TOWARDS SUSTAINABLE GROUNDWATER MANAGEMENT
IN THE AGRICULTURAL LANDSCAPE

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KEY MESSAGES FOR DECISION MAKERS

- Agricultural nutrient use has resulted in an accumulation of nitrate in groundwater systems. Chronic impacts on the quality of both shallow private wells and deep public supply wells are being documented with more frequency within Canada.
- Adopting nutrient best management practices (BMPs) to optimize crop uptake and reduce subsurface losses has economic and environmental benefits when applied in vulnerable areas.
- The considerable time lag between the implementation of a BMP and its full impact on groundwater can be managed in the short term through the implementation of temporary groundwater remediation strategies.

WHO IS THIS INFORMATION RELEVANT FOR?

- Farmers
- Municipal groundwater supply managers
- Provincial government authorities in agricultural and environmental management

WHAT WAS THE RESEARCH FOCUS?

Few field-based results are available to assess the performance and economic impact of best management practices (BMPs) designed to reduce nutrient losses. This research assessed the performance of BMP alternatives implemented across an active farm field, relative to impacts on groundwater quality and economic considerations. Long-term, on-farm studies were conducted where elevated levels of groundwater nitrate (likely originating from surrounding agricultural activity) had compromised public supply wells.

WHAT WAS THE RESEARCH METHOD?

A nutrient BMP program was implemented across a broad region of farmland in southern Ontario. Subsequently, soil water and groundwater quality were spatially monitored in sediment cores and in a network of monitoring wells over a 10-year period. Changes in nitrate concentrations in the sediments, groundwater flow system and public supply wells were monitored during this time period, along with nutrient application rates, crop rotations and crop production.

The utility of groundwater remediation based on in situ denitrification methods was evaluated as a strategy to reduce groundwater nitrate concentrations in the production aquifers. Predictive modeling tools were used to evaluate the potential magnitude and timing of the impacts of the BMPs on the public supply wells

WHAT WERE THE RESEARCH RESULTS?

- Combining optimal fertilizer application rates with crop rotation significantly reduced nitrate losses to the subsurface with no reduction in crop yields.
- Nutrient management BMPs resulted in gradual, progressive reductions in groundwater nitrate beneath the farm fields and in the public supply wells.
- In situ denitrification proved to be very effective at reducing nitrate concentrations in targeted regions of the production aquifer.

WHAT ARE THE IMPLICATIONS FOR DECISION MAKERS?

- Adopting nutrient-management BMPs over regional areas targeted for impact on groundwater supplies can significantly reduce existing or potential groundwater quality degradation associated with agriculture.
- Environmental benefits can be achieved with little or no impact on crop production and may be economically beneficial.
- Groundwater remediation strategies to reduce nitrate concentrations in situ can be employed in the interim period between the implementation of the BMP and its full influence on public supply wells.
- Reduction in nitrate concentration can be achieved in public supply wells within months of the initiation of the remedial system, so that the wells can be put back into operation quickly.
- The combination of regional BMPs and focused groundwater remediation systems can provide a novel approach to manage elevated nitrate concentrations in groundwater supply systems. This approach can be considered for a wide range geographic settings and agricultural land use activities.

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