Spreading Systems and Containment Ponds for Livestock Waste Management

Unal Kizil
Area Extension Specialist, North Dakota State University, Dickinson Research Extension Center

Summary: Two spreading and containment systems were designed in Oliver and Dunn Counties of North Dakota. The results showed that unit costs for the systems designed in Oliver County were 0.78 and 0.89 $/ft^2 for spreading and containment systems, respectively. Same numbers for Dunn County design were 0.67 and 0.54 $/ft^2 for spreading and containment systems, respectively. No significant differences were observed in any of the designs.

Introduction

Feedlot runoff contains numerous pollutants that can be a significant source of water pollution (Nye, 1982). If the nitrate-N reaches the groundwater and concentration exceeds 10 ppm, it may create serious health problem for babies, pregnant women, and livestock (Madison et al., 2002). Phosphorus transported by runoff can cause nutrient enrichment in surface water resulting increased biological productivity. This process is called eutrophication and has been identified as the main source of surface water pollution (EPA, 1996, and Sharpley et al., 1999). Increased growth of algae and oxygen shortage restricts water use for fisheries, recreation, industry, and drinking. Phosphorus concentration exceeding 0.02 ppm in lake water accelerates the eutrophication (Sharpley et al., 1999).

Yang and Lorimor (2000) reported runoff characteristics for a 22,720 m^2, 380-head beef cattle feedlot as 109, 34 ppm for N, and P respectively. In another study, Sweeten (1994) reported that feedlot runoff contains 3202, 93, and 31 ppm of COD, N, and P respectively. Due to the mentioned pollution potential, runoff should be controlled. There are two main runoff control options available including containment (storage ponds) and discharge (spreading) systems. Both systems gather all runoff from the feedlot(s) for application.

Feedlot operators are interested in using spreading systems which require relatively less capital expenditures. However, applicability of these systems may not be possible for all operations. Availability of spreading or infiltration area, number of days on feed, uniformity of discharge to the spreading area, proximity to creeks, roads, and neighbors are limiting factors. Even, in some cases, cost of these systems may not be as low as expected. When the spreading system is not an option, use of a containment system is inevitable. In this report, it was aimed to compare both systems referring 2 designed runoff control systems in North Dakota.

Operations

Operation 1: Operation 1 is located in Oliver County, North Dakota. This feedlot operation is used 12 months/year and averages 140 heads. The producer would like to abandon the west lots, and replace them to the east. The potential problem with the existing operation is the runoff from the existing lots drains into creek next to lots. The new feedlots will accommodate up to 300 heads. Two alternative systems were designed for this operation including spreading and containment. Cost items and their percentages in total cost for both systems are given in Table 1.

Table 1. Cost items and their percentages in total cost

	Percentage of cost item	
Cost item	***Spreading system***	***Containment system***
Excavation/earth fill	36.5	28.5
Erosion blanket	10.5	11.6
Solid separator	-	5.8
Access road	9.8	13.9
Heavy use areas	-	6.2
Fencing	28.2	26.0
Water supply	3.8	3.4
Shaping/seeding/grading	2.7	4.6
Perforated pipe	8.5	-
Total	100	100

A unit area of 500 ft^2/head was used. Thus the total feedlot surface area is 150,000 ft^2 for this operation. The total costs were $ 117,059 and $ 132,720 for spreading and containment systems, respectively.

Operation 1: This is an existing feeding operation. This feeding operation is used mainly 3-4 months/year and averages 950 head. The operation covers around 36-40 acres. Natural drainage flows into the Knife River, then into the Missouri River. The operator would like to use old lots which are located on the north of his section with a vegetative filter strip that will be constructed on the east of these lots (this is what the design reflects). Also, the producer has another feedlot located on the south-east

of aforementioned north lots. There will be some expansion to the east of these lots. Four larger lots will be constructed. To the south of these pens a new feedlot is proposed having 8 pens. North lots will drain into the spreading area, and the runoff from old and new south lots will be collected in a containment pond. There are existing and new lots in the design. In order to avoid confusion, the total cost will reflect only the runoff control systems excluding feedlot shaping/grading, fencing, feedbunks etc. Cost items and their percentages in total cost for both systems are given in Table 2.

Table 2. Cost items and their percentages in total cost

	Percentage of cost item	
Cost item	***Spreading system***	***Containment system***
Excavation/earth fill	44.2	72.3
Solid separator	42.0	9.9
Heavy use areas	3.4	0.3
Fencing	-	9.2
Shaping/seeding/grading	7.8	7.4
Culverts	2.6	0.9
Total	100	100

The total feedlot surface areas for north lots (spreading system) and south lots (containment system) are 77,824 ft^2 and 276,108 ft^2, respectively. The total costs were $ 52,192 and $ 149,322 for spreading and containment systems, respectively.

Results

To be able to make a justification, unit costs per animal head and ft^2 were calculated. The summary of the calculations and comparisons are given in Table 3.

Table 3. Comparisons of cost of spreading and containment systems in both operation.

	Operation 1		***Operation 2***	
	Spreading	***Containment***	***Spreading***	***Containment***
Capacity, head	300	300	155	500
Feedlot area, ft^2	150,000	150,000	77,824	276,108
Cost, $/head	390	442	336	272
Cost, $/$ft^2$	0.78	0.89	0.67	0.54
Total cost, $	117,059	132,720	52,192	149,322

As can be seen from Table 3, spreading system seems to be reasonable for operation 1. However, the difference is not big. On the other hand, for operation 2, containment system costs 0.54 $/$ft^2$ while the unit cost for spreading system is 0.67 $/$ft^2$. As a result, it can be said that spreading systems are not always cost effective options. The major factor that can make containment systems cost effective in North Dakota is the climate. Less precipitation, more evaporation makes the pond size smaller. Thus, containment systems are always alternative for runoff control in North Dakota.

References

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