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Donald C. Taylor
South Dakota State University

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Editor: Donald C. Taylor

Economics Department SDSU, Box 504A Brookings, SD 57007 Tele: (605) 688-4141

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by
Donald C. Taylor
Professor of Economics

This issue of the Newsletter focuses on a recently developed irrigation technology--reduced pressure water distribution. The amount of energy required to pump water under reduced pressure, and hence the dollar expenditure for fuel, is less than that required with traditional high pressure systems.

With water distributed under reduced rather than high pressure, the water application rate is greater. Unless soil textures are relatively coarse and field topographies are relatively level, the amount of water runoff may be greater with reduced pressure water distribution. The potential for added runoff and less even water infiltration associated with reduced pressure irrigation may result in low pressure irrigators having lower yields.

The Brookings County center pivot irrigation systems studied

In 1980, about 5% of South Dakota's center pivot irrigated area was estimated to involve low pressure water distribution. Several low pressure systems were introduced in Brookings County during 1980 and 1981.

The basic data set used in the study reported in this newsletter reflects the 1982 experiences of 37 Brookings County irrigators in using 57 electrically powered center pivot systems. The 57 center pivots were divided into "low" {less than 45 pounds per square inch (psi)}, "medium" (between 45 and 65 psi), and "high" (more than 65 psi) water distribution pressure categories.

The operating pressure for the 57 units averaged 53 psi and ranged among irrigators from 22 to 86 psi. About 3/4ths of the study center pivots involved either 7 or 8 towers and pivot arms ranging in length from 1,225 to 1,325 feet. The acreage irrigated per center pivot in 1982 averaged 132 and ranged from 50 to 304.

All of the respondents used groundwater rather than surface water. The depth to well water after drawdown for them averaged 42 feet.

The water discharge for the center pivots in 1982 averaged 689 gallons per minute. The pumping efficiencies averaged 67%. The electric energy payment per center pivot in 1982 averaged $1,800 and ranged from $390 to $4,330.

In-field impacts of reduced pressure irrigation

The corn grain yield with "high" pressure water distribution in 1982 averaged 1.4 bu per acre higher than that with "low" pressure. This difference is not statistically significant, however. The reduced pressure center pivots studied were placed on fields with relatively coarse soils and flat topographies. The failure for corn grain yields to be less with reduced pressure could reflect the rather favorable environment under which the reduced pressure systems are being used.

A possible confounding factor, however, is the much above-average precipitation during the 1982 irrigation season. Since use of the irrigation systems studied was only about 40% of normal in 1982, a full opportunity for the impact of reduced operating pressure on corn grain yield was not realized during the period of study.

The cost of energy for pumping irrigation water under the 57 center pivots in 1982 averaged $15.45 per acre. The energy cost for the "high" pressure center pivots was not significantly higher than that for the "low" pressure

center pivots.

If irrigation applications had been more nearly normal in 1982 (namely, 8 to 10 inches during the irrigation season), however, a definite energy savings would have been realized from the reduced pressure. The estimated annual energy savings from using "low" (30 psi) rather than "high" (75 psi) pressure water distribution is $8 to $12 per acre, or $1,040 to $1,560 per center pivot.

Economics of investment decisions

Decisions on whether to adopt reduced pressure irrigation arise in two situations: current irrigators who are considering whether to convert their systems from high to reduced pressure and prospective irrigators who are considering whether to select high or reduced pressure units.

The amount that can be profitably spent to convert an irrigation system from high to reduced pressure depends on several factors. Three important ones are the annual expected energy savings from reduced pressure irrigation (assumed to be $8 to $12 per acre) and the interest rate and pay-back period (assumed to be 14.5% and 8 years) over which the investment cost is to be amortized. With these and several other assumptions, it was determined that an irrigator could afford to pay between $4,900 and $7,355 to convert a system from "high" (75 psi) to "low" (30 psi) pressure.

The purchase cost of a low pressure irrigation system is usually quite similar to that for a high pressure system. The energy cost to operate an appropriately sized and managed reduced pressure system, as noted above, is less than that for a high pressure system.

If yields are no different with low than high pressure water distribution, an irrigation investor is well-advised to purchase a low pressure system. If yields are less with low pressure, however, the trade-off between reduced yield and energy savings from reduced pressure needs to be determined. With the assumptions in this analysis, the break-even yield reduction is 4%. In other words, a potential center pivot investor could expect to earn greater profit from a "low" (30 psi) than a "high" (75 psi) pressure system as long as the yield reduction (if any) with the reduced pressure is no more than 4%.

New publications

Readers interested to learn more detailed results from this study should request from the author a copy of "Irrigation in Brookings County: The Economics of Reduced Pressure Irrigation", B 693, SDSU, SDAES, Jan 1985, 26 pp. An abbreviated Fact Sheet, "Converting Center Pivot Systems from High to Reduced Pressure: Can You Afford It?", is also available. It presents information specifically designed to help irrigators decide whether converting center pivot systems from high to reduced pressure can be expected to be profitable.

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