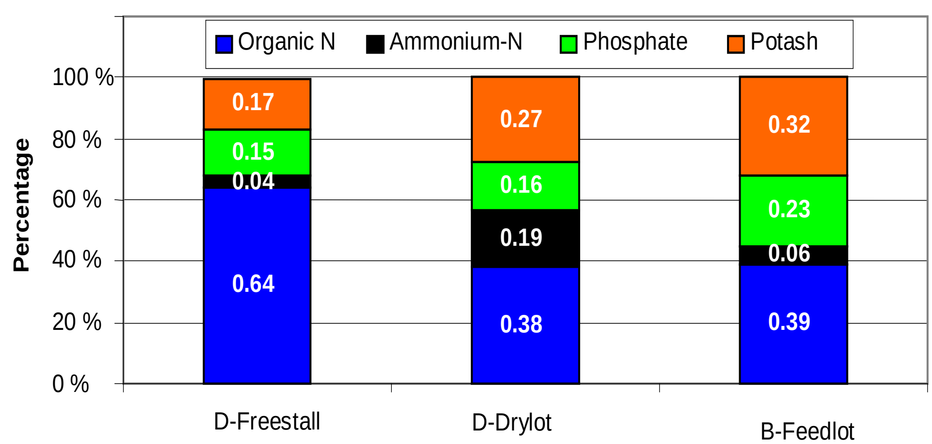

Figure 4. Comparison of percent nutrient value of different manure nutrients in the solids waste stream

Figure 5 compares the economic value of manure based on a dry weight bases. The figure shows the nutrient value of solids from a dry lot dairy equal about $0.0087 per lb (dry basis) as compared to $0.0075 for beef feedlots and $0.0065 for free stall dairies.

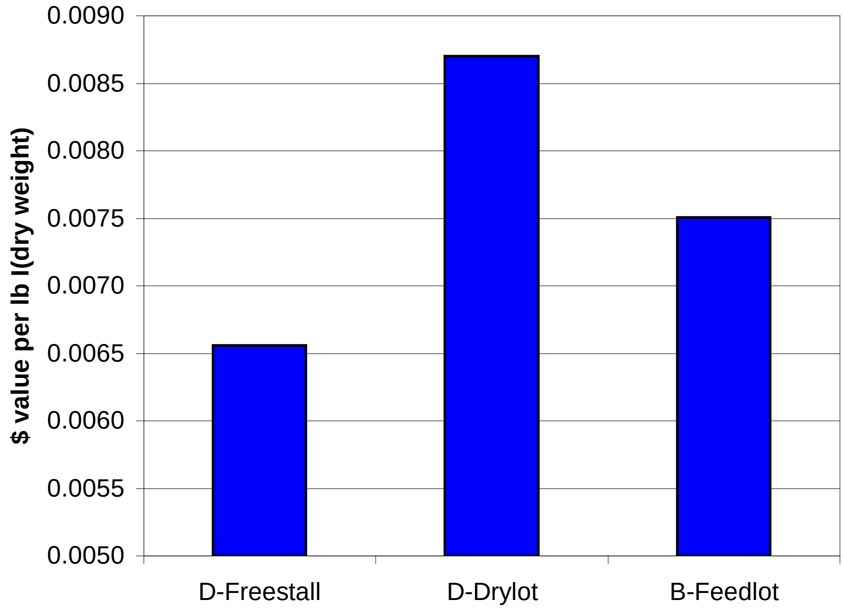

Figure 5. Manure nutrient value from different types of livestock enterprises compared on a dry basis.

Comprehensive nutrient management plans basically match manure nutrients to crop nutrient utilization. Table 3 shows the influence of milk production on land requirements based on different limiting nutrients for a 1,000-cow dairy. The table assumes crop nitrogen, phosphate and potash requirements at 200, 80 and 200 lbs per acre, respectively. It was also assumed that 50 percent of excreted volatized to the atmosphere. The table shows that if phosphate (phosphorus) is the limiting nutrients and requires 2, 5 and 3 times as much land as compared to nitrogen, potash (potassium) and water, respectively. Table 3 highlights the need to first consider the importance of ration formulation and eliminating excess phosphorus in the diet. Any excess phosphorus in the diet is excreted and results in additional land requirements if phosphorus is the limiting nutrient.

Many dairies in southwest Kansas are dry lot dairies. Typical space allocations are 500 to 700 square feet per cow per day. Based on an annual net evaporation rate of 36 inches, 250 square feet of lot space is required to evaporate the120 lbs of urine. About 100 square feet is required to evaporate the urine from beef cattle. The challenge remains is the 100 gallons of water usage in the milk parlor. Assuming a 1,000 cow dairy and 100 gallons per day in the parlor, it only requires 10 days of parlor water to equal the amount of water evaporated from a 1 acre lagoon losses 3 feet per year. The remainder of the water used throughout the year must be dealt with in another manner.

Table 3. Acres of cropland required for land application of excreted nutrients and parlor wash water from a 1,000-cow dairy assuming crop nutrient uptake is 200, 80 and 200 lbs/acre for nitrogen, phosphate and potash, respectively.

Milk Production	Acres Required Based on 100 percent Utilization of Manure Nutrients Annually			
	Nitrogen	Phosphate	Potash	Water*
50	761	1,476	290	532
60	800	1,558	323	546
70	838	1,639	355	569
80	877	1,721	388	592
90	915	1,802	421	615

*Water based on 100 gallons/cow/day in parlor and assumes application rate is 2 feet per acre.

Determining the real value of manure from a dairy requires consideration of the water component. One dairy cow uses 1/10 acre-ft of water in the milk parlor annually. For every 20 cows, there is enough water to apply 2 acre-ft of water to an acre of cropland. This water quantity is based on using 100 gallons per cow per day in the milk parlor. Dairies with free stall housing need to recover the manure nutrient value within the lagoon.