Irrigation in Canada: Improving Water Productivity through Research and Development

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Agriculture and Irrigation in Canada

80% of irrigation takes place in the arid/semi-arid regions of Canada

Surface water is primary water source for irrigation

1,000,000+ ha irrigated

<table>
<thead>
<tr>
<th>Province</th>
<th>Estimated Irrigated Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td>188,555</td>
</tr>
<tr>
<td>Alberta</td>
<td>639,887</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>137,500</td>
</tr>
<tr>
<td>Manitoba</td>
<td>32,300</td>
</tr>
<tr>
<td>Ontario</td>
<td>49,273</td>
</tr>
<tr>
<td>Quebec</td>
<td>22,579</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>1,144</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>3,491</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>2,000</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>188</td>
</tr>
<tr>
<td>Total</td>
<td>1,076,917</td>
</tr>
</tbody>
</table>
Water use in Canada by province, crop and source

% total irrigated volume
1,679 *10^6 m^3

Water use in Canada by province, crop and source

Annual water use by crop (%)
- Field crops: 54%
- Fruit & Veg: 6%
- Hay & Pasture: 40%

Water source % of farms
- Groundwater: 44%
- On farm surface: 38%
- Water purveyor surface: 18%

Note(s):
- Excludes Yukon, Northwest Territories and Nunavut.
- Totals may not add up to 100% because of rounding.

Source(s):
Irrigation in Canada - History

- Western Canada settled during period of adequate rainfall
- Change in precipitation caused failure of crops and loss of productivity
- Cycle to become more extreme as a result of climate change

Research by D. Sauchyn correlating tree ring data to river flow in South Saskatchewan River Basin (Western Canada)
• Decadal drought of the 30’s forced government to act
• Agriculture & Agri-Food Canada worked with farmers to:
  • Implement conservation practices
  • Research new varieties
  • Develop irrigation networks
Irrigation Expansion → Water Productivity

- Irrigation expansion occurring in some areas (Saskatchewan 2020-2030)
- Irrigation in some basins accounts for 85% of licensed volume (Southern Alberta)
- Shift in Government role: expansion/development → productivity

**Water Productivity** - marketable yield per unit of water input.

**How Do we Accomplish:**

- Genetics - Breeding
- System efficiency - conveyance and application
- Management efficiency - scheduling

“More Crop Per Drop”
Case Study: Alberta Irrigation District 10-yr plan

- Alberta water allocation volume is nearing capacity in some basins
- New allocation must come from internal efficiency
- Alberta developed 10-yr plan

**DISTRICT WATER BALANCE**

- Delivered for Irrigation: 75%
- Canal and Reservoir Seepage: 3%
- Canal and Reservoir Evaporation: 3%
- Return Flow: 8%
- Other: 11%

Alberta water allocation volume is nearing capacity in some basins. New allocation must come from internal efficiency. Alberta developed a 10-yr plan.
Conveyance Losses
- Seepage
- Evaporation
- Canal Spill

On-Farm Losses
- Evaporation
- Runoff
- Deep Drainage
Conveyance Efficiency

- Main Supply Canals → Lined Canal (2 - 3% Water Savings)
- Secondary Canals → Pipeline
  - Reduced Seepage, Evaporation, Maintain Capacity
Conveyance Efficiency

- Canal return flow accounts for 11% of water diverted
- SCADA - Supervisory Control and Data Acquisition
  - On demand systems reduces flow losses through diversions
Irrigation System Application Efficiency

Improved Efficiency

Improved Productivity
Irrigation System Conversion

![Irrigation System Conversion Graph](image-url)
## Net Result of On-Farm System Improvements

<table>
<thead>
<tr>
<th>System Type</th>
<th>Efficiency Range</th>
<th>Average Efficiency</th>
<th>Gross Delivery</th>
<th>Water Saving*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contour Flood</td>
<td>25% – 35%</td>
<td>30%</td>
<td>1000 mm</td>
<td></td>
</tr>
<tr>
<td>Levelled Surface</td>
<td>40% - 65%</td>
<td>55%</td>
<td>545 mm</td>
<td>455 mm</td>
</tr>
<tr>
<td>Hand-Move</td>
<td>55% - 65%</td>
<td>60%</td>
<td>500 mm</td>
<td>45 mm</td>
</tr>
<tr>
<td>Wheel-Roll</td>
<td>60% - 70%</td>
<td>66%</td>
<td>455 mm</td>
<td>45 mm</td>
</tr>
<tr>
<td>Hi Nozzle Ctr. Pivot</td>
<td>70% - 75%</td>
<td>72%</td>
<td>415 mm</td>
<td>40 mm</td>
</tr>
<tr>
<td>Drop Tube Ctr. Pivot</td>
<td>75% - 85%</td>
<td>82%</td>
<td>380 mm</td>
<td>35 mm</td>
</tr>
</tbody>
</table>

* Assumes an average NET application of 300 mm (300mm)
Case Study: Alberta Irrigation District 10-yr plan

Irrigation Productivity in Alberta
Case Study: Alberta Irrigation District 10-yr plan

Irrigation Licenses vs Annual Diversion in Alberta

Current Licence Allocation
2.869 million ac-ft
(3.539 million dam$^3$)
CSIDC

- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Federal/provincial/industry/university partnership dedicated to sustainable irrigated production practice
- Conducts, funds and facilitates irrigated research, demonstration, technology transfer and education in support of this goal
CSIDC: Variable Rate Irrigation

- Precision Agriculture applied to irrigation
- Irrigation rates are adjusted by ‘pulsing’ flow to each sprinkler using an electric/pneumatic water valve,
- Rates are adjusted to meet crop water demand
Variable Rate Irrigation (VRI)

Uniform Rate Irrigation
Total Applied = 175mm

Variable Rate Irrigation
Total Applied = 125 - 200mm

15% Increase in Water Use Efficiency
Management: Irrigation Scheduling

Irrigation scheduling - management of the timing and application depth of irrigation events.

- Improves crop yield and quality;
- Decreasing nutrient loss;
- Improves water use efficiency;

CSIDC promotes adoption through:

- Awareness/demonstration
- Training
- Research into new methods
Management: Remote Sensing

- Remote sensing methods use crop response/measurement as a trigger for irrigation,
- Requires crop canopy to be measured - post emergence,
- Requires additional info - only provides trigger, not measure of irrigation depth,
- Used for spatial management - VRI prescriptions
Management: Remote Sensing

- Agriculture & Agri-food Canada currently developing tools,
- Allow irrigator to view data in form to make informed decisions,
- Simple, cost effective tools to improve productivity and increase adoption.
CSIDC: Solar Power

• Where electrical infrastructure lacking, systems typically use diesel combustion generators,

• Research into optimizing management to maximize productivity and minimize cost of power system.
CSIDC: Extension

Research → Development → Knowledge Transfer

- CSIDC plays role on all phases of the RDT continuum.
- Knowledge Transfer occurs in collaboration with industry and provincial government partners. Through:
  - Training sessions,
  - Field Days,
  - Demonstration,
CSIDC: Collaboration

International Work

- Conduct International training and exchanges in support of AAFC mandate,
- Facilitated through CSIDC
ICID: International Commission on Irrigation and Drainage

International Work

- Canada hosted ICID Conference 2018
- ICID - is a leading scientific, technical, and professional not-for-profit international organization working in the field of irrigation, drainage, and flood management to promote and achieve sustainable agriculture water management.
Questions

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Thank-you