Tailwater Recovery (TWR) and On-Farm Storage (OFS) Reservoir: Economic Considerations

Figure 1. Tractors pull dirt pans and level land to create a TWR system in the Mississippi Delta.

Fitting conservation into your production system may require a significant contribution of time, money, and expertise. To ensure success, you should understand what contributions make a conservation system successful before implementing conservation practices. One of the most important components to consider before implementing a conservation system is your economic situation. One system of conservation practice is tailwater recovery (TWR), aimed at both water quantity and water quality conservation.

> *TWR systems are a combination of financially assisted NRCS conservation practices aimed at collecting runoff and storing that water for irrigation.*

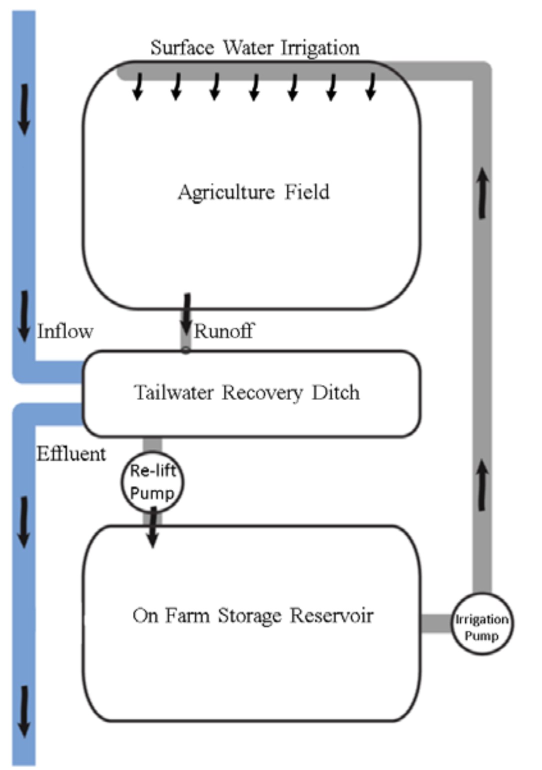

Figure 2. Diagram of a generic TWR system. Not all TWR systems are designed the same as this diagram. Some TWR systems do not require an extra on-farm storage (OFS) reservoir, and most of them collect water from multiple fields. Source: Omer et al. (in press a).

Figure 3. (**left**) Soybean field irrigated with water from a TWR system. (**middle**) Rice field irrigated with water from a TWR system. (**right**) Wheat harvested in the Mississippi Delta.

TWR System Considerations

Financial Considerations

When installing TWR systems on your farm, consider the following:

- Is the land owned?
- How long will the process take?
- What benefits (agronomic and/or environmental) does the practice provide?
- What is the cost of the practice?
- If a loan is necessary, what is the loan interest rate?
- What is the opportunity cost (loss of interest income on that money)?

Additional Considerations

The long-term benefits of a conservation system do not have an easily quantifiable monetary return, but conservation practices may help extend the health of your farming operations for future generations (for example, soil retention).

TWR System Costs

Advantageous Design

An appropriate design for each unique landscape is imperative to keeping the cost of TWR systems down. Not all landscapes are economical when installing a TWR system; however, landscapes where existing ditches and catfish ponds can be used are ideal. By using existing ditches and ponds, the amount of soil and the overall cost of the TWR system is decreased.

Capital Costs

Capital costs include all items used to direct and save water on the agriculture landscape, including the infrastructure required to reapply the saved surface water. These costs can range from $200,000 to $800,000 (150–1,500-acre collection area). The United States Department of Agriculture Natural Resource Conservation Service (NRCS) can provide financial assistance with around 60–80 percent of those costs (amounts of financial assistance vary according to state, county, and available assistance).

Figure 4. Tractor and dirt pan used to move soil to level land, as well as create TWR ditches and OFS reservoirs.

Maintenance

TWR systems require maintenance. The time required for maintenance depends on each individual system and how much sediment the system receives from fields. Sediment entering TWR systems depends on soil type and tillage practices. Maintenance involves cleaning out the TWR ditch or OFS reservoir to maintain its water-holding capacity. Observations show that maintenance schedules for TWR ditches and OFS reservoirs can range from 5 to 50 years. In addition, maintenance for additional pumping stations used to store and irrigate surface water is required.

Figure 5. Large TWR ditch in the Mississippi Delta. Notice the sediment buildup as a result of runoff from the adjacent field.

TWR System Benefits

TWR systems may reduce fuel costs to irrigate with surface water, reduce fertilizer costs due to recycling nutrients, and increase yield due to reduced cold stress placed on crops. Results show that small fuel savings (about $10 per acre-feet) may exist for producers who do not have to transfer water from TWR ditches to OFS reservoirs—other producers break even between pumping groundwater and re-lifting water while irrigating surface water (Omer et al., in press b). Reduction in fertilizer rates are unlikely due to the small amount of fertilizer actually recycled (Omer et al., in press c). Additional research is needed to quantify an increase in yield from using surface water instead of groundwater for irrigation.

Figure 6. Seasonal photos taken of the same TWR system bank. The edges of TWR systems provide a similar habitat to a moist soil unit.

Figure 7. Surface water pumping plant used to irrigate water from the adjacent TWR ditch.

TWR System Economic Analyses

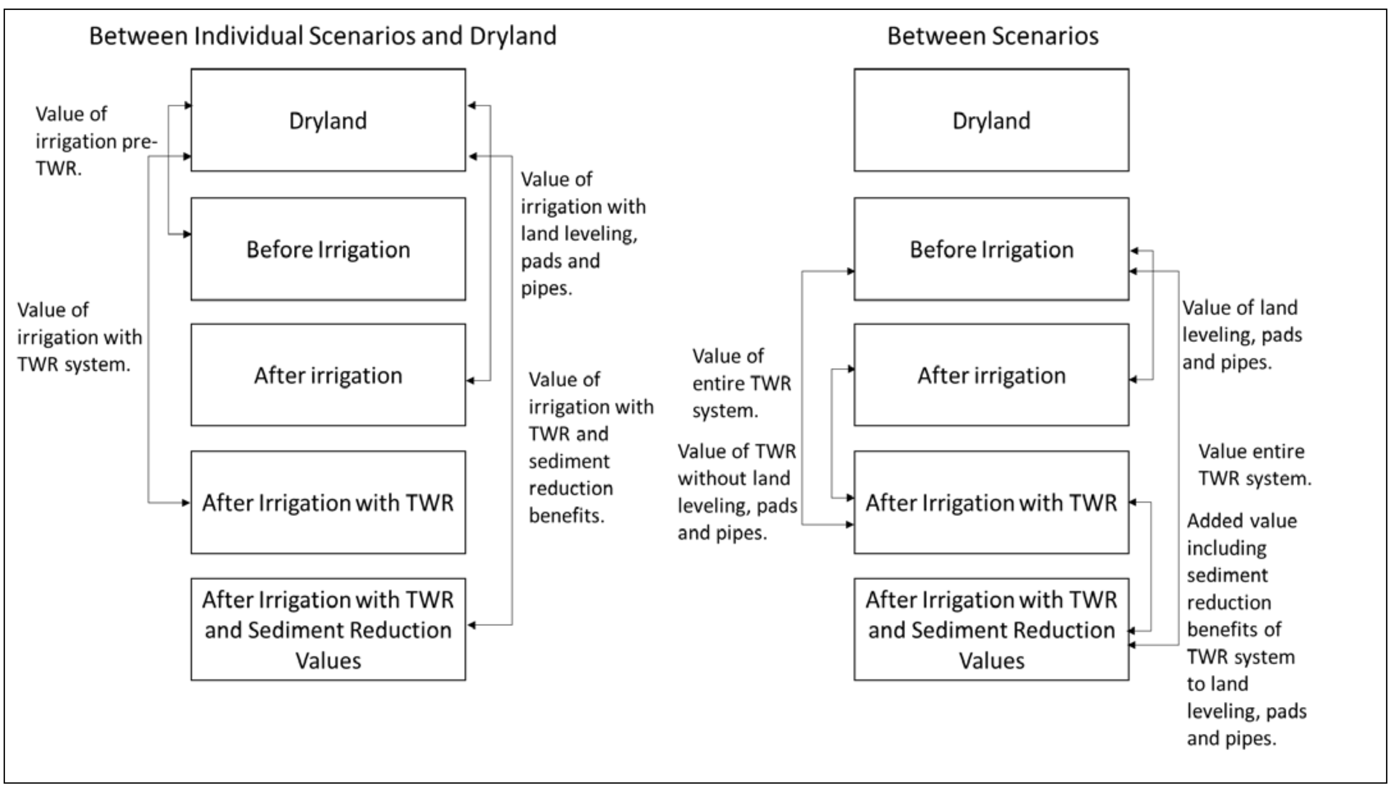

Figure 8. The different agricultural scenarios used to compare to TWR systems. Source: Omer et al. (in press b).

Table 1. Mean of net present values (NPV) per acre of production land.

	Owned land			Rented land		
Scenario	**3%**	**7%**	**10%**	**3%**	**7%**	**10%**
Dryland	$89	$122	$112	-$387	-$240	-$191
Before irrigation	$255	$246	$218	-$477	-$312	-$248
After irrigation	$399	$294	$251	-$288	-$238	-$194
TWR system	$317	$234	$188	-$415	-$325	-$278
TWR/sediment	$322	$237	$191	-$410	-$321	-$275
Before irrigation-dryland	$166	$123	$106	-$91	-$72	-$57
After irrigation-dryland	$310	$171	$139	$98	$2	-$2
TWR system-dryland	$228	$111	$77	-$28	-$84	$87
TWR/sediment-dryland	$233	$115	$80	-$23	-$81	-$84
After irrigation-before irrigation	$144	$48	$33	$189	$73	$56
TWR system-after irrigation	-$82	-$60	-$63	-$127	-$86	-$84
TWR/sediment-TWR system	$5	$4	$3	$5	$4	$3
TWR system-before irrigation	$62	-$13	-$30	$62	-$13	-$30
TWR/sediment-before irrigation type	$67	-$9	-$48	$67	-$9	-$48

Source: Omer et al. (in press b).
Data is for a 15-year planning horizon. Mississippi State University Enterprise Planning Budgets provide initial values with subsequent values based on projected rates of change in prices from the Food and Agriculture Policy Research Institute Baseline Briefing Book and linear regression. The discount rates of 3, 7, and 10% reflect possible required rates of return.

Understanding the Data

Table 1 shows net present values (NPV) of different scenarios and the difference in NPVs of those scenarios (Omer et al., in press b). The NPV capital budgeting method uses the discounting formula for a nonuniform series of payments to value the projected cash flows for an investment alternative at one point in time. A positive NPV is considered an acceptable investment that meets or exceeds the required rate of return, with the largest NPV being the preferred investment. Investments on rented land have negative NPVs in nearly all scenarios, including large negative values with the implementation of conservation practices including TWR systems. Owned-land scenarios result in all positive NPVs until TWR systems are installed, then NPVs are negative for larger discount rates. Analyses of NPVs of these scenarios help us to understand the economic returns for investments in conservation practices.

Examples

- The installation of land leveling, water-control structures, and dikes (after irrigation scenario) maintained a positive NPV compared to the baseline (before irrigation) scenario, showing that these practices are a good investment (due to the assumed increase in yields reflected in the MSU Planning Budgets).
- The installation of a TWR ditch, OFS reservoir, and surface water irrigation infrastructure (TWR system) resulted in a loss of NPV of $60–82 per acre for owned land and $84–127 per acre for rented land.
- Benefit transfers used in the TWR/sediment scenario show that the sediment reduction from these TWR systems (Omer et al., in press a) added $3–5 of NPV per acre to the scenarios. It's important to note that this value is added by providing downstream users with the service of cleaner water; the producer does not see a direct monetary return.

Costs of Using TWR Systems as a Conservation Practice

Table 2. Mean (standard deviation) of costs to reduce a pound of sediment or nutrients to downstream systems using TWR systems.

Funding source	Suspended solids	Nitrogen	Phosphorus
Producer capital	$0.08 ($0.17)	$16.26 ($50.08)	$135.38 ($302.65)
NRCS capital	$0.14 ($0.07)	$51.42 ($49.78)	$354.50 ($419.82)
Total cost*	$0.22 ($0.20)	$67.68 ($80.31)	$489.89 ($651.51)

Source: Omer et al. (in press d).
Costs calculated as the annual payment added to the revenue losses (lost tillable land) divided by the amount of the reduction from Omer et al. (in press a).

Table 3. Water usage costs.

Irrigation source	1	1.5	2
Groundwater	$17.31 ($6.19)	$17.31 ($6.19)	$17.31 ($6.19)
Producer TWR water	$162.45 ($253.40)	$116.03 ($172.00)	$92.83 ($131.33)
NRCS TWR water	$314.62 ($313.37)	$209.74 ($208.92)	$157.31 ($156.69)
Total TWR water	$477.06 ($514.41)	$325.77 ($346.77)	$250.14 ($262.95)

Table adapted from Omer et al. (in press d).
Mean (standard deviation) of five TWR systems in the Mississippi Delta and the costs to pump groundwater, save and use surface water (with both the producer's capital input and the USDA NRCS capital input), and the total combining the producers' costs and USDA NRCS costs. Headings 1, 1.5, and 2 are for different usage scenarios; for example, 1 being a producer who uses the volume of 1 times the capacity of their TWR system. Costs calculated as the annual payment added to the revenue losses (lost tillable land) and then added to the pumping costs divided by the amount of the reduction from Omer et al. (in press a).

Understanding the Data

Compared to other conservation practices, TWR systems are one of the most economical ways to reduce sediment loss from the farm (**Table 2**). However, TWR systems are one of the most expensive conservation practices to reduce nitrogen and phosphorus. In conclusion, the costs of saving water using TWR systems may be comparable to the value added to production systems from irrigation (Omer et al, in press d).

For More Information

Consult your county United States Department of Agriculture Natural Resources Conservation Service agent for more details on conservation practices.

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