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SUPPLEMENTARY NOTES ON FEEDLOT WASTE MANAGEMENT
for EC 63-716 "Beef Housing & Equipment Handbook"
University of Nebraska - 1969

There is currently much public and legislative attention to problems of pollution of our resources and environment. Authority for water pollution control by the Nebraska Water Pollution Control Council is provided by Sections 71-3001 through 71-3016, Revised Statutes, Nebraska, 1943. Objectives are defined in "Nebraska Water Quality Standards." Beef cattle feedlots are receiving particular attention.

Much design and research effort is being directed to feedlot waste handling systems. The problems of pollution are complex and more information is needed on practical methods of control. Intensive research is under way at the University of Nebraska and other research agencies to develop these improved methods.

In the meantime many people want to start new feedlots, expand existing ones or modify present facilities. The following suggestions are made available even though complete and firm recommendations are not now possible. Furthermore, individual characteristics of each feedlot make it necessary to adapt the recommendations to achieve best results. Those proceeding on the basis of these or other suggestions should recognize that research may result in future changes of designs and practices.

Site Selection

In selecting a site, the number of animals and type of lot (earth or surfaced) determine the area required. For unsurfaced lots, areas of as much as 400 square feet per head may be needed, while in hard surfaced lots the area may be 55 square feet (see pages 3 and 4 of EC 63-716 for further details). Feed storage handling facilities, cattle sorting lots, layout modification and future expansion must be provided (see page 2, EC 63-716, for space data).

Choose a site located away from a stream or waterway. Allow space so that drainage from lots can be retained on your property. Avoid a location that may allow drainage from your lots to run onto your neighbors property or into a waterway.

Feedlots adjacent to small towns or urban areas may present problems due to objections of odors, dust, noise and runoff. Do not locate new feedlots immediately adjacent to an urban area. Check to determine if local zoning ordinances exist.

Slope will affect drainage from feedlots. Grades of 4% to 6% or more are desirable to help keep lots dry. Flat areas that provide little or no runoff should be graded to provide mounds or internal drainage. Grading should be the first step in new lot construction. Use a topographic map to determine cuts and fills.

A south slope dries most rapidly. An east slope is second best. In some cases it may be desirable to change the direction of slope by grading (see pages 2 and 3, EC 63-716).

If windbreaks or shelters are used, locate them to provide animal protection and to avoid snow buildup within lots. Snow drifts in lots present operational problems and greatly increase runoff and pollution potential. Pages 15 and 47

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of EC 63-716 show snow patterns that can be expected from snow fences or tree windbreaks.

Lot Management

Lot management must create a desirable environment for animal performance and reduce surface runoff and manure handling to a manageable level. Well drained areas within the lot are required. Factors influencing the need for manure management or factors contributing to runoff are the following:

1. Cleaned lots tend to contribute greater quantities of runoff.
2. More cattle per pen increases the need for manure removal. However, manure buildup tends to decrease surface runoff.
3. Well drained surfaces support best animal performance. Adequate surface conditions may be obtained with the following:
   a. 0-3% slope (unsurfaced) - Increased manure management (scraping and mounding or removal) or increased area per animal is required (see pages 2 and 10, EC 63-716).
   b. 4% and greater (unsurfaced) - Manure management may be minimum and animal density greater in well drained lots.
   c. Hard surfaced lots - Frequent manure removal is required to reduce sloppy conditions. Area requirement is minimized (for outdoor lots).
4. Annual rainfall may alter management of manure in the lot as does the season.
5. The need for manure removal is increased by feeding high roughage rations and the addition of bedding.

A balance between conditions contributing to best animal response, minimum manure management and reduced surface runoff is required. Suggested systems for manure management are these:

1. Manure removal from lot once or twice a year or upon removal of cattle.
2. Periodic cleaning of critical areas such as concrete apron and watering areas within lots.
3. Stock piling manure within feedlot. Remove it when quantity exceeds the ability to mound or manage.

Runoff Management

Interception and control of feedlot runoff is much the same as on other areas of the same size, whether urban or agricultural. Doubling the area will usually double the runoff. The steepness of slope will not materially affect the volume of runoff but will affect velocity of surface runoff flow. Increasing the velocity of runoff flow increases its capacity to carry solids, whether in suspension or by movement along the ground surface.

Materials heavier than water and not in suspension that are moved along the ground surface by flowing water are called "bed loads." Both increased volume and velocity of flow add to the capacity to move more bed load and larger individual pieces of material. The addition of bed load to runoff flow increases the capacity to "scour" and detach even more material from the surface over which the runoff is flowing.

Manure on the feedlot surface provides protection to the soil from erosion. However, if a heavy load of manure is carried in runoff, problems of intercepting and handling the runoff flow are increased. If the manure pack is scoured off and the exposed soil erodes, the problem is further intensified. Besides the problems of rilling and gullying, soil deposits add to problems of manure handling.

Runoff must be intercepted on a slope before the combination of volume and velocity of the runoff flow becomes a serious problem. A few Nebraska feeders effectively use terraces in their lots. The terrace channels require periodic cleaning and the terrace cross sections require rebuilding every 3 to 4 years.

A number of plans for the control of runoff are shown on pages 3 and 5 of the Handbook. A basic rule stated in the handbook is "Avoid drainage from one lot to another." Once runoff from a lot is picked up, it can be carried to a detention pond or other holding area in a properly designed waterway. On steep slopes waterways may require structures for control of velocity and erosion.

Don't fail to divert all outside runoff water away from the feedlot. This is an easy first step in reducing feedlot.runoff.

Generally speaking, longer slope lengths should be possible between points of runoff interception on a feedlot than they would be with terraces on cultivated land. This assumes that a manure cover is present to protect the soil surface and that runoff will not be concentrated to start rills and gullys in the soil. Experience is the only guideline available at this time. Downslope lengths of 500 feet on 10 per cent slopes show definite evidence of serious erosion in some eastern Nebraska feedlots.

With normal annual precipitation of 26 to 27 inches, roughly a foot of runoff can be expected from a sloping feedlot in eastern Nebraska. However, nearly as much runoff can be collected in a few days from periods of heavy rainfall in some years. Plans for holding and disposal of runoff must be based on periods and amounts of rainfall that can be expected every 5 or 10 years as a minimum for design capacity (your SCS office has such data for your locality). Increasing the capacity of structures is always difficult after flooding and damage from overflow.

Keep solids out of runoff retention or storage structures to avoid loss of capacity and more costly removal. Removal of sediments is discussed on page 12.

Disposal Factors and Systems

1. Solids held on the feedlot may be picked up by conventional manure handling equipment and hauled and spread on fields. It is poor practice to spread waste on snow or frozen ground. Thawing may result in highly polluted runoff.
2. Plowing or disking after spreading on fields will reduce the probability of polluted runoff and odor nuisance. A heavy vegetative cover may serve the same purpose.
3. Select spreading areas which are not adjacent to a water course to minimize polluted runoff entering surface waters. Terracing reduces danger of solid materials being carried in runoff from sloping fields.
4. Liquid waste from detention ponds or pits may be disposed of as discussed under "Field Spreading," page 13 in Beef Handbook. Minimize the solids reaching the detention ponds by design and management.
5. Retained runoff can also be disposed of by evaporation. The mean annual evaporation ranges from 35 inches in extreme northeastern Nebraska to over

50 inches in southwestern Nebraska. After subtracting the annual precipitation the effective evaporation is about 6 inches in eastern Nebraska and about 34 inches in the western part of the State. This means that over a period of years in eastern Nebraska a three-acre water surface would evaporate the runoff from a four-acre feedlot. Evaporation can be increased by spraying into the air.

6. Irrigation of crops or grassland is yet another way of disposing retained liquid. The irrigation and rainfall runoff from the irrigated fields must be controlled. Reuse systems for runoff control are described in Nebraska Extension Circular 69-777, Management and Re-Use of Irrigation Runoff Water. Disposal by irrigation has the drawback of increased supplies of feedlot runoff in wet years when the need of crops for additional water is low.
7. If runoff containing small pieces of manure is used for sprinkler irrigation, nozzles with orifice diameters of ½ inch or more should be used. This usually requires a volume gun type of sprinkler. Special sprinkler heads, made of flexible materials, are available for field sprinkler manure distribution. If only liquid is pumped conventional sprinkler equipment can be used. The effect of manure acids and solids should not be overlooked in selection and operation of equipment.
8. Lagoons are not completely effective as digestive units. Solid wastes will remain and a drag-line may be needed to clean the lagoon periodically.

Ground Water Pollution

Pollution of ground water beneath beef cattle feedlots appears to be determined by a number of factors; stocking rate, manure removal, depth of water table, and soil texture and structure. Indications are that low stocking rates and frequent manure removal contribute to nitrate leaching into the water table. In fact, beef cattle feedlots having no manure removed for several years generally show a lower nitrate level in the ground waters underlying the area. Also, ground water under feedlots with a shallow water table is more apt to contain nitrates than ground water under feedlots with a deeper water table. Beef cattle feedlots established on coarse-textured sandy soils may permit more movement of pollutants to the ground water than those established on fine-textured clay soils.

Pollution of ground water can also result from the direct movement of runoff into inadequately cased or poorly protected wells located in, or in the immediate vicinity of, a feedlot. Wells drilled into limestone formations can be polluted by materials carried into the formation by water at some distance from the well. Ground waters in Nebraska are usually in sand and gravel formations, however.

NOTE: These supplementary comments relate to EC 63-716 "Beef Housing and Equipment Handbook" and to the Nebraska situation in the spring of 1969. Extensive research is seeking additional information. As such information is developed it will be made available in future supplements or revisions.

Copies of the "Beef Housing & Equipment Handbook" with supplementary notes may be obtained for $1.00 (plus sales tax) each from your County Extension Agent or from the Agricultural Engineering Department, University of Nebraska, Lincoln, Nebraska, 68503.

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Other related publications available from these sources are the following:

1. Similar handbooks on dairy, sheep, and swine housing & equipment, also $1.00 each (plus sales tax).
2. Livestock Liquid Manure Disposal Systems - EC68-776 - no charge.
3. Feedlot Pollution - CC206 - no charge.
4. Lagoon Manure Disposal - EC66-724 - no charge.
5. Management and Reuse of Irrigation Runoff Water - EC69-777 - no charge.

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