Tailwater Recovery and On-Farm Storage Reservoir:

Nutrient Runoff Mitigation and Reuse Potential

Tailwater recovery (TWR) systems are a combination of financially assisted USDA Natural Resource Conservation Service (NRCS) conservation practices aimed at collecting runoff and storing that water for irrigation. This surface-water storage structure is a viable option for capturing and recycling precipitation and irrigation runoff (**Figure 1**). In addition to storing water for irrigation, these systems have the potential—and have been funded—to reduce nutrient runoff leaving the agricultural landscape.

Figure 1. Water movement through a TWR system. Note that not all TWR systems have the same components. Some TWR systems are comprised of only a large TWR ditch and no on-farm storage reservoir (OFS). Top left: Nutrient- and sediment-laden water running off a field in the Mississippi Delta region. Top right: Runoff water being captured by a TWR ditch. Bottom left: Nutrient- and sediment-laden water being pumped into an on-farm storage reservoir. Bottom right: Surface water being irrigated from a TWR/OFS system.

Preventing Nutrient Runoff

Biological

Plant and microbial activity impact the water leaving agricultural fields. Biological activity occurs naturally in agricultural drainage ditches and also may occur in TWR systems. Plants and algae take up nutrients required for their growth (**Figure 2**). Microorganisms also play a central role in nutrient transformation and removal. When oxygen is not present, microorganisms in the soil can carry out a process called denitrification to reduce nitrogen in the water and return it to the air.

Physical

Holding water on the landscape in a TWR system allows the heavier sediment and sediment-bound phosphorus to settle out of the water. This also allows time for biological processes to take place to reduce nitrogen. Finally, by recycling this water onto the landscape, TWR systems prevent sediment and nutrients from leaving the farm landscape (**Table 1**).

Table 1. Annual mean loads leaving fields and running off into TWR systems and amount captured (prevented from leaving farms) by TWR systems in the Delta.

Source	Sediment	Phosphorus	Nitrogen
Runoff (lb)	550,911	449	1,972
Captured (lb)	270,579	179	1,087

Source: Omer et al. (2018)

Sediment and Nutrient Runoff

Sediment and nutrient runoff from agricultural fields occurs year-round with precipitation and irrigation events. However, there are times of the year when more sediment and nutrient loss occurs. **Figure 3** shows sediment, phosphorus, and nitrogen field runoff occurring from March to July each year. Most of the field runoff coincides with precipitation in the Mississippi Delta region. Runoff events occurring in March to July also overlap with the primary growing season in the region (**Figure 4**).

TWR System Sediment and Nutrient Capture Performance

Results show that TWR systems do not reduce concentrations of sediment and nutrients in captured runoff; however, loads of sediment and nutrients are reduced (Omer et al. 2018) (**Figure 5**). The impact TWR systems have on load reductions is substantial and is comparable to nutrient-loading goals of state and federal agencies. Captured nutrients are available in TWR system water for irrigation; however, the loads of nutrients are too little to reduce fertilizer application rates (Omer et al. 2017).

Nutrients Available for Irrigation Reuse

Runoff captured by a TWR system is stored and reused as irrigation water, allowing potentially available nutrients to be put back into the field to meet crop needs (**Figure 6**). Results from this study showed relatively low nutrient values available per acre in TWR water stores (**Table 2**). The available amount of nutrients will fluctuate throughout the year with changes in temperature, precipitation, and fertilizer inputs in the field.

Figure 2. Plant and algal growth in TWR ditches in Mississippi's Delta region.

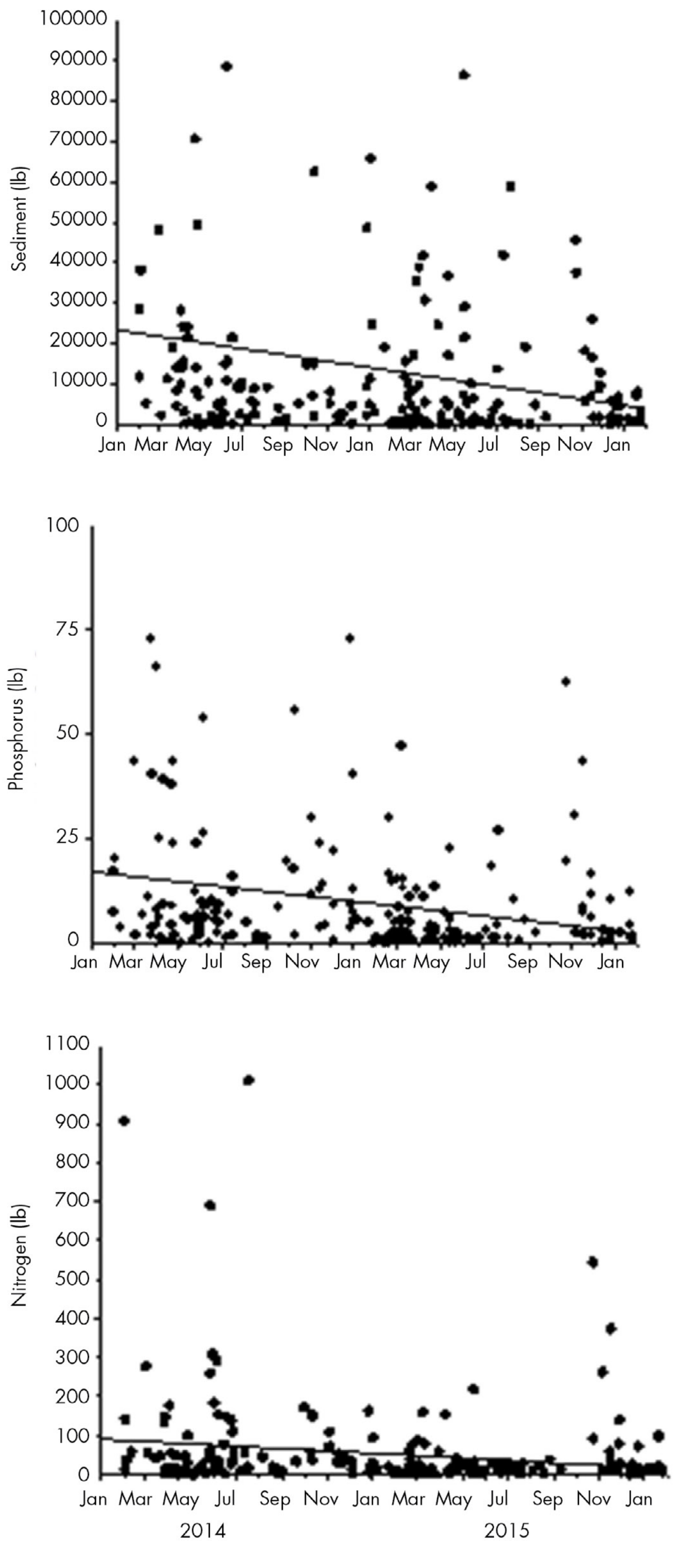

Figure 3. Sediment and nutrient loads leaving fields and running off into TWR systems annually (monitored for 2 years). Six TWR systems were monitored. The systems were within watersheds ranging from 141 to 385 acres and were all tilled land (except for turn rows). Solid lines represent the trend over the 2-year monitoring period.

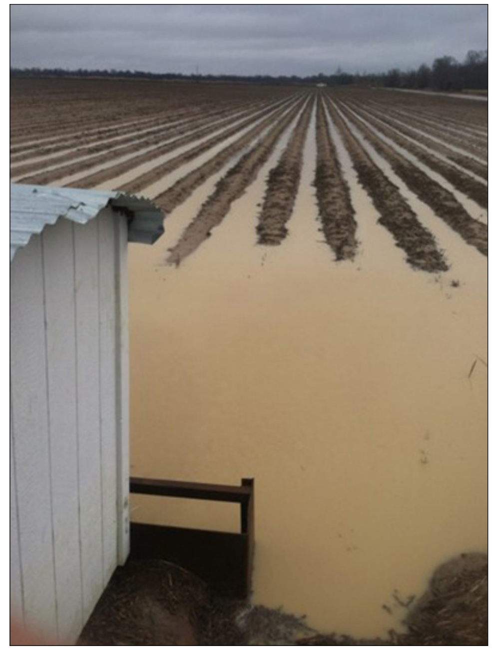

Figure 4. Runoff leaving a field after a precipitation event in the Mississippi Delta region. The small building on the bottom left houses water-quality sampling equipment used to monitor runoff leaving the field and entering the TWR system (not pictured).

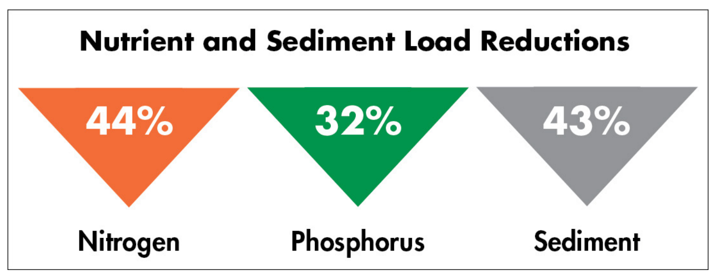

Figure 5. Mean percent load reductions from TWR systems in the Delta.

Figure 6. Rice irrigation with water from a TWR system in the Mississippi Delta region.

Table 2. Mean loads of nutrients available (in the TWR system's water) to irrigate back onto crops during the irrigation season.

	Phosphorus	Nitrogen	Inorganic Nitrogen
2014 (lb/ac)	0.9	9.0	1.4
2015 (lb/ac)	0.7	4.0	1.3
Mean (lb/ac)	0.8	6.5	1.3

Source: Omer et al. (2017)

Summary

Tailwater recovery systems are a combination of conservation practices that can provide water-quality and water-conservation benefits, but they also require economic investments. The cost of TWR implementation is higher than other conservation practices to achieve similar nutrient-reduction benefits. Other conservation practices to help achieve water-quality goals include controlled drainage and cover crops. Consult your county USDA-NRCS agent for more details on conservation practices.

References

Omer, A. R., Miranda, L., Moore, M. T., Krutz, J., Prince Czarnecki, J. M., Kröger, R.,…Allen, P. J. (2018). Reduction of suspended solids and nutrient loss from agricultural lands by tailwater recovery systems. *Journal of Soil and Water Conservation*, *73*(3), 284–297. **https://www.jswconline.org/content/73/3/284**

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MISSISSIPPI STATE UNIVERSITY™ EXTENSION

Publication 3263 (POD-01-23)

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Produced by Agricultural Communications.