AGRICULTURAL BENEFICIAL MANAGEMENT PRACTICES FOR NITROGEN AND PHOSPHORUS LOAD REDUCTION

THE UNIQUELY CHALLENGING CASE OF THE RED RIVER BASIN OF THE NORTH

Adopting agricultural beneficial management practices (BMPs) is critical to reducing nitrogen (N) and phosphorus (P) loads to surface waters and resulting water quality impacts. While much is known about nutrient BMP effectiveness in warm regions, recent research has revealed a need to validate the efficacy of many BMPs in cold climate regions like the Red River Basin of the North (RRB).

Key features of a cold climate

There are several key features of a cold climate that can hamper BMP efficacy, as well as BMP adoption:

- A short growing season reduces agronomic options and time available for BMP implementation.
- Precipitation falls as both rain and snow, which affects where and when water accumulates and moves.
- Prolonged sub-zero temperatures can freeze soil to great depths, delaying water movement in spring and the onset of a new growing season.
- Freeze-thaw events, both the frequency and duration, affect water and nutrient dynamics.
- Snowmelt is a mechanism for runoff, which influences runoff timing and the forms of nutrients contained in runoff.

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Implications of a cold climate for nutrient transport

Unlike in warm parts of the world where runoff is mainly driven by rainfall events, nutrient transport in a cold climate region occurs mainly during spring snowmelt. Rather than being attached to eroded soil particles in rainfall-driven runoff, nutrients in snowmelt runoff are predominantly in dissolved forms, at relatively low concentrations.

Nutrient load reductions in cold climate regions then cannot be achieved solely by addressing soil erosion risk but also, and more so, by managing the runoff itself. This principle must guide the process of validating and refining BMPs for nutrient load reduction in a cold climate region such as the RRB.

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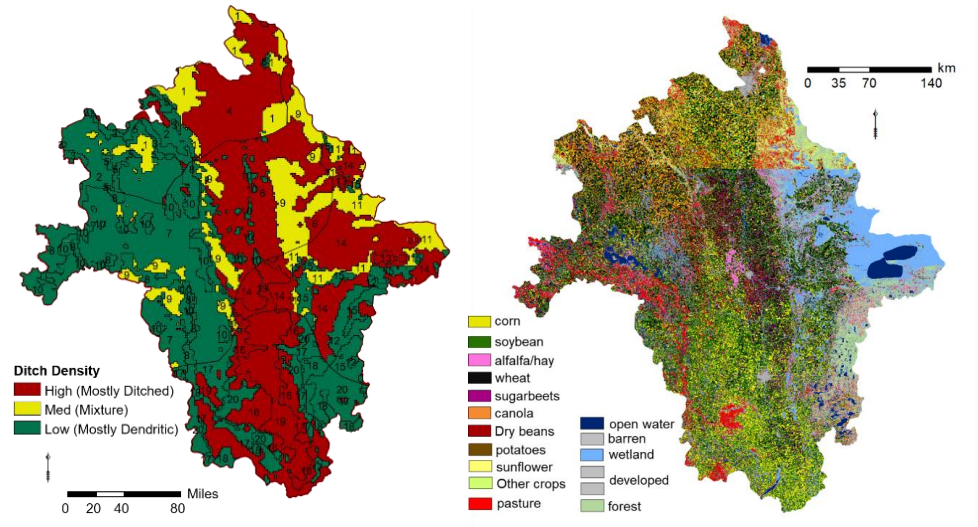
What else complicates BMP efficacy in the RRB?

A cold climate is not the only factor affecting BMP effectiveness in the Red River Basin of the North. This region has a set of unique characteristics that further complicate BMP efficacy, as well as the adoption of BMPs by farmers.

The RRB is a vast region in which land use is dominated by agriculture – over 26 million acres (10 million hectares) or 73% of the basin is used for farming. The land is predominantly nearly level with micro-relief in the form of ridges, swales, and some small, closed depressions. This topography combines with fine to very fine textured soils over much of the Basin to discourage water movement, be it via surface flow or downward into and through the soil profile. Consequently, large areas can become waterlogged for prolonged periods of time, necessitating extensive networks of artificial surface drainage.

This intensification of drainage is most evident on the Red River Plain, historically making possible the establishment of thriving communities with agriculture as the backbone of the economy. Dramatically altering the landscape and its hydrology, however, has changed the Basin's hydrography by reducing water storage and magnifying streamflow volumes, creating higher peak flows, and shortening intervals between precipitation events and flow response in surface drains. In combination with the regularity of freeze-thaw events, these changes in water dynamics exacerbate nutrient export from agricultural land.



Superimposed on this unique combination of physical characteristics of the RRB is the complicating factor of geo-political boundaries. Agricultural management is influenced by policy and regulation, as well as market forces, which vary among two federal jurisdictions and four state/provincial jurisdictions. Collaboration across the Basin is critical to addressing the challenge of nutrient loading to surface waters from agricultural land.

Finally, climate change is creating uncertainty about the future efficacy of agri-environmental BMPs. Altered temperature and moisture regimes, growing season length and patterns of variability may mean that BMPs must be adapted to achieve nutrient loading objectives.

The RRB / Cold Climate Ag Nutrients BMP Workshop

To address the efficacy of BMPs in cold climates and discuss the unique characteristics of the RRB a diverse group of university researchers and extension staff, state/provincial and federal government researchers and water resource managers, and industry professionals came together for a workshop in the spring of 2019. Collectively, participants critically examined the existing research and current thinking on the effectiveness of nutrient reduction BMPs in cold climates, and their potential suitability in the Basin.

Information on the workshop presentations and discussions, an overview of those BMPs that attendees broadly agreed were effective in cold climates like the RRB, and the research gaps and next steps identified is available in the full workshop summary report, which can be found at www.redriverbasincommission.org/rrbc-projects.