Crossing Boundaries with Teamwork and Economics for Water Management

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Abstract

The Water Team utilized teamwork and economics to transcend water boundaries. Recommendations implemented and physical improvements extended the irrigation season by 16 days in 2008, increased potential farm profits, and increased water conservation. The Team is now poised to cross more boundaries, assembling data and coordinated plans for watershed management and groundwater recharge; for larger geographic areas, watersheds and organizations.

Background

The Big Wood Canal Company (BWCC) was formed in 1907, following completion of Magic Dam, to serve an area lying primarily in Lincoln County, Idaho. Water shortages have always been a way of life in this area, since the development company grossly oversold the amount of land to be irrigated. The droughts of the 70's, 80's, 90's and now the 2000's have continued to make this area a very difficult place to farm and ranch for a living.

The amount of water available during the irrigation season is not consistent from year to year. Consequently, agricultural producers lack adequate information to make long-term decisions, playing a guessing game on when to implement irrigation system upgrades, when to replant alfalfa, which crops to grow based on water availability for that season, and whether or not to apply for funding to transition to center pivots or buy additional pipe to reduce ditch losses. Banks are reluctant to provide irrigation equipment funding without consistent crop production potential. This creates a limiting environment for BWCC shareholders to make water conservation or long-term planning decisions, and reduces their potential farm profitability.

Our Response

In an effort to improve the water situation, the BWCC Board appointed a committee to research options. The BWCC Water Team (Team) was formed, consisting of nine shareholders (farm/livestock producers), the manager, the water master, a ditch rider, a consultant, an Extension Educator, and an Extension Irrigation Specialist. All agreed that solutions required creativity, open-minded thinking, and be factually based with supportive data. The Team's broad knowledge base, willingness of each member to actively participate in research/synthesis of data, and the use of economics, initiated an innovative approach with a strong emphasis on teamwork--critical to move past age-old battles and forward into solutions that work.

To cross water management boundaries we needed a "mix of technical tools and people skills, so ranch and farm families could manage their current and future risks" (Fetsch 1999). True teamwork with a "co-creation" attitude of "let's create the future we individually and collectively want" (Senge et. al, 1994) was critical to start shifting mental paradigms to increase water conservation and potential farm profitability, across the entire canal system. Multiple recommendations for creating successful, amicable family estate transfer plans (Fetsch 1999) and successful integration for farm businesses (Olsen *et. al*. 2009) were applied to cross water management boundaries, including common vision/goals, relationship building through open communication, mutual respect, critical listening, understanding of shared information, and rational assessment of economic feasibility/profitability through concrete data and not personal assumptions. The Team's focus on data and use of technical tools (economic and hydraulic modeling and analysis, automated soil moisture determination, stream and canal flow measurements, handheld computers, and Google earth), reduced emotional decisions that limit necessary mental paradigm shifts.

The jointly-created mission was to discover and present pertinent facts/data to answer the question—"Are there practices and/or improvements the BWCC can do to enhance the profitability and value of the resources for its grower/owners?" Over 40 hours of Team meetings, plus individual research, investigation, and computer modeling, were conducted to address the mission. Five focus areas were identified: 1) economic analysis; 2) how much irrigation water are we losing and where; 3) what are other canal companies doing to cope with short water supplies; 4) specific physical improvements, prioritized by cost per unit of water saved; 5) management practices at the farm and company level to increase days of water.

Water Team Outcomes

The Team presented the mission, executive summary, and complete report with 17 recommendations to the BWCC Board. Recommendations included water conservation practices, soil moisture monitoring by tracts, identification/assessment of water loss, water saving improvements, plus more flexible and demand-based water delivery. Many of the recommendations required a shift in traditional thinking (paradigm shift).

A flexible demand-based delivery system was instrumental in water conservation and days of water extension. It allowed shareholders to store water ahead, then use their stored allocation up to 150%. For example, utilize 0% water while cutting and baling hay, then draw up to 150% volume for a short period of time to refill the soil profile. Each shareholder was allocated a certain volume of water based on expected days of irrigation water available during the season. Shareholders could utilize their allocated water when and where they needed for their farming operations, as long as it was coordinated with management. If a producer went over their allocated volume of water, they were cut off from any more water for the rest of the season. This naturally encouraged cooperation and water conservation by everyone, without any mandates. The Team recommended the flexible demand-based system be used along with 1) 100+ days of water, irrigate at 100%, 2) 70+ days of water, reduce water flow to 80% to extend irrigation days, and 3) 45-60 days to run at 100% flow (economics in Table 1 and 2). The goal is to reach 100 days of irrigation water available consistently.

Management and shareholders needed to support and encourage one another to increase efficiency. Increasing efficiency in the BWCC system, or on-farms, by 1% is valued at $300,000. To see the full benefit of physical improvements, management had to align with the "save water and make money" paradigm.

Physical improvements were recommended and implemented to the canal system, starting with the projects that had the greatest return/cost ratio. The Lincoln By-Pass improvements resulted in an 83:1 return/cost ratio in one year. Other physical improvements are continuing.

The Team recommended irrigation initiation in the spring, only when 60% of shareholders had requested water, with a 48 hour notice policy enforced, and based on soil moisture data. Automated soil moisture monitoring by tract in alfalfa fields (Figure 1), along with soil texture quantification and climatic crop influences were valuable to start developing BMP's (best management practices) for determining irrigation initiation. It also helped reduce emotional decisions, focusing on data instead. In Dietrich area, river water was utilized early in the spring on sandy soils to meet validated crop water demands. The other tracts did not need water then, allowing a delay in any water release from Magic Reservoir to extend irrigation days of the overall canal system.

Figure 1. Echo soil moisture sensors inserted into the soil by depth, the meter, and installation.

Using an economic analysis tool developed for this area, the Team determined that the best method to increase financial returns to farms/ranches was to increase days of irrigation water available, even if it required reducing irrigated acreage. This principle holds true regardless of the crop, size or type of the operation. Returns are maximized where producers can shift crop mixes. Table 1, Table 2 and Figure 2 show examples of gross returns for a 30 and 520 acre farm with variable irrigation amounts and the financial incentives for extending days of irrigation water available.

In order to perform analysis, basic assumptions were utilized.

- ✓ Alfalfa production at 5.5 tons per year potential with full water.
- ✓ Alfalfa growth averages 73 lb. per day per acre (150 days at 73 lb/day equals 5.5 tons per year)
- ✓ Value of alfalfa production per day at $3.65 per acre (73 lb/2000 lb x $100 ton). Grain at $5.00 per acre per day ($600/120 days).
- ✓ When about two thirds of the tracts are grain and hay, the BWCC daily value of production is about $79,000 for these two crops alone. This conservative value is used throughout the analysis as a comparison.
- ✓ The production value of water is computed based on how much more land could be irrigated if efficiency could be improved by 1%. Each 1% increase in water efficiency means 1% more land could be irrigated (about 370 acres). The production value of this, in today's market, is about $300,000 ($810 per acre). This uses the assumption that water can be delivered on a full season basis. Sometimes this is not possible, but the analysis does show how valuable a full season of water is to shareholders.
- ✓ Water delivery efficiency in the canal system was estimated at 60%. The canal records for the three main tracts show that this estimate is high. Additional measurements will keep this from being a guess and help truly quantify this important factor.
- ✓ A major shift of canal water delivery efficiency has to take place to help shareholders pay for the investment they have made in field irrigation technology.
- ✓ The canals could deliver 80% flow for 20% more days with little change in canal delivery efficiency.
- ✓ The canal system could adopt efficiency techniques used by other irrigation companies.
- ✓ Farmers still have room for increasing irrigation efficiency.
- ✓ Farmers are willing to pay for increased days of water.

The acres and dollars per acre can be changed to depict any farm with those common crops. Each column in Table 1 and 2 represent a different scenario. Potatoes and sugarbeets were not included because they will have higher returns and will only be planted when water is available.

Column 1. This represents a full flow of water for 120 days, with full gross value achieved, and should be considered the standard. It shows that with full flow for 120 days, alfalfa could be planted after grain, or volunteer grain could be watered for fall grazing.

Column 2. Here all the land is irrigated for only 96 days. The result would be less hay and pasture for the 96 days (75% yield). Grain yield could reach full potential. Fall feed from newly seeded hay, or volunteer grain would not be an option.

Column 3. This is the same total volume of water as Column 2, but flows were reduced to 80% to extend the days of irrigation to a full season. The result is 80% of the gross value of 100% flow. There will be some value on the non-irrigated acres for hay and pasture. The 20% not irrigated is estimated to have 30% of the normal irrigated hay and pasture (1.6 tons/acre), and will provide additional value. The extended days of irrigation will facilitate new seeding of alfalfa or volunteer grain for added returns.

Column 4. This represents 60 days of water at 100% flow on all the farmland. Yield is estimated at 60% of full water for hay and pasture, and 80% for grain. This represents what has happened several times in the last 10 years. In Table 2 corn silage had to be replaced with small grain silage due to lack of adequate water.

Column 5. This is the same total volume of water as Column 4. The water was delivered at 80% flow on 80% of the land, but was extended from 60 to 75 days. Values for small grain silage are shown in Table 2. Extending the days of irrigation, in combination with beneficial natural precipitation, could increase the profitability considerably if a short season corn was able to mature for corn silage, instead of small grain silage as shown in Column 4. Yield of hay and pasture were estimated at 75% of normal, but the grain should be able to produce 100%. The 20% non-irrigated land in hay or pasture will produce an estimated 30% of normal.

Column 6. This represents a 45 day supply of water. Economic analysis did not show a benefit to reduced flows in this case. However, water conservation and planning for a crop mix to obtain the highest yields under these conditions is important (i.e. winter cereals planted for hay, silage or grazing; or warm season annuals). Yields were calculated at 40% of normal.

Table 1. Gross $ return for a 30 acre farm on the BWCC with variable irrigation water available, irrigating either 100% or 80% of the irrigated land.

			Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**	**Column 6**
Acres	Crop	Value w/ full irrig.	100% H_20 100% land 120 days	100% H_20 100% land 96 days	80% H_20 80% land 120 days	100% H_20 100% land 60 days	80% H_20 80% land 75 days	100% H_20 45 days
10	Hay	$550	$5,500	$4,125	$4,400	$3,300	$3,300	$2,200
10	Pasture	$450	$4,500	$3,375	$3,600	$2,700	$2,700	$1,800
10	Grain	$600	$6,000	$6,000	$4,800	$4,800	$6,000	$2,400
	Total Irrig. Land		$16,000	$13,500	$12,800	$10,800	$12,000	$6,400
Plus Fall	Hay				$330			
	Pasture				$270		$330	
	Grain		$1,200		$960		$270	
	Total All Land		$17,200	$13,500	$14,360	$10,800	$12,600	$6,400
	Per Acre		**$573.33**	**$450.00**	**$478.66**	**$360.00**	**$420.00**	**$213.33**

Table 2. Gross $ return for a 520 acre farm on the BWCC with variable irrigation water available, irrigating either 100% or 80% of the irrigated land.

			Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**	**Column 6**
Acres	Crop	Value w/ full irrig.	100% H_20 100% land 120 days	100% H_20 100% land 96 days	80% H_20 80% land 120 days	100% H_20 100% land 60 days	80% H_20 80% land 75 days	100% H_20 45 days
130	Hay	$550	$71,500	$53,625	$57,200	$42,900	$42,900	$28,600
260	Corn silage	$450	$208,000	$156,000	$166,400	$74,880	$93,600	$62,400
130	Grain	$600	$78,000	$78,000	$62,400	$62,400	$78,000	$31,200
	Total Irrig. Land		$357,500	$287,625	$286,000	$180,180	$214,500	$122,200
Plus Fall	Hay				$4,290		$4,290	
	Pasture							
	Grain		$15,600		$12,480			
	Total All Land		$373,100	$287,625	$302,770	$180,180	$218,790	$122,200
	Per Acre		**$717.50**	**$553.13**	**$582.25**	**$346.50**	**$420.75**	**$235.00**

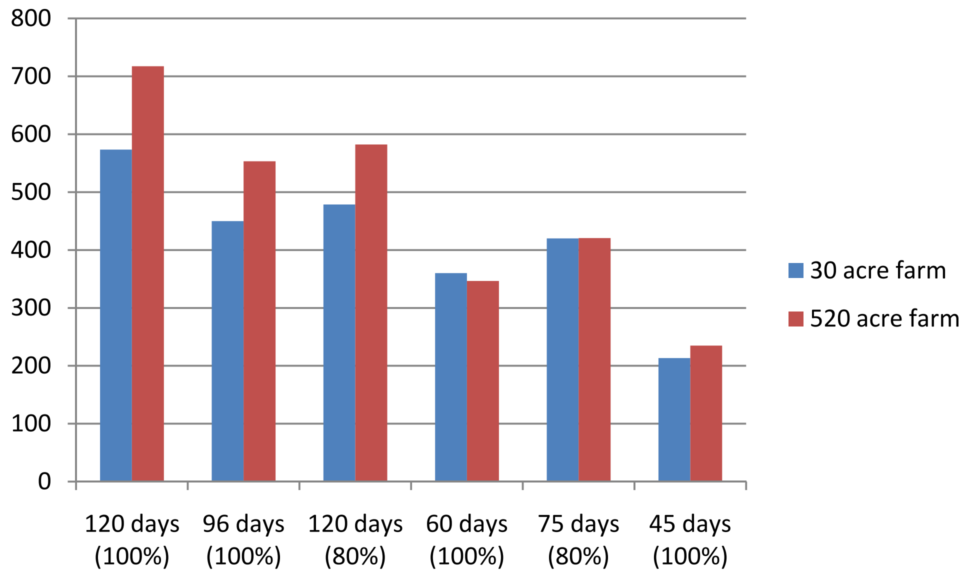

Figure 2. A summary of the financial advantage at the farm level to a demand-based, reduced flow of irrigation water to extend the growing season. There is an equal volume of water for 96 days (100% land) and 120 days (80% flow and 80% land). Sixty days at 100% flow and 75 days at 80% flow were both using the same total volume of water.

Changes implemented in 2008 resulted in an estimated increase of $2.56 million, by extended irrigation water for the whole system by at least 16 days. An economic analysis based on the 2008 cropping mix indicated that each day of irrigation season extension was worth $160,000. Crop prices were high in

2008, but even at a more conservative averaged value of $79,000 per day, a 16-day water extension increased crop value to shareholders by $1.26 million.

Extending the irrigation days and achieving a more consistent supply of irrigation water for cropping systems facilitates on-farm implementation of technology and physical improvements, because the costs can be amortized across multiple years.

The Team successfully combined existing individual knowledge with new analyses into a coordinated package to benefit the whole irrigation system. Below are highlights of the Team's success:

*Seventeen Team recommendations implemented (2008)
*Days of water use extended 16 days (2008)
*Potential farm profits increased by $2.56 million (2008)
*Encouraged water conservation—saving water and only asking for it when necessary
*Cooperation among neighbors increased to keep water in the reservoir
*Instead of a "use it or lose it" mentality for farm/ranch water management, the thought process is changing to "save water and make money."

The Team results and collaborative approach can be extended to other similar locations. In 2009, some of the Team recommendations were utilized in surrounding areas. Reshaping canals to reduce water loss and equipment design / flow measurement implementation are two examples.

Conclusion

The Team results agreed with Conway et. al. 2003, in that those successful watershed-focused projects were achieved with an informed and effective group making the decisions. Beneficial outcomes were achieved for all shareholders by planning and implementing (integrating the human process with technical, scientific, and practical knowledge) jointly conceived, cost-effective programs (Boone 1990) to resolve major water issues. Mutual learning and respect, and an true openness to new ideas were crucial. Critical water management improvements recommended by the Team are continuing. The Team is now poised to cross more boundaries, assembling data and coordinated plans of watershed management and groundwater recharge; for larger geographic areas, watersheds and organizations.

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