Climate Adaptation Strategies

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Factsheet #3

Economics of Supplemental Irrigation

Peace Agricultural Adaptation Strategies Working Group Members

The working group consists of representatives from Peace Agriculture Organizations, provincial and local government:

⇒ BC Agriculture & Food Climate Action Initiative

⇒ BC Branch Canadian Seed Growers Association

⇒ BC Grain Producers Association

⇒ BC Ministry of Agriculture

⇒ Peace Region Forage Seed Association

⇒ Peace River Forage Association of BC

⇒ Peace River Regional Cattlemen's Association

⇒ Peace River Regional District

Introduction:


Courtesy of the American Society of Agronomy

Prior to beginning almost any project, numbers must be crunched in order to determine whether or not the benefits and opportunities of an activity will outweigh the costs. A supplemental irrigation system has the potential to increase crop yield; however, depending on a number of factors (see Fact Sheet #2, *Irrigation Site Specifics*), capital and operational costs may make the project unfeasible when compared to potential yield increases.

A 2016 Kerr Wood Leidal report - *Evaluation of Irrigation Potential in the BC Peace* – evaluated six irrigation scenarios in the Peace Region. The report indicates that there are significant limitations with regards to the feasibility of irrigation in the B.C. Peace Region, but under favourable conditions, irrigating cereals and oilseeds could provide net revenue. However, location, water source, energy costs and crop prices are all contributing factors to the economic feasibility of an irrigation project.

A thorough analysis of gains and costs prior to implementing a supplemental system will provide a better idea of whether or not supplemental irrigation is suitable for a particular parcel of land.

Potential Benefits of Supplemental Irrigation:

When discussing opportunities for supplemental irrigation, it is important to note that the word 'potential' is inextricably linked to the word 'benefit'. So much depends on individual site conditions, crop type and irrigation system type that, without direct local research, crop response may be difficult to quantify. The costs of implementing these systems, however, are much more firmly quantifiable. Figure 1 outlines examples of average yield and moisture data which gives an idea of potential gains to be made through irrigation.

In general, potential gains of supplemental irrigation are as follows:

- Increased yield benefits (site/crop specific), including for forage seed crops
- Uniform germination which may lead to increased yield but also to improved crop quality and grade (i.e. better pricing for crop), as well as easier and earlier harvest conditions and likely reduced costs for drying grain
- For forage crops, there may be potential for an additional cut of high quality hay, as well as potential to extend the productive life of the forage stand through the avoidance of drought stress (forage crops are high moisture users and become drought stressed easily - problems with moisture reserve in an extended growing season can be eased with timely irrigation)

For more information:

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This and more fact sheets can be found at
www.bcgrain.com; www.peaceforageseed.ca; peaceforage.bc.ca

Figure 1. Examples of potential benefits for supplemental irrigation

Examples	Crop Type	Moisture Amount	Gain***	Monetary Value
1	Canola*	100 mm added	16 bushels/acre increase in yield	$174 gross revenue/acre
2	Wheat*	100 mm added	24 bushels/acre increase in yield	$108 (CPSR) to $160 (CWRS) gross revenue/acre
3	Barley*	100 mm added	32 bushels/acre increase in yield	Not calculated
4	Wheat	Enough to promote uniform germination	Shift in wheat grade from feed to CWRS	Increase of $85/tonne
5	Tall Fescue Seed**	Under minimal moisture Under optimal moisture	200-900kg/ha 700-1500kg/ha	Not calculated

*estimates based on Alberta Agdex 100/561-1 Crop water use and requirements and actual crop response will vary with individual scenarios
**estimate based on Alberta Agdex 9860 Tall fescue seed production in western Canada
***once crop has reached full potential additional water will not increase the yield

Potential Benefits cont'd

- For forage seed crops, some of the above applies as well, and good moisture in the fall is essential for tillering that will produce seed heads in the spring; furthermore, depletion of spring soil moisture plays a major role in reduced yields for the second year - a problem which could be abated with irrigation (it should be noted that for forage seed crops there is little data on average potential crop response to moisture alone and potential gains cannot be firmly estimated without further data - see Fig. 1)

One way of determining the potential gain from irrigation is to evaluate the crop yields on a parcel of land over the last twenty years. It can be assumed that the highest yield on that parcel could be expected more often under irrigation, provided that weeds, disease, and fertility are well-managed. Excessive soil moisture saturation (water-logged or drowned soils) must also be prevented. An alternative approach is to use the examples in Fig. 1 and adjust the scenario accordingly with the help of a knowledgeable local producer and/or agronomist.

It is worth noting that even when the average moisture deficit is zero, there will still be moisture deficits about half the time, as there will be a moisture surplus, or sufficiency, the other half of the time. Therefore, supplemental irrigation should not be discounted in this case.

Capital Costs

The annualized capital costs for supplemental irrigation can be as much or higher than the annual operational (energy) costs. These costs can be broken down into five general categories: system; pipes; pumps; installation; and (depending on individual situations) financing.

1. Cost of Systems

It is important to keep capital costs down, and for this reason it could be advantageous to purchase a used center pivot system which is still functional. This reduces the investment risk, and since the system will be used at about one third the rate of common use in southern Alberta for field crops, it is likely to last longer. Used systems are available in Canada or in the northern USA. Where aquifers have become depleted, or where older systems have been replaced, some used systems have been sold for about 20% of the new price. Occasionally these systems lack some of the options of newer systems, but some do have low drift nozzles, swing extensions and other options.

Wheel move systems can be very economical to purchase, since many of these have been replaced by center-pivots and have become surplus. However, wheel-move systems are much more labor intensive than center-pivots using ten times as much labor.

Capital Costs cont'd

On the other hand, they can be very beneficial for use in odd-shaped fields and for higher value small-acreage crops.

Center pivots can range in cost from $60,000 to $140,000, depending on age and options, although some used systems have been available for as low as $30,000. The advantage of center-pivots is that they can be operated and monitored remotely; however, of course, they cannot be repaired remotely.

2. Cost of Pipes
Six-inch aluminum pipe (used) has been advertised online (e.g. Kijiji) for $3.75 per foot, or $9000 for 2400 feet. Such pipe would be used for a supply pipe to bring water from source to the pivot. Sometimes larger pipe such as eight-inch diameter is required to meet the needs of the system. If buried, the costs of trenching need to be considered, but as long as pipes are drained before frost they can be buried at relatively shallow depths. In some cases the pipe can be on the surface of the ground if the pivot does not need to cross the pipe.

3. Cost of Pumps
Pump costs can vary greatly, depending on the size and whether they are powered by diesel or electricity. Electric power tends to be the least costly, but obtaining sufficient power to the pump can increase capital costs. The pivot itself will require power for around 10hp for the motors to drive the wheels of the pivot.

4. Cost of Installation
Costs of installation vary greatly, depending on the type of supply lines used, whether the water lines are buried or left on the surface, the distance from source to pivot, the type of pump used, installation of three-phase electrical power, etc. Each of these costs will be situation dependent, and must be investigated locally. In some cases, installation costs will be as great as the cost of the purchased system.

The biggest factor in the cost of irrigation is the capital cost of purchase and installation; therefore, the more that can be done to reduce these costs, the more feasible the system becomes.

5. Cost of Financing
In addition, the financial situation of the owner will play a role in determining the economics of supplemental irrigation. If money must be borrowed to purchase a system, then interest rates and cash-flow will be significant. If money is not borrowed, then the implications for taxes and opportunity costs should be considered. In some cases, purchasing more land may be a better option, while in other cases, where land is scarce and high-priced, irrigation may be a viable way of increasing production.

Operational (Energy) Costs

Energy costs vary depending on supplier, location, and amount used. In addition, fixed costs of energy supply can also be affected if larger transformers or three-phase power is introduced to the farm system.

Example
- ⇒ if energy cost is $4.68 per 25mm/ac for a 100 ft lift; and
- ⇒ if water source is 300 ft below land parcel and 16 km horizontally from land parcel and water required is 100mm per acre; then
- ⇒ energy costs for lift would be $32.70/acre to $48.00/acre plus $24.92 to pipe 16km from source

BC Hydro has an irrigation energy rate of $0.0537/kwh, with a fixed cost of $5.37 per KW of connected load (motors/pumps) per month. With a 40kw pump, this fixed cost equates to about $220/month for 8 months. The size and capacity of the system, and the amount of water added per week will impact the KW requirements and the kwh used. The elevation requirement for pumping will impact the size of the pump required. Various online calculators can help provide a general estimate of the power requirements needed for an scenario you are proposing.


Wheel move , photo credit of flickr user Brad Smith

Pricing

A quarter-section system that irrigates about 132 acres typically costs $1300 to $1500 per acre, excluding the cost of groundwater well construction, pumps and power units. Larger systems usually cost less on a per-acre basis, down to $900 to $1000 per acre.

Every parcel of land, every water and energy source, as well as the efficiency of every system, will be different; therefore, a detailed individual economic analysis is necessary before any decisions are made to purchase and install a system on a particular parcel of land.

Example: Costs and gains for a BC irrigation system with a 100 foot elevation

Costs

- $3 to 18 per acre depending on energy source
- For electricity, operating cost of approximately $3 per acre for 100mm water (Using the calculator at the bottom of the page https://www.uaex.edu/environment-nature/water/irrigation.aspx)
- Combined with fixed cost for interest and depreciation of $75.00/acre and fixed cost to BC Hydro of $11.00/acre
- Total cost in year where 100mm used would be $90/acre for 132 acre pivot

Potential issues/costs: crop price changes; fertilizer and fungicide requirements increased

Gains

- Gross return of $160 per acre for 100mm added; therefore **net return of $70 per acre**
- ***Note***: increased water needs do not add much to costs (e.g. $93/acre for 200mm) though fixed costs remain the same even if water is not required that year (i.e. $86/year for 0mm)
- Forages could require up to 350mm or more

Resources:

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