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Investigation of Select Drainage Ditches in the Arroyo Colorado Watershed

Agriculture in the Arroyo Colorado Watershed

Agriculture in the Arroyo Colorado watershed has been known to contribute to the current impairments in the Arroyo Colorado. As a result, demonstration projects showing the effectiveness of best management practices (BMPs) have been occurring since 2006 to better measure progress of meeting the Arroyo Colorado Watershed Protection Plan goals. An important component of those goals is to evaluate and quantify the nature and extent of nutrient loadings from agricultural activities in the region. This information is fundamental to promote BMPs and foster sustainable agricultural activities.

Agricultural Impacts to the Watershed and Mitigation Approaches

Agricultural nonpoint source (NPS) runoff has been identified as responsible for high levels of the suspended sediment, biological oxygen demand (BOD), nitrate, ammonia, and phosphate load in the Arroyo Colorado. To address this, the Arroyo Colorado Agricultural Issues Workgroup was formed in December 2003 to develop a strategy. The strategy encourages voluntary adoption of BMPs to reduce suspended sediment levels resulting from cropland erosion, BOD (oxygen demanding organic material) from runoff of crop residue, and nitrogen and phosphorus fertilizer runoff from irrigated cropland fields.

Objective of Project

As most agricultural runoff is carried to the Arroyo Colorado River through the drainage ditches, quantifying nutrient dynamics in the drainage ditches is of paramount importance. Therefore, focus of the project was to characterize the use of drainage ditches to remove excess nutrients in runoff water received from agricultural fields. Four representative drainage ditches were selected for extensive monitoring with two located in Cameron County and two in Hidalgo County. Additionally, this study was paired with a separate field study to assess edge-of-field characteristics with regard to irrigation runoff water quality from six different fields and various crops. Results from that study can be found in *Evaluation of BMPs to Reduce NPS Pollution at the Farm Level*, Enciso et al., 2011 (TR-423 available at twri.tamu.edu).

Results

The comparison of concentrations observed in agricultural edge-of-field runoff leaving the farms, and those in the drainage ditches highlight the reduction capabilities of the drainage ditches, particularly with regards to phosphorus compounds. It was observed that the concentration of both phosphorus and nitrogen compounds are higher in the runoff water leaving the edge-of-field than what is observed in drainage ditch flows. The drainage ditches effectively reduced forms of nitrogen (total Kjeldhal nitrogen and ammonia nitrogen), but the removal of oxidized forms of nitrogen (nitrate-nitrogen) was linked to the hydraulic characteristics of the ditches. It should be noted that during this study, the Arroyo Colorado Watershed experienced the effects of several major storms, including Hurricane Dolly and Tropical Storm Ike, and one of the most severe droughts in recent history that spanned the study period of 2009–2011. These meteorological events contributed to extreme values and high variability in the observed flow and water quality.

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Overall, drainage ditches help attenuate initial loadings of direct runoff from the fields and lead to a more uniform nutrient loading that is spread out over a larger period of time. Therefore, drainage ditches can act as both nutrient sources and sinks. Results also implied that dissolved oxygen in the ditches are controlled by climate (temperature) and any additional mixing associated with increased flows are unlikely to enhance re-aeration in the ditches.

Recommendations

Proper management of land (i.e. before entering the drainage system) as well as maintenance and management of ditches are necessary to ensure that the pollutant loadings are minimized and the ditches facilitate nutrient removal and or storage in a sustainable manner. Deepening certain sections of the ditch (where possible and feasible) can help improve nitrogen removal capabilities. Additionally, biomass removal during the months of June–October could be beneficial for mitigating both nitrogen and phosphorus loadings within the ditches. This removal will also provide for new vegetative growth which facilitates additional nutrient removal capabilities.

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