South Dakota Irrigation Regional Shifts During the 1970's

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South Dakota Irrigation
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PREFACE

Unlike irrigation projects in most western states, the vast majority of the irrigated area in South Dakota has been developed by individuals and groups under state-issued permits with private financing.

The primary focus in this circular is the state's privately developed irrigated area. The data on which the circular is based are annual summaries of information submitted by the state's private irrigation permit (license) holders which are published by the Division of Water Rights in the South Dakota Department of Water and Natural Resources (DWNR, annual). Unless specific data sources are cited—in which case the information pertains to all irrigation in the state—the data presented should be interpreted to represent only the state's privately developed irrigated land.

Much of the information is organized with respect to three broad regions in the state (Fig 1). The middle area comprises the Missouri Mainstem Region. The group of five river basins east of the Missouri Mainstem in the glaciated part of the state is termed the East River Region. The group of eight river basins west of the Missouri Mainstem in the non-glaciated part of the state is termed the West River Region.

State-wide perspective

Between 1969 and 1978, the irrigated area in South Dakota increased by over 2.3 times, a faster relative rate of development than that in any other Great Plains state, and second nationally only to that in Georgia. Nevertheless, South Dakota today ranks only 20th in the nation in its total irrigated acreage.

The total irrigated area in South Dakota in 1979 was estimated to be about 450 thousand acres. About 80% of the total, or 377 thousand acres, involves land on which irrigation facilities have been developed by individuals and groups with private financing.

In 1970, 45% of South Dakota's privately developed irrigated area was dependent on groundwater sources and 55% was dependent on surface water sources. During the 1970's, the pace of groundwater development for irrigation exceeded that for surface water. Thus, by 1979, the percentage of privately developed irrigated area relying on groundwater sources increased to 57%. Compared to other states, South Dakota is above average in the proportion of total irrigation withdrawals from groundwater sources, but below average in the proportion of on-farm pumped irrigation water from groundwater sources.

Between 1969 and 1982, the total irrigation permit area in South Dakota increased from less than 0.5 million to over 1.2 million acres. During this same period, the area actually irrigated, as a ratio to the irrigation permit area, showed a definite upward trend. Underlying the trend are changes in both the regulations surrounding the granting of permits and the perceptions of farmers concerning their applying for irrigation permits.

The principal crop grown under irrigation in South Dakota (corn) covers about 1/2 of the total irrigated area in the state. Alfalfa ranks second. During the 1970's, the rate of increase in irrigated corn production slightly exceeded that for irrigated alfalfa (20 versus 16%/yr).

In 1970, about 7% of the irrigation water distribution systems in South Dakota were center pivot machines. By 1982, this had increased to nearly 70%. Two factors underlying the rise of the center pivot are a relatively low labor requirement for center pivot water distribution and the fact that the period of accelerated irrigation development in the state occurred when the new center pivot technology had already become developed and was available on the market.

About 80% of South Dakota's irrigated systems involve electric power (about 35% did in the early 1970's). An underlying reason for the shift toward electricity is a lower rate of escalation in the price of electricity than in the prices of competing energy sources during the 1970's.

Regional perspective

The initial development of irrigation in South Dakota was virtually all in the West River Region. Over time, however, irrigation was introduced along the Missouri River and in the East River Region. In 1976, the privately developed irrigation area in each of these regions surpassed that in the West River Region.
Nearly 2/3rds of the state's groundwater irrigation is east of the Missouri Mainstem. About 7/8ths of the state's privately developed surface water irrigation, on the other hand, is shared between the Missouri Mainstem and West River regions.

Nearly 1/2 of the state's corn raised on privately developed irrigated land is in the East River Region. About 1/2 of the state's irrigated alfalfa is grown in the West River Region. Within the Missouri Mainstem and East River regions, nearly 2/3rds of the irrigated cropland is under corn production. The corresponding fraction for the main irrigated crop in the West River Region—alfalfa—is 2/5ths.

About 1/2 of South Dakota's over 2,000 center pivot machines on privately developed irrigated land are in the East River Region. Nearly 7/8ths of the state's flood irrigation systems, on the other hand, are in the West River Region. The third most common means of irrigation water distribution—gated pipes—is distributed more uniformly across the state.

About 3/4ths of the irrigated areas in both the Missouri Mainstem and East River regions receive water diverted by electric energy. Electricity is the main source in the West as well (covering about 2/5ths of the area), but the fraction of the irrigated area involving diesel energy in the West River Region (1/3rd) is considerably higher than for diesel in either other region.

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**INTRODUCTION**

South Dakota is a relative late comer to irrigation. During the 1970's, however, the state's privately developed irrigated acreage expanded rapidly. The decade of the 1970's also saw a major continued shift to the east in the geographic locus of the state's irrigation.

**TOTAL IRRIGATED AREA**

Current estimates

The total irrigated area in South Dakota in 1979 is estimated to be about 450 thousand acres (Table 1). About 80% of the total, or 377 thousand acres, involves land on which irrigation facilities have been developed by individuals and groups under state-issued permits and with private financing. Most of the expansion in South Dakota's irrigation during the 1970's took place on this privately developed land. The vast majority of the state's other irrigated acreage is in the federal Belle Fourche and Angostura projects.

According to the 1978 Census of Agriculture, South Dakota's irrigated land is widely spread throughout the state (Fig 1) (USDC, 1982). Eleven counties have over 10,000 irrigated acres each. Three of the counties—accounting for about 72,000 acres, or just over 20% of the state's total irrigated area—are in the extreme west central portion of the state. The other eight "high-density" irrigation counties are scattered throughout the state, with two adjacent to the east bank of the Missouri River and five in various locations in the eastern part of the state. The nine counties with less than 500 irrigated acres each are also widely scattered throughout the state.
Fig 1. Irrigated land in South Dakota, by county, river basin, and region, 1978.

Source: USGS (1982, 121)
Historical development

Irrigation began to develop in South Dakota during the mid-1800's when the state was first settled. In 1889, about 16,000 acres were irrigated (Fig 2). Between 1889 and 1919, the irrigated area in the state--virtually all west of the Missouri River--increased by 74,000 to 90,000 acres (USGS, 1964; USDA, 1981). The completion in 1914 of the federally supported Belle Fourche Project in the west central part of South Dakota was a milestone in this stage of the state's irrigation development. Since 1969, however, the irrigated area in the state has expanded very rapidly. The 2.3 fold increase in irrigation in South Dakota between 1969 and 1978 represents a faster relative rate of irrigation development than that which occurred during the same period anywhere else in the United States except in Georgia (USDA, 1981, 417). Notwithstanding this rapid rate of increase during the 1970's, South Dakota still ranks only 20th in the nation in total irrigated acreage.

During the next 50 years, the total irrigated area in South Dakota increased by less than 60,000 acres. A retarding influence was the Great Depression of the late 1920's and 1930's.

Table 1. Estimated irrigated area, South Dakota, 1979.

<table>
<thead>
<tr>
<th>Type of irrigation development</th>
<th>Acres (thousands)</th>
<th>Percent of state total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Privately developed land under irrigation permit, 1979</td>
<td>377.2</td>
<td>82.2</td>
</tr>
<tr>
<td>Area in originally designed federal irrigation projects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belle Fourche</td>
<td>55.0</td>
<td></td>
</tr>
<tr>
<td>Angostura</td>
<td>11.4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>66.4</td>
<td>14.5</td>
</tr>
<tr>
<td>Vested water rights originating before 1907</td>
<td>9.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Irrigation by Indian tribes</td>
<td>6.0</td>
<td>1.3</td>
</tr>
<tr>
<td>South Dakota state total</td>
<td>458.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

a In addition, about 52,300 acres of "drydraw, spreader irrigation" involve the intermittent backing up of water behind dams in small creeks for occasional irrigations by farmers and ranchers. Since this irrigation is only sporadic and non-intensive, it is omitted from most counts of the state's irrigation.

b In any one year, not all of the indicated land is necessarily irrigated.
Fig 2. Total irrigated area, South Dakota, 1889-1978.

Regional patterns of growth

Between 1970 and 1979, the total privately developed irrigated area in South Dakota increased by four times—from 93,000 to 377,192 acres (Table 2). This represents a growth rate of 18%/yr.

The annual growth rates in irrigated area were highest in the Missouri Mainstem (22%) and East River (20%) regions and lowest in the West River Region (11%). By 1976, the area under privately developed irrigation in each of the Missouri Mainstem and East River regions surpassed that in the West River Region.

The most rapid rates of growth in all three regions were between 1974 and 1977. This was a period when farm commodity prices were generally high and there was severe drought in much of the state. Decisions to make irrigation investments were reinforced by the continued escalation in land prices and relative moderation in irrigation equipment price increases.

IRRIGATION WATER SOURCES

Current situation

About 214 thousand of South Dakota’s privately developed irrigated acres, or 57% of the state total, utilize groundwater (Table 3). The aquifers tapped for irrigation tend to be rather shallow east of the Missouri (commonly less than 200 ft) and much deeper west of the Missouri.

Compared to other states, the proportion of on-farm pumped irrigation water from underground sources in South Dakota (53%) is below average (78% for the United States) (Sloggett, 1982, 13 and 14). The proportion of total irrigation withdrawals from groundwater sources in South Dakota (about 57%), however, is above average (39% for the United States) (Frederick, 1980, 166). The reason for this apparent anomaly is that water is distributed on 87% of South Dakota’s irrigated area via sprinklers, whereas the corresponding figure throughout the United States is only 53% (Irrigation Survey, 1982). Large-scale, publicly supported gravity systems are not nearly as prevalent in South Dakota as elsewhere in the irrigated West.

Table 2. Privately developed irrigated area, by region in South Dakota, 1970 and 1979.

<table>
<thead>
<tr>
<th>Region</th>
<th>Irrigated area (thousand acres)</th>
<th>Increase from 1970 to 1979</th>
<th>Ratio of 1979 to 1970</th>
<th>Annual growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West River</td>
<td>34.9</td>
<td>85.7</td>
<td>50.8</td>
<td>2.46</td>
</tr>
<tr>
<td>Missouri Mainstem</td>
<td>23.3</td>
<td>130.8</td>
<td>107.5</td>
<td>5.61</td>
</tr>
<tr>
<td>East River</td>
<td>35.7</td>
<td>160.7</td>
<td>125.0</td>
<td>4.50</td>
</tr>
<tr>
<td>South Dakota</td>
<td>93.9</td>
<td>377.2</td>
<td>283.3</td>
<td>4.02</td>
</tr>
</tbody>
</table>

1 All growth rates reported in the circular were computed as compound annual growth rates.
Fig 3. Privately-developed irrigated area, percentages of ground water and surface water, by region in South Dakota, 1970 and 1979.
Variations among regions in South Dakota in the relative importance of groundwater sources for irrigation are considerable. The percentage is highest in the East River Region (88%) and lowest in the West River Region (25%).

Of the total groundwater irrigation in the state, 66% is in the East River Region, 24% is in the Missouri Mainstem Region, and 10% is in the West River Region. For the state's surface water, on the other hand, only 12% is east of the Missouri Mainstem, 49% is in the Missouri Mainstem Region, and 39% is west of the Missouri Mainstem. These data imply that the majority of the state's groundwater irrigation is east of the Missouri Mainstem, and that the vast majority of privately developed surface irrigation is shared between the Missouri Mainstem and West River Regions.

Changes over time

Between 1970 and 1979, the privately developed irrigated area in South Dakota from surface sources tripled—from 54 to 163 thousand acres. For groundwater, the 214 thousand acres in 1978 was 5.3 times the 40 thousand acres in 1970. These increases represent annual growth rates of 13 and 22% for surface water and groundwater irrigation, respectively.

Between 1970 and 1979, additional land was brought under irrigation from surface sources in each of the three main regions of the state. Both the absolute increase and relative rate of increase in the Missouri Mainstem Region—65 thousand acres and 22%/yr—were much greater, however, than elsewhere in the state.

Between 1970 and 1979, additional land was brought under irrigation from ground sources in each of the three main regions of the state. Whereas the absolute increase was much greater in the East River Region (115 thousand acres) than in either of the other regions, the relative rates of increase in groundwater irrigation differed little among the three regions (ranging from 20 to 23%/yr).

As a result of these changes, the relative importance of groundwater in the state's total privately developed irrigation increased from 42% in 1970 to 57% in 1978 (Fig 3). The same general pattern of change prevailed in each of the three regions, but the extent of relative shifting from surface to ground sources was less in the Missouri Mainstem Region than in the other regions.

Table 3. Privately developed irrigated area, groundwater and surface water, by region in South Dakota, 1979.

<table>
<thead>
<tr>
<th>Region</th>
<th>Groundwater (thousand acres)</th>
<th>Surface water (thousand acres)</th>
<th>Total (thousand acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West River</td>
<td>21.6</td>
<td>64.1</td>
<td>85.7</td>
</tr>
<tr>
<td>Missouri Mainstem</td>
<td>50.3</td>
<td>80.5</td>
<td>130.8</td>
</tr>
<tr>
<td>East River</td>
<td>142.0</td>
<td>18.7</td>
<td>160.7</td>
</tr>
<tr>
<td>South Dakota</td>
<td>213.9</td>
<td>163.3</td>
<td>377.2</td>
</tr>
</tbody>
</table>
Current situation

In 1955, the South Dakota Legislature passed the major legislation that currently governs water rights in the state. All water is declared to be "the property of the people", rights to water use now are in accordance with the "appropriation" system, ground water mining is prohibited, and water is to be applied to its fullest beneficial use. The right for a potential irrigator to use water has to be secured via procedures formally prescribed in the statute.

According to legislation passed in 1972 and 1977, a farmer in South Dakota desiring to develop a possible water source for irrigation must obtain a permit which depends on two state sanctioned approvals, one certifying basic soil-water compatibility and the other certifying no probable adverse impacts of the proposed water development on current groundwater users.

To retain a permit, a farmer must complete construction of necessary waterworks within 5 years of receiving his permit. The water must be "applied to beneficial use"—i.e., used for irrigation—within 4 years of the completion of construction work.

Assuming that these conditions are met, the irrigator then receives a license permitting him to exercise his right to use water for irrigation. If he fails to use the water for a period exceeding 3 consecutive years, however, his right to use the water is forfeited.

As of 1982, the Department of Water and Natural Resources had issued irrigation permits covering 1.12 million acres of land. Of this total, just under 500 thousand acres involved groundwater permits and about 625 thousand acres involved surface water permits.

Slightly over 1/3rd of the total permit area in the state has actually been developed for irrigation. The proportion is higher for groundwater (2/5ths) than for surface water (1/4th). A possible explanation for this difference is the greater cost commonly associated with obtaining water samples from ground than from surface sources. With surface sources, samples can be obtained directly from stream flows. With groundwater sources, however, expenses for test-hole borings from which water samples can be drawn are often required.

Changes over time

Between 1969 and 1982, the total irrigation permit area in South Dakota increased from less than 0.5 million acres to over 1.1 million acres. Nearly 1/2 of this increase was in the East River Region. The remainder of the increase was split about equally between the Missouri Mainstem and West River regions.

Between 1969 and 1979, the ratio of area actually irrigated to irrigation permit area in South Dakota showed a definite upward trend. For the state as a whole, the ratio increased from less than 1/5th in the late 1960's to slightly over 1/3rd in the late 1970's. The upward trend in the ratio reflects changes in both the regulations surrounding the granting of permits and the perceptions of farmers concerning their applying for irrigation permits.

Regulatory changes involve larger payments for water permit applications in recent years and the basing of the amount of the payment on the acreage (technically on the acre-feet of water) intended to be developed rather than on the earlier flat rate per permit. Farmers are also believed to be speculating less on future irrigation potentials. This includes a reduced role of feeling that "I must obtain the right to an unclaimed water source now before someone else does". A further reason arises from the expanded role of groundwater in the state-wide mix of irrigation.
IRRIGATED CROPS

Current situation

The principal crop grown under irri-
gation in South Dakota is corn. In
1979, 57% of the state's privately
developed irrigated land was under corn
production (Table 4). The second most
important crop under irrigation—alfalfa—
accounts for 19% of the irrigated area.

Nearly 1/2 of the state's corn raised
on privately developed irrigated land is
in the East River Region. About 2/5ths
is in the Missouri Mainstem Region and
1/8th is west of the Missouri Mainstem.
Of the State's alfalfa produced on
privately developed irrigated land, near-
ly 1/3rd is in the East River Region, and
about 1/5th is in the Missouri Mainstem
Region.

Regional differences in the mix of
corn and alfalfa on privately developed
irrigated land are substantial. Corn is
grown on 62 to 65% of the irrigated land
in the Missouri Mainstem and East River
regions, with the corresponding figure in
the West River Region being only 30%.
The percentage of irrigated alfalfa is
much higher in the West River Region
(over 40%) than in the Missouri Mainstem
or East River regions (less than 15%).
The only area in which a third irrigated
crop comes close to approaching either
corn or alfalfa in area irrigated is the
West River Region. There the area of ir-
rigated "hay and pasture" is not much
less than the area of irrigated corn.

Changes over time

Between 1969 and 1979, the corn
acreage on privately developed irrigated
land in South Dakota increased from 44 to
194 thousand (an increase of 20%/yr)
(Table 5). For irrigated alfalfa, the
 corresponding shift was from 21 to 69
thousand acres (an increase of 16%/yr).
As a result, the relative role of corn in
the state-wide mix of irrigated crops
increased (at the expense of alfalfa)
during the 1970's by about 5 percentage
points.

Between 1969 and 1979, the annual
rate of increase of alfalfa on privately
developed irrigated land in the Missouri
Mainstem and East River regions slightly
exceeded that for corn (Table 5). In the
West River Region, however, the irrigated
corn acreage increased at a faster rate
than the irrigated alfalfa acreage. The
primary implication of these changes is a
drop during the 1970's in the relative
role of the West River Region in ir-
rigated alfalfa production (dropping from
65 to 47% of the state's total irrigated
alfalfa area).

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acres (thousands)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>215.6</td>
<td>57.2</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>72.5</td>
<td>19.2</td>
</tr>
<tr>
<td>Beans</td>
<td>38.4</td>
<td>10.2</td>
</tr>
<tr>
<td>Other</td>
<td>50.7</td>
<td>13.4</td>
</tr>
<tr>
<td>Total</td>
<td>377.2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

^aThis category presumably reflects both soybeans and smaller amounts of "dry field" or "edible" beans.
Fig 4. Relative importance of selected types of systems for distributing privately-developed irrigation water, by region in South Dakota, 1970 and 1979.

The percentages in each sub-graph for the respective years do not total to 100, since these are percentages of all systems, not percentages of just the total of the four systems portrayed in each sub-graph.
WATER DISTRIBUTION SYSTEMS

Current situation

About 78% of the water distribution systems on privately developed irrigated land in 1979 in South Dakota involved pressurized sprinklers (Table 6). Center pivots are the dominant type of sprinklers. Of the gravity systems (which constitute 22% of the total), about 1/2 involve the flooding of fields and about 1/2 involve gated pipe furrow irrigation.

In 1979, about 1/2 of the over 2,000 center pivot machines on privately developed irrigated land were in the East River Region. About 3/8ths were in the Missouri Mainstem Region, and 1/8th were west of the Missouri Mainstem. Over 85% of the state's flood systems were concentrated in the West River Region alone. The gated pipe systems were distributed more equally among regions, with the percentage ranging from 42 in the West to 22 in the East.

Within both the Missouri River and East River regions, center pivot machines comprise about 2/3rds of distribution systems. Only 1/5th of West River systems, on the other hand, are center pivots. Nearly 2/5ths of the systems there involve flood irrigation.

Changes over time

The 1970's saw the rise of the center pivot machine in South Dakota. In 1970, only 7% of the water distribution systems on the state's privately developed irrigated land involved center pivot distribution, whereas 9 years later the percentage was nearly 60 (Fig 4). The Irrigation Survey (1980) shows 69% of all the state's systems in 1982 to be center pivots. The percentage is roughly the same in North Dakota, but only about 35% in 3rd and 4th-ranking Kansas and Nebraska in the 10-state Great Plains region.

Two features of the 1970's undoubtedly help to explain the rapid development during the 1970's and the current dominance of center pivot irrigation in the Dakotas. This was a time when both (1) the relative rate of expansion of ir-

Table 5. Annual growth rates in irrigated alfalfa and corn, privately developed irrigation, by region in South Dakota, 1969-1979.a

<table>
<thead>
<tr>
<th>Region</th>
<th>Alfalfa (percentage)</th>
<th>Corn (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West River</td>
<td>10.4</td>
<td>14.5</td>
</tr>
<tr>
<td>Missouri Mainstem</td>
<td>21.1</td>
<td>20.2</td>
</tr>
<tr>
<td>East River</td>
<td>20.6</td>
<td>18.1</td>
</tr>
<tr>
<td>South Dakota</td>
<td>15.9</td>
<td>20.4</td>
</tr>
</tbody>
</table>

aThe annual growth rates are computed with respect to 3 year averages centered on 1970 and 1978.
bBecause the years during 1969-1971 for which data are available differ among the four geographic areas covered in the table, the state-wide annual growth rate is not necessarily expected to be intermediate among the growth rates for the various regions.
Fig 5. Relative importance of selected energy sources for pumping privately-developed irrigation water, by region in South Dakota, 1970 and 1979.

The percentages in each sub-graph for the respective years do not total to 100, since these are percentages of all energy sources, not percentages of just the three energy sources portrayed in each sub-graph.
Irrigation in the Dakotas exceeded that in the other Great Plains states and (2) the center pivot technology had become well developed and was readily available on the market. Further, the labor requirement for center pivot machines is considerably less than that for other types of sprinklers and gravity systems.

The rise of the center pivot machine during the 1970's was felt much more intensively in the Missouri Mainstem and East River regions than in the West River Region (Fig 4). The only other type of system in the Missouri Mainstem and East River regions to experience growth of any significance was the big gun sprinkler, but in neither region did big guns account for more than 10% of the distribution systems in 1979. In the West River Region, there was growth not only in the number of center pivot systems, but also in the numbers of flood and gated pipe systems. The relative importance of flood systems in the West during the 1970's dropped, however.

### Irrigation Energy Sources

**Current situation**

In 1979, electricity was the energy source used for diverting (lifting and/or distributing) water onto about 68% of the state's privately developed irrigated area (Table 7). Diesel ranked second—covering 23% of the total irrigated area. No other source accounted for more than 5% of state-wide irrigation.

About 3/4ths of the irrigated areas in both the Missouri Mainstem and East River regions receive water diverted by electric energy. Electricity is the main source in the West as well (covering about 2/5ths of the area), but the fraction of the irrigated area involving diesel energy in the West (1/3rd) is considerably higher than that for diesel in either other region.

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**Table 6. Types of systems for applying privately developed irrigation water, South Dakota, 1979.**

<table>
<thead>
<tr>
<th>Type of system</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprinkler</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center pivot</td>
<td>2,059</td>
<td>59.1</td>
</tr>
<tr>
<td>Big gun</td>
<td>221</td>
<td>6.3</td>
</tr>
<tr>
<td>Hand move</td>
<td>163</td>
<td>4.7</td>
</tr>
<tr>
<td>Tow line</td>
<td>155</td>
<td>4.4</td>
</tr>
<tr>
<td>Other a</td>
<td>114</td>
<td>3.3</td>
</tr>
<tr>
<td>Sub-total</td>
<td>(2,712)</td>
<td>(77.8)</td>
</tr>
<tr>
<td>Gravity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flood</td>
<td>372</td>
<td>10.7</td>
</tr>
<tr>
<td>Gated pipe</td>
<td>342</td>
<td>9.8</td>
</tr>
<tr>
<td>Syphon</td>
<td>58</td>
<td>1.7</td>
</tr>
<tr>
<td>Sub-total</td>
<td>(772)</td>
<td>(22.2)</td>
</tr>
<tr>
<td>Total</td>
<td>3,484</td>
<td>100.0</td>
</tr>
</tbody>
</table>

aIncludes sidewheel roll and portable boom water distribution.
Changes over time

In 1970, about 83% of privately developed irrigated land involved three different energy sources. Electricity accounted for 34% of the total irrigated area, and propane and diesel for 27 and 22%, respectively (Fig 5). The other sources of energy for diverting irrigation water included gravity, gasoline, and natural gas.

During the 1970's, South Dakota experienced a strong trend toward specialization in its irrigation energy sources. Virtually all of the privately developed irrigated area in South Dakota added during the 1970's involved either electricity or diesel power sources. The expansion for electricity was nearly 3.5 times as great as that for diesel.

As a result, the relative importance of electricity on privately developed irrigated land in 1979 (68%) was double what it was in 1970 (34%). In 1982, 80% of the state’s total irrigation power units are reported to have been electrically powered (Irrigation Survey, 1982).

One reason for the shift toward electricity is a lower rate of price increase during the 1970's for electricity than for other energy sources. Between 1973 and 1980, the percentage increases in energy prices were: electricity 139; LPG 210; gasoline 254; diesel 335; and natural gas 400 (Sloggett, 1982, 6). In very recent years, however, electricity prices have increased more rapidly than those of other energy sources.

Changes in the mix of energy sources within each of the three regions between 1970 and 1979 were almost identical (Fig 5). In general, the regions experienced a substantial increase in the relative importance of electricity, either no change or a modest increase in the relative importance of diesel, and a substantial drop in the relative importance of propane.

In a few cases, the extent of change in energy-mix varied interregionally. The two most important examples are a below-average rate of shifting toward electricity in the West River region and an above-average rate of relative decrease in the use of propane in the Missouri Mainstem Region.

Table 7. Types of energy for diverting privately developed irrigation water, South Dakota, 1979.

<table>
<thead>
<tr>
<th>Type of energy</th>
<th>Acres (thousands)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>255.8</td>
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<td>Total</td>
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REFERENCES CITED


Published in accordance with an Act passed in 1881 by the 14th Legislative Assembly, Dakota Territory, establishing the Dakota Agriculture College and with the Act of re-organization passed in 1887 by the 17th Legislative Assembly, which established the Agricultural Experiment Station at South Dakota State University. File: 3.5--.3M—4—84mb