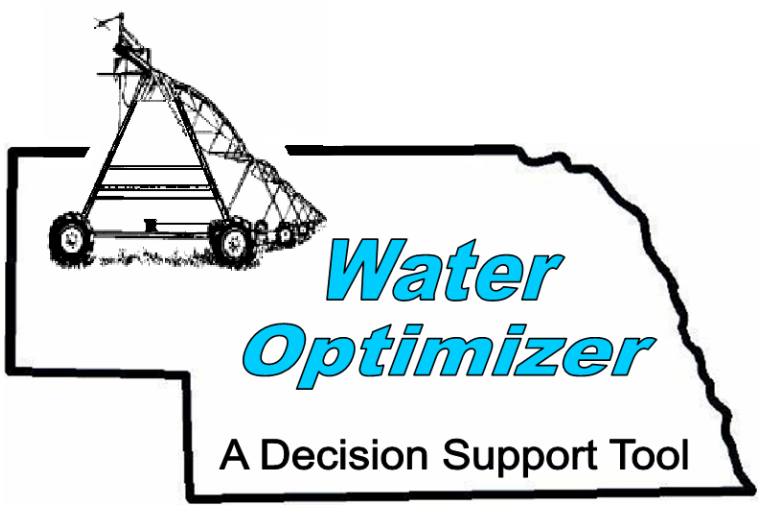
WATER OPTIMIZER

DECISION SUPPORT TOOL FOR DEFICIT IRRIGATON

Multi-field Water Optimizer Model



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Chris Thompson[1], Ray Supalla[1], and Derrel Martin[2]
[1]Department of Agriculture Economics
[2]Department of Biological Systems Engineering

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What is the Multi-field Water Optimizer?

- The Multi-field Water optimizer is an expanded version of Water Optimizer that allows the user to simultaneously evaluate the allocation and use of water between multiple fields. From 1 to 5 fields with different characteristics can be simultaneously evaluated, with or without allowing trading, which is the transfer of water between fields. If trading is not allowed, the results are the same as if each field were considered one at a time. If the user indicates that trading is allowed, then the program calculates how to optimally distribute the water between fields.

What can the Multi-field Water Optimizer be used for?

- The Multi-field Water Optimizer is especially valuable to a user who would like to evaluate the economic benefits of moving water right allocations between fields. For example, individual irrigators may want to consider whether it would be more profitable to cease irrigating some of their certified irrigated acres and use the allocation on other fields which they own or operate, or they may wish to estimate the economic value of selling water to or buying water from another irrigator.

- Water policy officials could use Multi-field Water Optimizer to evaluate policy options such as:

    - Efficiently analyzing the effect of pumping regulations on net economic returns from irrigation (Can evaluate multiple field characteristics simultaneously instead of doing them one at a time with the single field model).
    - Estimating the economic gains and the consumptive use effects from the transfer or trading of water allocations.

How to Use the Multi-field Water Optimizer

Understanding the Inputs and Outputs.

This application paper will run though an example to illustrate the proper use and understanding of the Multi-field Water Optimizer model. Like the single field Water Optimizer, the Multi-field Water Optimizer calculates how to use water in a way that will maximize profits. It determines how a total water supply should be allocated between fields, the number of acres of irrigated and the amount of water that should be applied to each crop, assuming normal rainfall. The user can analyze from 1 to 5 fields simultaneously, with or without allowing the water to be traded between fields. Each field can vary by soil type, size, water cost, irrigation system type, water use efficiency, amount of water available, and crop choices. The user can also vary production costs by field, although this would be appropriate only if tillage or pesticide use differed by field.

Example:

Suppose a producer in Red Willow County has two quarter sections of land, the first quarter section has coarse soil and the second has a fine textured soil. Both quarters have pivots which irrigate approximately 130 acres, but one is a deep well (100 ft) which yields 700 GPM, with a moderate pressure diesel powered irrigation system (45 psi) characterized by high pumping costs and a Water Use Efficiency (WUE) of 0.7; and the other is a shallow well (60 ft) which yields 800 GPM, with a low pressure electric system (30 psi) having low pumping costs and a WUE of 0.8. This producer prefers to raise irrigated or dryland corn or soybeans and plans to use minimum tillage. He is located in the Upper Republican NRD (URNRD) and has a water allocation of 13 acre inches for each well.

This producer agrees with the default production costs except for nitrogen, for which he expects to pay $.40 per pound.

To properly plan for this years growing season, this producer checked crop prices at the local co-op and estimated that he would be able to sell this years corn for $4.30 per bushel, soybeans for $9.60 per bushel and grain sorghum for $3.65 per bushel.

Using this information, we will now go through a step-by-step application of the Multi-field Water Optimizer model.

Step 1: Open Multi-field Water Optimizer.

The opening page of this program will appear. At the bottom of the page there is a clickable blue bar that states, “Water Optimizer (Click Here).” Click the bar and it will take you to the starting worksheet for your Water optimizer analysis.

Step 2:

“Basic Info” Worksheet

1) Title the Field and describe the scenario.
2) Click the circle indicating that you want to evaluate 2 fields.

3) Click the circle indicating whether you want to allow trading, which is the transfer of water between fields. For this illustration, click beside “No Trading”

4) a) In Cells C9 and C10 enter the acre size of irrigated field. Because each field contains 130 irrigable acres, type 130 in cells C9 and C10.
b) Chase County has an allocation of 13 acre inches so type 13 in cell C14.

5) Select Chase County from the drop down list.

6) Select medium and coarse soil types from the drop down menus for fields 1 and 2, respectively.

7) Check to see if the default yields for both dryland and irrigated crops are an accurate representation of your expectations at this point. This illustration assumes the answer is yes, so no input is needed.

8) Check the default values for nitrogen price and the estimated nitrogen requirement for each crop. If you believe your nitrogen requirements are different, you may adjust them by either change the values for soil organic matter and soil column nitrates, or change the requirement more directly by adjusting the “% of UNL Recommendation” up or down. For this illustration we assume the defaults are correct except for the nitrogen price which we change to $.40. The following is how the “Basic Info” sheet should look when it is finished:

Figure 1: “Basic Info”

Basic Information Page

1. Enter the name of the field and a description of the scenario to help identify the run.

Field ID:	North 130	North 130	North 130	North 130	North 130
Scenario Description:	Example	Example	Example	Example	Example

Allow Trading?

2. How Many Fields Do you wish to Evaluate? ☐ 1 Field ☑ 2 Fields ☐ 3 Fields ☐ 4 Fields ☐ 5 Fields ☐ YES ☑ NO

2. Enter the size of the field and the water depth per acre.

	Field 1	Field 2				
Size of Irrigated Field	130	130				**Acres**
Water Allocation Depth	13	13				**Acre Inches**
Water Available	1690	1690				**Total Acre Inches**
Total Water All Fields (ac/ins)	**3380**					

3. Select the county in which the field is located.

	Field 1	Field 2			
County	Red Willow	Red Willow			

Set all Counties the Same

4. Select the type of soil that most resembles the soil in the field.

	Field 1	Field 2			
Soil type	Coarse	Fine			

Set all Soils the Same

5. Choose your soil characteristics.

Soil Organic Matter, %	2.0%	2.0%			
Soil Column (2-4 ft.) Nitrate-N, ppm	3	3			
Other Credits for Nitrate-N, ppm	0	0			
BELOW IS FOR BEETS ONLY					
Residual N lbs/acre in 6ft.	95	95			
N Credits lbs/acre in 6ft.	7	7			

7. Nitrogen Requirements by Crop

Nitrogen Cost per pound	**$0.40**			
Crop	Fully Watered N lbs/acre	% of UNL recommended	Dryland N lbs/acre	% of UNL recommended
Alfalfa	0			
Corn	204	100%	53	100%
Edible Beans	0	not applicable		
Grain Sorghum	140	100%	45	100%
Soybeans	0	not applicable		
Sugar Beets	0	100%	no dryland option	
Sunflower	70	100%	0	100%
Wheat	118	100%	46	100%

Step 3:

Click on the Worksheet tab, “Water Cost F1.” It is located near the bottom of the screen.

1) Select the Check box for “Diesel.”
2) Insure the water source is “Pump/Well” and that the pumping rate is 700 GPM. Also select “Pivot” from the drop down menu in C12, and type 0.7 in C13, which is the Water Use Efficiency for Field 1. Continue to enter other characteristics of the well and irrigation system: lift of 100 feet, pressure of 45 psi, diesel price of $3.00/gallon and a pump performance rating of 75. If in practice you did not know the performance rating, you could calculate it by entering the flow rate of the well, which we have assumed is 700 GPM and the amount of fuel used by the pump per hour. “Good” pump performance ratings are around 75.
3) The input data for irrigation labor, start-up costs and electricity connect charges are assumed for this illustration to match the default values. Any of the green cells can be changed by the user if necessary to better match their field situations.

The following is how the “Water Cost Field1” sheet should look when finished.

Figure 2: "Water Cost Field1"

Water Optimizer Water Cost Calculator (Field 1)

1. Select the type of energy used for pumping.

Energy Source: (•) Diesel ( ) Electric ( ) Gasoline ( ) Propane ( ) Natural Gas

2. Select the source of water.

Water Source:	Pump/Well	
Pumpage Rate	700	gallons per minute

Time of Operation	1093	hours
System Type	Pivot	
Water Use Efficiency	**0.7**	

Suggested Water Use Efficiencies		
System	Pivot	Gravity
Poor	0.70	0.50
Good	0.75	0.65
Excellent	0.80	0.75

3. Enter values to compute the cost to pump irrigation water.

Quantity	Value	Units
Pumping Lift	100	feet
Pump Pressure	45	psi
Performance Rating	75	%
Energy Cost	3.00	$ / gallon

Performance Rating Calculator	
4.5	Units per Hour
65	Performance Rating

4. Enter values to compute additional operating expenses for irrigation.

Labor - Fixed, yearly setup	16	hours
Labor Required per Irrigation	0.03	hours
Labor Cost	$10.00	$/hour
Repairs, Maint & Use Depr	$9.80	$/ac-in

Variable Cost of Water	$13.56	**$ / acre-inch**

5. Enter the irrigation start-up costs.

Motor Horse Power	48.1
Connect Charge, $/Hp	$3.00
Total Connect Charge per field	$0.00
Canal Service Charge, $/Ac	$2.00
Canal Service Charge	$260.00
Labor-Fixed, yearly setup	$160.00
Total Startup Cost	$420.00

Step 4:

Click on Worksheet tab, “Water Cost Field2.”

1. Select the Check box for “Electricity.”
2. Insure the water source is “Pump/Well” and that the pumping rate is 800 GPM. Also select “Pivot” from the drop down menu in C12, and type 0.8 in C13, which is the Water Use Efficiency for Field 2. Continue to enter other characteristics of the well and irrigation system: lift of 60 feet, pressure of 30 psi, electric price of $0.09/kWh and a pump performance rating of 75.
3. The input data for irrigation labor, start-up costs and electricity connect charges are assumed for this illustration to match the default values. Any of the green cells can be changed by the user if necessary to better match their field situations.

The following is how the “Water Cost Field 2” sheet should look when finished.

Figure 3: “Water Cost Field2”

Water Optimizer Water Cost Calculator (Field 2)

1. Select the type of energy used for pumping.

Energy Source: (•) Diesel ( ) Electric ( ) Gasoline ( ) Propane ( ) Natural Gas

2. Select the source of water.

Water Source:	Pump/Well	
Pumpage Rate	800	gallons per minute

Time of Operation	956	hours
System Type	Pivot	
Water Use Efficiency	**0.8**	

Suggested Water Use Efficiencies		
System	Pivot	Gravity
Poor	0.70	0.50
Good	0.75	0.65
Excellent	0.80	0.75

3. Enter values to compute the cost to pump irrigation water.

Quantity	Value	Units
Pumping Lift	60	feet
Pump Pressure	30	psi
Performance Rating	75	%
Energy Cost	0.09	$ / kWh

Performance Rating Calculator	
4.5	Units per Hour
665	Performance Rating

4. Enter values to compute additional operating expenses for irrigation.

Labor - Fixed, yearly setup	16	hours
Labor Required per Irrigation	0.03	hours
Labor Cost	$10.00	$/hour
Repairs, Maint & Use Depr	$7.54	$/ac-in

Variable Cost of Water	$10.27	**$ / acre-inch**

5. Enter the irrigation start-up costs.

Motor Horse Power	34.8
Connect Charge, $/Hp	$0.00
Connect Charge	$0.00
Canal Service Charge, $/Ac	$0.00
Canal Service Charge	$0.00
Labor-Fixed, yearly setup	$160.00
Total Startup Cost	$160.00

Step 5:

Click on Worksheet tab, “Crop Options F1”

1) Corn and soybeans are the only irrigated crops this user is interested in considering. Assume that soybeans were produced on Field 1 last year. Hence the irrigated crop options to check are corn after beans and continuous soybeans.

2) Assume that the dryland crops you are willing to produce are corn after beans, continuous soybeans and grains sorghum, and click the appropriate boxes.

The following is how the “Crop Options F1” sheet should look when finished.

Cropping Options and Information (Field 1)

Remember, this model is a multi-field, single year planning model. Take into account what your last year's crop was on this field.
Do not choose both Corn Continuous and Corn After Beans OR Soybeans Continuous and Soybeans After Corn!

Cropping Options	Minimum Acres	Maximum Acres	Maximum Yields	Units	Market Price	LDP Payment	Total Value of Crop	Misc. Returns	Nitrogen lbs/acre	Fixed Costs	Dependent Costs
☐ Irrigated Alfalfa											
☐ Irrigated Corn, Continuous											
☑ Irrigated Corn, After Beans	**0.0**	**130.0**	**240.8**	**Bushels**	**$4.30**	$0.00	**$4.30**	$0.00	**232.5**	**$246.67**	**$0.08**
☐ Irrigated Edible Beans											
☐ Irrigated Grain Sorghum											
☑ Irrigated Soybeans, Continuous	**0.0**	**130.0**	**58.0**	**Bushels**	**$9.60**	$0.00	**$9.60**	$0.00	**0.0**	**$135.88**	**$0.08**
☐ Irrigated Soybeans, After Corn											
☐ Irrigated Sugar Beets											
☐ Irrigated Sunflowers											
☐ Irrigated Wheat, After Row Crop											
☐ Irrigated Canola											
☐ Irrigated Camolina											
☐ Dryland Alfalfa											
☐ Dryland Corn, Continuous											
☑ Dryland Corn, After Beans	**0.0**	**130.0**	**52.4**	**Bushels**	**$4.30**	$0.00	**$4.30**	$0.00	**59.2**	**$171.34**	**$0.08**
☑ Dryland Grain Sorghum	**0.0**	**130.0**	**52.6**	**Tons**	**$3.65**	$0.00	**$3.65**	$0.00	**44.7**	**$134.46**	**$0.08**
☑ Dryland Soybeans, Continuous	**0.0**	**130.0**	**19.3**	**Bushels**	**$9.60**	$0.00	**$9.60**	$0.00	**0.0**	**$117.40**	**$0.08**
☐ Dryland Soybeans, After Corn											
☐ Dryland Sunflower											
☐ Dryland Wheat, After Row Crop											
☐ Dryland Wheat - Fallow											

Step 6: Click on Worksheet tab, “Crop Options F2”

1. Corn and soybeans are the only irrigated crops this user is interested in considering for this field also. Assume that corn was produced on Field 2 last year. Hence the irrigated crop options to check are beans after corn and continuous corn.
2. Assume that the dryland crops you are willing to produce are corn after beans, continuous soybeans and grain sorghum, and click the appropriate boxes.

The following is how the "Crop Options F2" sheet should look when finished.

Cropping Options and Information (Field 2)

Remember, this model is a multi-field, single year planning model. Take into account what your last year's crop was on this field.
Do not choose both Corn Continuous and Corn After Beans OR Soybeans Continuous and Soybeans After Corn!

Cropping Options	Minimum Acres	Maximum Acres	Maximum Yields	Units	Market Price	LDP Payment	Total Value of Crop	Misc. Returns	Nitrogen lbs/acre	Fixed Costs	Dependent Costs
☐ Irrigated Alfalfa											
☑ Irrigated Corn, Continuous	0.0	130.0	209.4	Bushels	$4.30	$0.00	$4.30	$0.00	203.6	$232.90	$0.08
☐ Irrigated Corn, After Beans											
☐ Irrigated Edible Beans											
☐ Irrigated Grain Sorghum											
☐ Irrigated Soybeans, Continuous											
☑ Irrigated Soybeans, After Corn	0.0	130.0	64.5	Bushels	$9.60	$0.00	$9.60	$0.00	0.0	$135.88	$0.08
☐ Irrigated Sugar Beets											
☐ Irrigated Sunflowers											
☐ Irrigated Wheat, After Row Crop											
☐ Irrigated Canola											
☐ Irrigated Camolina											
☐ Dryland Alfalfa											
☐ Dryland Corn, Continuous											
☑ Dryland Corn, After Beans	0.0	130.0	78.2	Bushels	$4.30	$0.00	$4.30	$0.00	83.0	$171.34	$0.08
☑ Dryland Grain Sorghum	0.0	130.0	78.3	Tons	$3.65	$0.00	$3.65	$0.00	72.9	$134.46	$0.08
☑ Dryland Soybeans, Continuous	0.0	130.0	29.0	Bushels	$9.60	$0.00	$9.60	$0.00	0.0	$117.40	$0.08
☐ Dryland Soybeans, After Corn											
☐ Dryland Sunflower											
☐ Dryland Wheat, After Row Crop											
☐ Dryland Wheat - Fallow											

Step 7. Click on Worksheet tab, "Price Inputs"

1. In the appropriate green cells, under "Market Prices", type in your expected prices, which we previously assumed were corn = $4.30; grain sorghum = $3.65 and soybeans = $9.60.

2. In the appropriate green cells, under "Energy Input Prices", type in your expected prices, which we previously assumed were Diesel = $4.30; grain sorghum = $3.65 and soybeans = $9.60.

The following is how the "Price Inputs" sheet should look when finished.

Market Prices				
Crop	Price at time of sale	LDP Payment	Misc. returns per acre	Units
Alfalfa	$135.00	$0.00	$0.00	Tons
Corn	$4.30	$0.00	$0.00	Bushels
Edible beans	$0.30	$0.00	$0.00	Pounds
Grain Sorghum	$3.65	$0.00	$0.00	Bushels
Soybeans	$9.60	$0.00	$0.00	Bushels
Sugar Beets	$38.00	$0.00	$0.00	Tons
Sunflower	$0.12	$0.00	$0.00	Pounds
Wheat	$4.99	$0.00	$0.00	Bushels
Canola	$0.13	$0.00	$0.00	Pounds
Camolina	$0.13	$0.00	$0.00	Pounds

Energy Input Costs These costs relate to water pumping plants and are specific to each field					
Energy Type	Field 1	Field 2	Field 3	Field 4	Field 5
Diesel Fuel ($/gal)	$3.00	$3.00	$3.00	$3.00	$3.00
Electric ($/Kwh)	$0.09	$0.09	$0.09	$0.09	$0.09
Gasoline ($/gal)	$2.35	$2.35	$2.35	$2.35	$2.35
Propane ($/gal)	$1.43	$1.43	$1.43	$1.43	$1.43
Natural Gas ($/gal)	$6.81	$6.81	$6.81	$6.81	$6.81

Step 8. Go to the Worksheet tab titled "Results".

1) This is the worksheet where the optimal combination of acres irrigated, crops produced and water applied is calculated. To start the calculation, go to the bottom of the page and click on the "Run Water Optimizer" button.

Previously on the “Basic Info” page we indicated that we didn’t wish to consider trading water between fields, so the program will now solve for each field independently. This may take 3 or 4 minutes.

2) The solution for the “No Trading” option indicates that the optimal plan for Field 1 would be to produce 130 acres of irrigated corn after soybeans, applying 13 inches per acre, resulting in a net return of $55,854. The optimal plan for Field 2 would be to irrigate 130 acres of corn after corn, applying 13 inches per acre, resulting in a net return of $58,136. The combined net return for both fields is $113,990.

3) Now, let us consider the potential economic benefits from transferring water between fields. If the two fields are within a single ownership unit, this is equivalent to treating the combined water supply for both fields as a single supply which can be used wherever it is most profitable. If the two fields are under different ownerships, the same result could be achieved by negotiating a trade between the two parties. We can analyze this option by returning to the “Basic Info” page, clicking the circle for “With Trading”, then return again to the bottom of the “Results” page and click on the “Run Water Optimizer” button.

4) The solution for the “With Trading” option indicates that the optimal plan for Field 1 would be to produce 130 acres of irrigated corn after soybeans, applying 13.9 inches per acre (1803 inches total), resulting in a net return of $58,294. The optimal plan for Field 2 would be to irrigate 130 acres of corn after corn, applying 12.1 inches per acre (1577 inches total), resulting in a net return of $55,987. The combined net return for both fields is $114,281.

Your screen and the optimal solution should look like this when the computer is finished calculating your answer.

Multi-Field Optimization Routine

	Crops	Field 1		Field 2		Field 3		Field 4		Field 5	
		Acres Produced	Water Applied	Acres Produced	Water Applied	Acres Produced	Water Applied	Acres Produced	Water Applied	Acres Produced	Water Applied
Irrigated Crops	Alfalfa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Corn, Continuous	0.0	0.0	130.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0
	Corn, after Beans	130.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Edible Beans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grain Sorghum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soybeans, Continuous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soybeans, After Corn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sugar Beets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sunflowers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wheat, After Row Crop	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Canola	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Camolina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryland Crops	Alfalfa	0.0		0.0		0.0		0.0		0.0	
	Corn, Continuous	0.0		0.0		0.0		0.0		0.0	
	Corn, after Beans	0.0		0.0		0.0		0.0		0.0	
	Grain Sorghum	0.0		0.0		0.0		0.0		0.0	
	Soybeans, Continuous	0.0		0.0		0.0		0.0		0.0	
	Soybeans, After Corn	0.0		0.0		0.0		0.0		0.0	
	Sunflowers	0.0		0.0		0.0		0.0		0.0	
	Wheat, After Row Crop	0.0		0.0		0.0		0.0		0.0	
	Wheat, after Fallow	0.0		0.0		0.0		0.0		0.0	
	Total Acres Produced	130.0		130.0		0.0		0.0		0.0	
	Total Water Applied		1690.0		1690.0		0.0		0.0		0.0
	Total Water Consumed		1373.2		1397.9		#DIV/0!		#DIV/0!		#DIV/0!
	TNR per Field	$50,233.13		$54,393.99		$0.00		$0.00		$0.00	

This worksheet is the 'meat' of the Water Optimizer program and deserves a thorough explanation.

The main purpose of the 2 field water optimizer is to properly illustrate how, with out any restrictions, water will 'move' to its highest and best use. This Water Optimizer is especially relevant in the Republican basin of Nebraska where some water transfers take place in the form of floating townships. As one can see, the program allocated the water to its highest and best use by equating the marginal revenue of the next acre inch of water. Field two has a more efficient pumping system that cost less to pump the water. While field two requires more water to produce its fully watered yield the pumping system can afford to apply more water to the field thus returning a higher yield. Field One is more costly to apply water and the result is the remainder of its 13 acre inch allocation is pumped from the well on Field Two. By allowing the water to be pumped on another field, you will increase Net Returns and in this specific case reduce water consumption by a small amount.

Step 9:

Click on the "Crop Summary" worksheet tab.

1) These worksheets simply summarize all of the cropping pattern costs and application aspects which are part of the cropping pattern.

Field 1: Crop Activates Summary Page

Field ID:	North 130
Scenario:	Example
County:	Red Willow
Soil Type:	Coarse

CROP CHOICES AND RETURNS

	Crops	Was the Crop Evaluated?	Minimum Acres	Maximum Acres	Acres in Production	Water Applied (acre/in)	Yield Unit / Acre	Gross Return $/Acre	Total Cost $/Acre	Nitrogen Cost $/Acre	Net Return $/Acre	Total Net Return
Irrigated Crops	Alfalfa	No	0	130	0	0	-	$707.40	$202.26	$0.00	$505.14	$0.00
	Corn, Continuous	No	0	130	0	0	-	$900.39	$249.65	$81.46	$569.28	$0.00
	Corn, after Beans	Yes	0	130	130	13	211.27	$908.45	$439.90	$82.15	$386.41	$50,233.13
	Edible Beans	No	0	130	0	0	-	$0.00	$222.04	$0.00	-$222.04	$0.00
	Grain Sorghum	No	0	130	0	0	-	$509.18	$163.17	$56.10	$289.90	$0.00
	Soybeans, Continuous	Yes	0	130	0	0	-	$213.28	$137.66	$0.00	$75.62	$0.00
	Soybeans, After Corn	No	0	130	0	0	-	$619.04	$141.04	$0.00	$478.00	$0.00
	Sugar Beets	No	0	130	0	0	-	$0.00	$362.75	$0.00	-$362.75	$0.00
	Sunflowers	No	0	130	0	0	-	$288.00	$305.68	$28.00	-$45.68	$0.00
	Wheat, After Row Crop	No	0	130	0	0	-	$393.76	$167.06	$47.35	$179.35	$0.00
	Canola	No	0	130	0	0	-	$384.28	$403.99	$0.00	-$19.71	$0.00
	Camolina	No	0	130	0	0	-	$332.28	$314.94	$0.00	$17.34	$0.00
Dryland Crops	Alfalfa	No	0	130	0		-	$0.00	$171.24	$0.00	-$171.24	$0.00
	Corn, Continuous	No	0	130	0		-	$195.93	$204.11	$21.17	-$29.35	$0.00
	Corn, after Beans	Yes	0	130	0		-	$225.32	$175.54	$23.68	$26.10	$0.00
	Grain Sorghum	Yes	0	130	0		-	$192.07	$138.67	$17.87	$35.52	$0.00
	Soybeans, Continuous	Yes	0	130	0		-	$185.11	$118.94	$0.00	$66.16	$0.00
	Soybeans, After Corn	No	0	130	0		-	$205.67	$119.11	$0.00	$86.56	$0.00
	Sunflowers	No	0	130	0		-	$0.00	$113.68	$0.00	-$113.68	$0.00
	Wheat, After Row Crop	No	0	130	0		-	$153.08	$203.10	$18.41	-$68.43	$0.00
	Wheat, after Fallow	No	0	130	0		-	$204.11	$137.38	$24.54	$42.18	$0.00

Total Net Return	**$ 50,233**

PRICES, COSTS, & DRYLAND YIELDS

Crops	Dryland Yields	Total Price Received ($/Unit)	Misc. Returns (per acre)	Irrigated Costs Per Acre: Production Costs	Irrigated Costs Per Acre: Yield Dependent Costs	Irrigated Costs Per Acre: Nitrogen Cost	Dryland Costs Per Acre: Production Costs	Dryland Costs Per Acre: Yield Dependent Costs	Dryland Costs Per Acre: Nitrogen Cost	Dryland Net Return
Alfalfa	0.00	$135.00	$0.00	$171.24	$5.92	$0.00	$171.24	$5.92	$0.00	$17.34
Corn, Continuous	45.56	$4.30	$0.00	$232.90	$0.08	$81.46	$200.47	$0.08	$21.17	-$171.24
Corn, after Beans	52.40	$4.30	$0.00	$246.67	$0.08	$82.15	$171.34	$0.08	$23.68	-$29.35
Edible Beans	-	$0.30	$0.00	$222.04	$0.08	$0.00	-	-	-	-
Grain Sorghum	52.62	$3.65	$0.00	$152.01	$0.08	$56.10	$134.46	$0.08	$17.87	$35.52
Soybeans, Continuous	19.28	$9.60	$0.00	$135.88	$0.08	$0.00	$117.40	$0.08	$0.00	$66.16
Soybeans, After Corn	21.42	$9.60	$0.00	$135.88	$0.08	$0.00	$117.40	$0.08	$0.00	$86.56
Sugar Beets	-	$38.00	$0.00	$362.75	$0.08	$0.00	-	-	-	-
Sunflowers	0.00	$0.12	$0.00	$113.68	$0.08	$28.00	$113.68	$0.08	$0.00	-$113.68
Wheat, After Row Crop	30.68	$4.99	$0.00	$160.75	$0.08	$47.35	$200.65	$0.08	$18.41	-$68.43
Canola	-	$0.13	$0.00	$167.51	$0.08	$0.00	-	-	-	-
Camolina	-	$0.13	$0.00	$110.46	$0.08	$0.00	-	-	-	-
Wheat, after Fallow	40.90	$4.99	$0.00	$134.11	$0.08	$24.54	$134.11	$0.08	$24.54	$42.18

Field 2: Crop Activates Summary Page

Field ID:	North 130
Scenario:	Example
County:	Red Willow
Soil Type:	Fine

CROP CHOICES AND RETURNS

	Crops	Was the Crop Evaluated?	Minimum Acres	Maximum Acres	Acres in Production	Water Applied (acre/in)	Yield Unit / Acre	Gross Return $/Acre	Total Cost $/Acre	Nitrogen Cost $/Acre	Net Return $/Acre	Total Net Return
Irrigated Crops	Alfalfa	No	0	130	0	0	-	$707.40	$202.26	$0.00	$505.14	$0.00
	Corn, Continuous	Yes	0	130	130	13	204.88	$880.97	$382.76	$79.79	$418.42	$54,393.99
	Corn, after Beans	No	0	130	0	0	-	$1,035.45	$265.94	$93.02	$676.50	$0.00
	Edible Beans	No	0	130	0	0	-	$0.00	$222.04	$0.00	-$222.04	$0.00
	Grain Sorghum	No	0	130	0	0	-	$509.18	$163.17	$56.10	$289.90	$0.00
	Soybeans, Continuous	No	0	130	0	0	-	$557.13	$140.53	$0.00	$416.61	$0.00
	Soybeans, After Corn	Yes	0	130	0	0	-	$296.59	$138.36	$0.00	$158.23	$0.00
	Sugar Beets	No	0	130	0	0	-	$0.00	$362.75	$0.00	-$362.75	$0.00
	Sunflowers	No	0	130	0	0	-	$288.00	$305.68	$28.00	-$45.68	$0.00
	Wheat, After Row Crop	No	0	130	0	0	-	$393.76	$167.06	$47.35	$179.35	$0.00
	Canola	No	0	130	0	0	-	$384.28	$403.99	$0.00	-$19.71	$0.00
	Camolina	No	0	130	0	0	-	$332.28	$314.94	$0.00	$17.34	$0.00
Dryland Crops	Alfalfa	No	0	130	0		-	$0.00	$171.24	$0.00	-$171.24	$0.00
	Corn, Continuous	No	0	130	0		-	$292.50	$205.91	$29.43	$57.16	$0.00
	Corn, after Beans	Yes	0	130	0		-	$336.37	$177.60	$33.19	$125.58	$0.00
	Grain Sorghum	Yes	0	130	0		-	$285.73	$140.73	$29.16	$115.84	$0.00
	Soybeans, Continuous	Yes	0	130	0		-	$278.18	$119.72	$0.00	$158.46	$0.00
	Soybeans, After Corn	No	0	130	0		-	$309.09	$119.98	$0.00	$189.11	$0.00
	Sunflowers	No	0	130	0		-	$0.00	$113.68	$0.00	-$113.68	$0.00
	Wheat, After Row Crop	No	0	130	0		-	$194.60	$203.77	$23.40	-$32.57	$0.00
	Wheat, after Fallow	No	0	130	0		-	$259.47	$138.27	$31.20	$90.00	$0.00
										Total Net Return		**$ 54,394**

PRICES, COSTS, & DRYLAND YIELDS

Crops	Dryland Yields	Total Price Received ($/Unit)	Misc. Returns (per acre)	Irrigated Costs Per Acre: Production Costs	Irrigated Costs Per Acre: Yield Dependent Costs	Irrigated Costs Per Acre: Nitrogen Cost	Dryland Costs Per Acre: Production Costs	Dryland Costs Per Acre: Yield Dependent Costs	Dryland Costs Per Acre: Nitrogen Cost	Dryland Costs Per Acre: Dryland Net Return
Alfalfa	0.00	$135.00	$0.00	$171.24	$5.92	$0.00	$171.24	$5.92	$0.00	$17.34
Corn, Continuous	68.02	$4.30	$0.00	$232.90	$0.08	$79.79	$200.47	$0.08	$29.43	-$171.24
Corn, after Beans	78.23	$4.30	$0.00	$246.67	$0.08	$93.02	$171.34	$0.08	$33.19	$57.16
Edible Beans	-	$0.30	$0.00	$222.04	$0.08	$0.00	-	-	-	-
Grain Sorghum	78.28	$3.65	$0.00	$152.01	$0.08	$56.10	$134.46	$0.08	$29.16	$115.84
Soybeans, Continuous	28.98	$9.60	$0.00	$135.88	$0.08	$0.00	$117.40	$0.08	$0.00	$158.46
Soybeans, After Corn	32.20	$9.60	$0.00	$135.88	$0.08	$0.00	$117.40	$0.08	$0.00	$189.11
Sugar Beets	-	$38.00	$0.00	$362.75	$0.08	$0.00	-	-	-	-
Sunflowers	0.00	$0.12	$0.00	$113.68	$0.08	$28.00	$113.68	$0.08	$0.00	-$113.68
Wheat, After Row Crop	39.00	$4.99	$0.00	$160.75	$0.08	$47.35	$200.65	$0.08	$23.40	-$32.57
Canola	-	$0.13	$0.00	$167.51	$0.08	$0.00	-	-	-	-
Camolina	-	$0.13	$0.00	$110.46	$0.08	$0.00	-	-	-	-
Wheat, after Fallow	52.00	$4.99	$0.00	$134.11	$0.08	$31.20	$134.11	$0.08	$31.20	$90.00

Step 10:

Click on the “Irrigation Summary” worksheet tab.

2) These worksheets simply summarize all of the water pumping and application aspects which accompany the optimal cropping pattern.

Figure 6: “Irrigation Summary”

Field 1: Irrigation Summary Page

Field ID: North 130
Scenario: Example
County: Red Willow
Soil Type: Coarse

IRRIGATION INFORMATION

	Crops	Was the Crop Evaluated?	Irrigation Depth	Opt. Land Limit Depth	Irrigated Yield	Fully Watered Yield	Marginal Net Return $/Ac-in	Average Net Return $/Ac-in	Consumptive Use per acre	Total Consumptive Use Acre inches
Irrigated Crops	Alfalfa	No	0	0.00	5.24	5.24	-	-	0.0	0.0
	Corn, Continuous	No	0	0.00	209.39	209.39	-	-	0.0	0.0
	Corn, after Beans	Yes	13	17.42	211.27	240.80	$23.36	$27.84	10.6	1373.2
	Edible Beans	No	0	0.00	0.00	0.00	-	-	0.0	0.0
	Grain Sorghum	No	0	0.00	139.50	139.50	-	-	0.0	0.0
	Soybeans, Continuous	Yes	0	0.00	22.22	58.03	-	-	0.0	0.0
	Soybeans, After Corn	No	0	0.00	64.48	64.48	-	-	0.0	0.0
	Sugar Beets	No	0	0.00	0.00	0.00	-	-	0.0	0.0
	Sunflowers	No	0	0.00	2,400.00	2,400.00	-	-	0.0	0.0
	Wheat, After Row Crop	No	0	0.00	78.91	78.91	-	-	0.0	0.0
	Canola	No	0	0.00	2,956.00	2,956.00	-	-	0.0	0.0
	Camolina	No	0	0.00	2,556.00	2,556.00	-	-	0.0	0.0

Water Supply Data	
Total Water Available	1690
Total Water Used	1690
Water Allocation (Acre/inches)	13
Cost of Water (per acre/inch)	$ 13.56

Water Source Data	
Water Source	Pump/Well
System Type	Pivot
Water Use Efficiency	0.7
Hours of Operation	1093

Pumping Characteristics	
Pumping Lift	100
Pump Pressure	45
Performance Rating	75
Energy Cost	3

Field 2: Irrigation Summary Page

Field ID: North 130
Scenario: Example
County: Red Willow
Soil Type: Fine

IRRIGATION INFORMATION

	Crops	Was the Crop Evaluated?	Irrigation Depth	Opt. Land Limit Depth	Irrigated Yield	Fully Watered Yield	Marginal Net Return $/Ac-in	Average Net Return $/Ac-in	Consumptive Use per acre	Total Consumptive Use Acre inches
Irrigated Crops	Alfalfa	No	0	0.00	5.24	5.24	-	-	0.0	0.0
	Corn, Continuous	Yes	13	13.87	204.88	209.39	$17.02	$29.64	10.8	1397.9
	Corn, after Beans	No	0	0.00	240.80	240.80	-	-	0.0	0.0
	Edible Beans	No	0	0.00	0.00	0.00	-	-	0.0	0.0
	Grain Sorghum	No	0	0.00	139.50	139.50	-	-	0.0	0.0
	Soybeans, Continuous	No	0	0.00	58.03	58.03	-	-	0.0	0.0
	Soybeans, After Corn	Yes	0	0.00	30.89	64.48	-	-	0.0	0.0
	Sugar Beets	No	0	0.00	0.00	0.00	-	-	0.0	0.0
	Sunflowers	No	0	0.00	2,400.00	2,400.00	-	-	0.0	0.0
	Wheat, After Row Crop	No	0	0.00	78.91	78.91	-	-	0.0	0.0
	Canola	No	0	0.00	2,956.00	2,956.00	-	-	0.0	0.0
	Camolina	No	0	0.00	2,556.00	2,556.00	-	-	0.0	0.0

Water Supply Data	
Total Water Available	1690
Total Water Used	1690
Water Allocation (Acre/inches)	13
Cost of Water (per acre/inch)	$ 10.27

Water Source Data	
Water Source	Pump/Well
System Type	Pivot
Water Use Efficiency	0.7
Hours of Operation	956

Pumping Characteristics	
Pumping Lift	60
Pump Pressure	30
Performance Rating	75
Energy Cost	0.09

Step 11:

Other Worksheet Tabs.

The worksheet tabs that have not been explored are the tabs that control the costs of each crops' production. These tabs have default costs that are based on estimates derived from the University of Nebraska Extension Budgets and Custom Cropping Rates. In these Worksheet there is the opportunity to change costs of inputs, however, they are fairly self-explanatory and do not require an in-depth analysis.

Conclusion:

When 2-Field Water optimizer is properly used it can be a powerful tool in helping to analyze various water moving schemes. This program can be used to investigate increased Net Returns from government program such as EQUIP or can be used for larger policy analysis.