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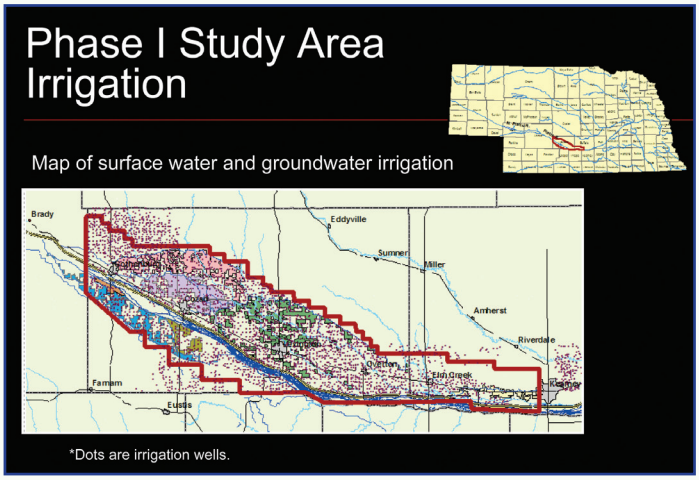
Case Study 9.1-3 Water and nutrient management practices improve groundwater quality in Nebraska, USA.

Since 1985, across the Lower Platte Natural Resource District (NRD), Nebraska, USA nitrate concentrations in ground- and surface water across the district have been monitored.



The terrace area in the north of the district has silt loam and medium to fine sandy soils with a water table 5 to 25 ft below the surface, and is intensively cropped to irrigated corn. In this terrace area, groundwater nitrate levels have consistently exceeded the drinking water standard of 10 ppm nitrate-N.

Three tiers (phases) of N management have been implemented, depending on groundwater nitrate-N levels. Areas with irrigation well nitrate concentrations averaging ≤7.5, 7.6 to 15, and ≥15.1 ppm are designated Phase I, II, and III, respectively. Since 1987, most farmers have been required to meet the Phase I requirements, with fewer required to meet Phases II, III, and IV. All operators using fertilizer must be certified every four years, and are encouraged to use practices from the higher phases even where not required. Recommendations for N rate are based on yield goals (set at 105% of past 5 years) with credits for preceding crops, N in irrigation water, and soil nitrate to 3 ft depth. Some of the requirements related to nutrient management are listed below.

Phase I

- Fall application of N fertilizer is prohibited on non-sandy soils before November 1.
- Application of N fertilizer is prohibited on sandy soils until after March 1.

Phase II

- Annual soil and irrigation water tests for nitrate-N.
- Annual fertilizer application reports.
- Nitrogen fertilizer only permitted on non-sandy soils from November 1 to March 1 if approved nitrification inhibitor is used, with records from fertilizer dealer.

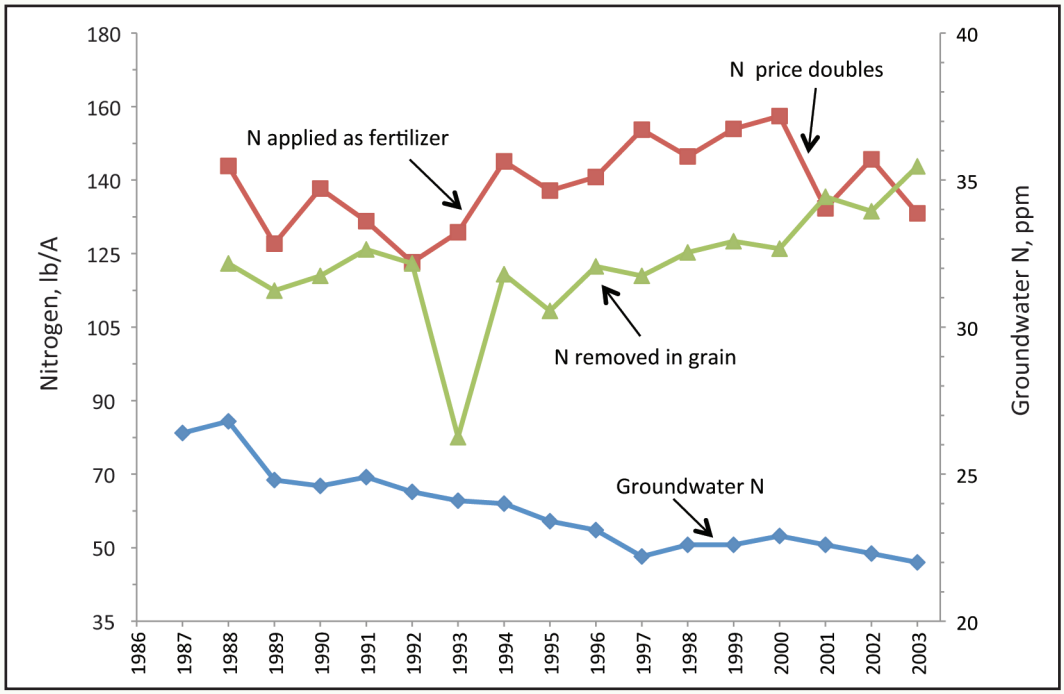
Phase III

- Application of N fertilizer prohibited in fall and winter on all soils until after March 1.
- Spring applications of N fertilizer require split application (pre-plant and sidedress) or the use of an approved nitrification inhibitor, with records from fertilizer dealer required if 50% or more of N fertilizer is applied pre-plant.

Phase IV (for areas where groundwater nitrate is not declining at an acceptable rate)

- Crop yield goal set by NRD.
- Fertilizer N rates not to exceed NRD recommendation.
- NRD staff work directly with operators on best management practices.

Results: Groundwater nitrate in the terrace (north) area declined from 1987 to the end of the study in 2005 (see Figure). About 20% of the decline is attributed to increasing N removal with crop harvests, and 50% is attributed to shifts from furrow irrigation to sprinkler irrigation. Perhaps, by difference, one can conclude that the remaining 30% of the decline arose from changes to time of application and source (increased use of nitrification inhibitors). Further reductions in groundwater nitrate may require increased adoption of current BMPs, or adoption of additional technologies such as controlled-release N fertilizers and the use of crop canopy N sensors.



As crop yields and N removal increased over time, groundwater nitrate levels declined.

Note: These data are for commercial N fertilizer applied and N removed in the grain for irrigated corn acres on the terrace of the NE CEAP study area in the Central Platte Natural Resources District and the nitrate concentration in the primary aquifer beneath the terrace. **Adapted from** Exner, M.E., H. Perea-Estrada, and R.F. Spalding. 2010. The Scientific World Journal 10: 286-297. Data for Figure provided by Dr. R. Ferguson and Dr. M. Exner, U. of Nebraska.

About half the decline in groundwater nitrate was attributed to shifts from furrow to sprinkler irrigation.

Submitted by C.S. Snyder, IPNI, USA, January 2012.