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Selecting Your Irrigation System … Comparing Five Common Types

Cooperative Extension South Dakota State University

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By F. F. Kerr, Water Resources Specialist, Cooperative Extension Service

Before taking the big step into irrigation, stop and consider:

- What type of system will fit my needs?
- What are advantages and disadvantages of these systems?
- What are some cost comparisons?
- What physical characteristics on my farm limit my choice of systems?

We'll discuss these considerations here. Other Extension publications on irrigation available from your County Extension Agent discuss such things as water quality, water supply needed, suitability of soils, and probable return on investment.

First, what about types of systems? On the next page let's look at five types which are being used in South Dakota. The "rule of thumb" comparison is for a 160-acre farm and includes initial cost of the system (excluding well and pump), plus fuel and labor costs needed for operation.

SYSTEMS NOT CONSIDERED HERE

Several types of systems are not considered here. Some are omitted because irrigators in South Dakota are not showing a preference for them. Those omitted include: the hand move sprinkler, siphon tubes, and giant sprinklers. The trend away from hand move systems appears to be an attempt by irrigators to substitute capital for labor, since initial investment is quite low in the hand move systems and labor costs are high. The same is true of siphon tubes compared with gated pipe plus the fact that gated pipe does not take as much land out of production as does a ditch system. Water distribution with the giant sprinklers has not been very successful in South Dakota because of high winds during much of the irrigating season.

This does not necessarily mean that these systems have no place in irrigation. For example, a hand move system might very well be a logical choice for the truck farmer where only a few acres are to be irrigated or for the alfalfa grower who does have sufficient labor.

Our "Rule of Thumb" Comparison . . .

Comparisons here assume that a square 160 acres are to be irrigated from a 100-foot-deep well situated in the center of the quarter section. This ideal situation is seldom found. It also assumes: that water supply is adequate for any of the systems; that soils are capable of taking the water at the design application rate; and that the land is relatively level. Crops to be irrigated are corn or alfalfa.

Actual investment, fuel and labor costs on a given development will be higher or lower than those computed here depending on actual water source location, actual soil and topography differences, and on competition among equipment dealers. These differences may be considerable. **Therefore, cost figures here should be considered only as a relative comparison.** For example, if plenty of family labor is available, a system of relatively low initial cost and relatively high labor costs may be an advantage. If labor is scare or labor costs are high, the opposite may be an advantage.

LIMITATIONS RULE OUT SOME SYSTEMS

Thin soil over impermeable subsoil usually rules out any type of gravity system (gated pipe or siphon tubes) since it would not be possible to level the land without cutting away the top soil in high areas to use in filling low areas. This would not be true if slopes were so perfect that leveling was unnecessary. This seldom happens.

Very sandy soils also rule out gravity irrigation. Since water enters these soils so rapidly, excessively deep percolation causes the system to be inefficient. If runs are shortened to compensate for this, they usually become impractical.

Excessive slopes, usually in excess of 2%, will rule out gravity irrigation regardless of depth of top soil, since it becomes too expensive to reduce these slopes sufficiently to avoid undue erosion. Fields with slopes greater than 2% could be bench leveled if top soils are sufficiently deep. If only a small part of the field has excessive slopes, frequently this portion can be dry farmed and leveling done only on that part of the land that lends itself to being properly shaped.

A limited water supply gives sprinkler irrigation a slight advantage over gravity irrigation. This is because sprinklers are slightly more efficient applicators of water than gravity systems. It is possible to "stretch" the water supply over about 10% to 15% more acres by applying it through sprinklers.

TYPE	TOW LINE	BOOM	SELF PROPELLED	SIDE-MOVE TOW	GATED PIPE
What It Looks Like →					
Brief Description →	The tow-line sprinkler system takes advantage of the low operating costs of the hand move system and reduces labor costs. The lateral is towed in one piece with a tractor rather than handling the pipe one section at a time. To avoid damage to tall crops, fields should be laid out as shown in figure 1 (back page). Soy beans, grain sorghum or alfalfa may be used as the low growing crop. Fields should be rectangular without obstructions.	Boom sprinkler systems (sometimes called "whirlybirds") are mounted on a wheeled carriage that also serves to carry sections of the lateral pipe line. The lateral sections are added or picked up as the sprinkler is moved through the field. Units are available in 80- to 250-foot lengths with the 140-foot and the 180-foot sizes being most popular. One to three acres are irrigated per set. The boom carriage is moved to successive sets by using a tractor and cable.	The self propelled sprinkler system uses its own hydraulic power to move itself around a central pivot. Its speed and/or nozzle selection can be adjusted to change the amount of water applied per revolution. Fields must be square and unobstructed. Less labor is required than for any other system now in common use. These systems do not irrigate the corners of fields since they move in a circle. A so-called 160-acre unit actually irrigates 138 to 145 acres depending on how the large outside sprinkler is used.	The side-move tow sprinkler system, new to South Dakota, is a modification of earlier side roll systems. (Several modified systems are on the market.) It has the unique characteristic of trailing additional sprinklers at 50- and 100-foot spacings behind the main lateral mounted on wheels. This reduces number of moves required. A gasoline engine mounted at the center of the main lateral moves the unit. It transmits power to all wheels through a drive shaft paralleling the main lateral. The unit can be moved—by tractor or its own power—to another field by turning the drive wheels 90° and locking them in place. The unit is being modified to make it more adaptable for tall growing crops.	The gated pipe gravity system seems to be the most popular gravity system for privately developed irrigation in South Dakota. In project irrigation developments in western South Dakota, siphon tubes are used extensively since the project delivers water through a canal and ditch system. The cost comparison does not include land leveling because costs for this operation vary greatly from farm to farm. While land leveling costs are frequently high, remember that once land is leveled, it does not depreciate as a sprinkler system does and only a small amount of yearly maintenance is required. A two-way plow and a land plane are important tools for the gravity irrigator. These are included in the cost comparison.
Irrigation System Costs ↓					
Initial Investment. (Cost per acre.) Based on 15-year depreciation and 5½% interest. Does not include well and pump.	$5.30	$6.15	NOTE: Based on 138 irrigated acres. $11.60	NOTE: Based on using two units to serve 160 acres. Two are needed to meet this particular design criteria. Generally only one unit is used. $12.40	NOTE: Land leveling costs not included. Cost of land plane and two-way plow is included. $3.32
Annual Fuel Cost. (Cost per acre.) Based on propane at 10 cents per gallon.	$6.60	$7.65	$8.10	$6.90	$3.95
Annual Per Acre Labor Cost. Based on Nebraska labor studies with labor at $1.25 per hour.	$0.70	$2.10	$0.25	$0.50	$2.65
Annual Per Acre Total Cost	$12.60	$15.90	$19.95	$19.80	$9.92

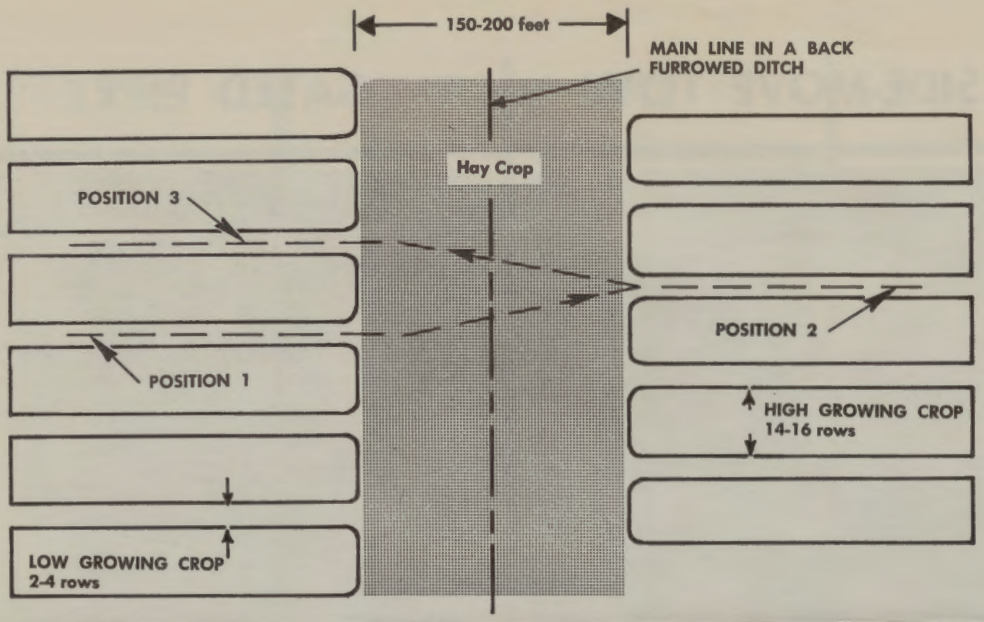

Figure 1. Field layout for tow-line sprinkler system.

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