



Liquid Dairy Waste Transport and Land Application Cost Comparisons Considering Herd Size, Transport Distance, and Nitrogen versus Phosphorus Application Rates



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Objectives

- To provide realistic cost estimates and net fertilizer value returns for the transport and application of liquid dairy waste
- To examine cost and net fertilizer value differences between nitrogen and phosphorus-based land applications
- To evaluate the impacts of herd size and transport distance on costs and net fertilizer values



Liquid Slurry Tank System Equipped with an Injection Toolbar

Background

- Land application is the most prevalent method of utilizing animal manure
- A wide variety of equipment is available to transport and land apply animal waste
- The costs incurred in the transport and application of animal waste can be a significant portion of a dairy's total operational cost
- Animal waste should be applied at rates that match crop nutrient requirements
 - Nutrients applied in excess of crop requirements can be detrimental to the environment
 - New proposed federal regulations favor the implementation of phosphorus-based applications



Big Gun Hard Hose Traveler System



Center-Pivot Irrigation System



Big Gun Soft Hose System

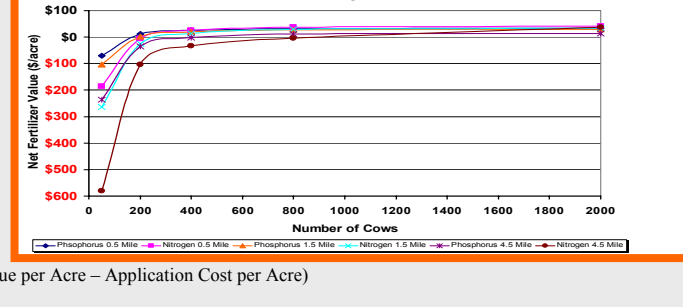
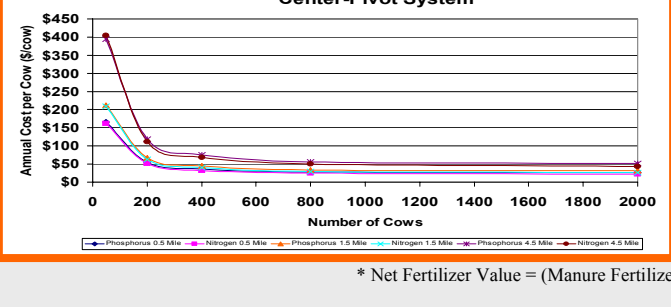
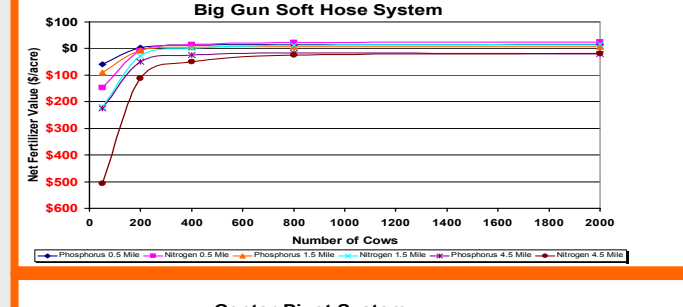
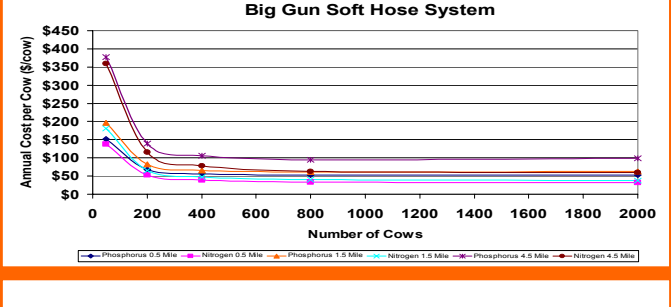
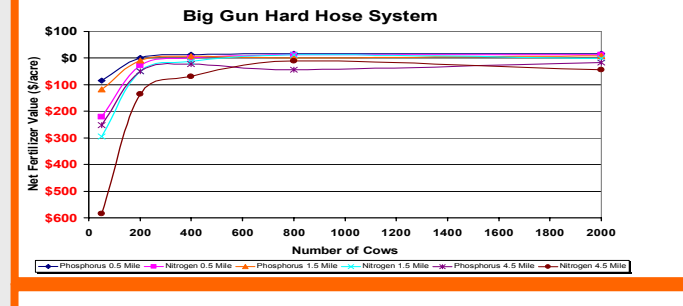
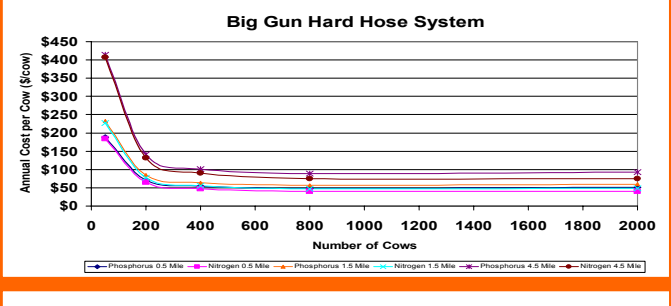
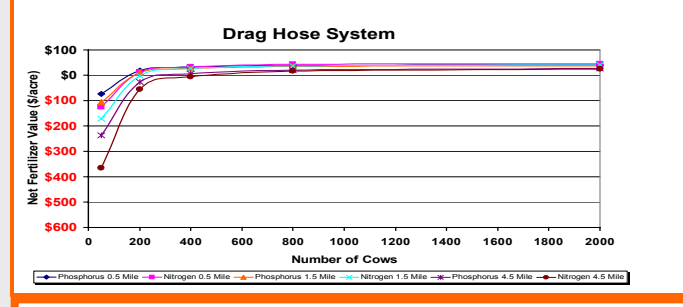
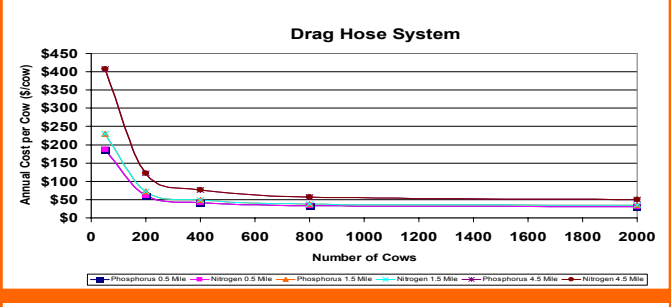
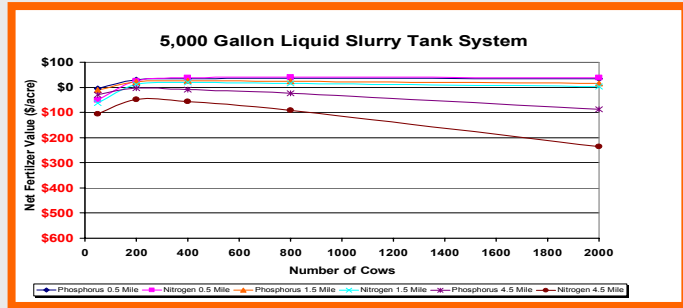
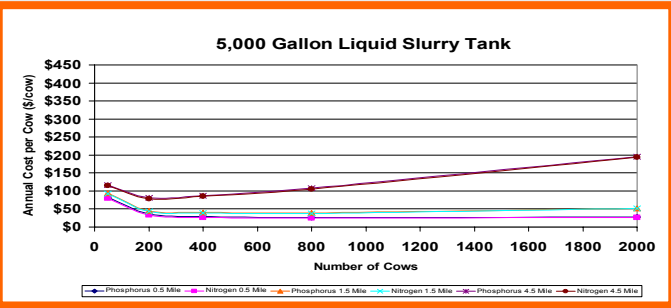


Drag Hose Direct Injection System

Annual Cost per Cow

Results

Net Fertilizer Value *



* Net Fertilizer Value = (Manure Fertilizer Value per Acre – Application Cost per Acre)

Annual Operational Time for Hauling Systems

Number of Cows	5,000 Gallon Liquid Slurry Tank			10,000 Gallon Liquid Slurry Tank		
	Operation Time in Hours					
	0.5 Mile	1.5 Mile	4.5 Mile	0.5 Mile	1.5 Mile	4.5 Mile
50	27	40	79	23	30	49
200	106	158	315	93	119	197
400	212	317	630	186	238	395
800	424	633	1260	372	476	790
2000	1060	1583	3151	930	1190	1975

Annual Operational Time for Pumping Systems

Number of Cows	Drag Hose	Big Gun Hard Hose	Big Gun Soft Hose	Center-Pivot		
	Operation Time in Hours					
	P & N	P	N	P	N	P
50	12	25	20	26	16	30
200	49	98	81	104	66	69
400	97	196	162	208	132	130
800	194	392	324	417	263	252
2000	484	980	810	1043	658	625

Materials and Methods

- Developed**
 - a cost estimation model to calculate operational costs for animal waste transport and application equipment
- Determined**
 - total annual economic cost
 - application cost per acre
 - annual cost per cow
 - net fertilizer value per acre
- Compared**
 - nitrogen and phosphorus based application rates
 - 0.5, 1.5, & 4.5 mile transport distances
 - 50, 200, 400, 800, & 2,000 lactating cow operations

User Inputs			Calculated Values							Default Values			
Age of Equipment (years) =	5		Depreciation (\$/HR)							Useful Life (years) =			
Annual Hours of Use =	271.5		Interest (\$/HR)							Salvage Value % =			
Accumulated Hours of Use =	1,357.3		Insurance (\$/HR)							Interest Rate % =			
Labor (\$/HR) =	\$0.00		Repairs and Maintenance (\$/HR)							Tank Capacity (gallons)			
			Fuel (\$/HR)							Insurance Rate = \$10 per \$1000 of			
			Salvage Value							Purchase Price =			
			Total Operating Cost (\$/HR)							Repair Factors			
										RF1		RF2	
										0.16		2	
										Fuel Price per Gallon of Diesel			
										\$1.20			
										Capital Cost (\$)			
Tank Capacity	Capital Cost (purchase price)	Useful Life	Salvage Value	Age of Equipment	Accumulated Hours of Use	Annual Hours of Use	Depreciation	Interest	Insurance	Repairs and Maintenance	Fuel	Labor	Total Operating Cost
2,300	\$12,000	10	\$2,400	5	1,357	271	3.54	0.27	0.44	5.73	0.00	0.00	\$9.98
3,000	\$16,800	10	\$3,360	5	1,357	271	4.95	0.37	0.62	8.03	0.00	0.00	\$13.97
4,000	\$17,600	10	\$3,520	5	1,357	271	5.19	0.39	0.65	8.41	0.00	0.00	\$14.63
5,000	\$23,000	10	\$4,600	5	1,357	271	6.78	0.51	0.85	10.99	0.00	0.00	\$19.12
6,000	\$29,500	10	\$5,900	5	1,357	271	8.69	0.65	1.09	14.09	0.00	0.00	\$24.53
7,500	\$38,000	10	\$7,600	5	1,357	271	11.20	0.84	1.40	18.16	0.00	0.00	\$31.59
10,000	\$47,000	10	\$9,400	5	1,357	271	13.85	1.04	1.73	22.46	0.00	0.00	\$39.08
12,000	\$63,300	10	\$12,660	5	1,357	271	18.65	1.40	2.33	30.24	0.00	0.00	\$52.63

Liquid Slurry Tank Spreadsheet from the Cost Estimation Model

Conclusions

- Hauling systems are best suited for small operations (<400 cows) with short transport distances (<1.5 miles)
 - Hauling systems produced competitive values for large operations and long transport distances, but their annual operational times were not feasible
 - Hauling systems are more cost sensitive to increases in transport distance than pumping systems
 - Total annual economic costs were identical for hauling systems
 - Incorporated hauling systems were slightly higher with phosphorus-based applications
- Pumping systems are best suited for large operations (>400 cows) with long transport distances (>1.5 miles)
 - Incorporating or injecting the waste generally increased net fertilizer values as compared to non-incorporated applications
 - Operations of 400 cows and greater generally produced the greatest net fertilizer values
 - Irrigation systems have lower annual total economic costs if applications are based on nitrogen crop requirements than on phosphorus requirements

Cost Estimation Model software interface is under currently under development: Available at <http://uik.edu/wastepage> in the future