A Brief Review of Facts Surrounding Agricultural Phosphate Use in Saskatchewan and Levels in Lakes and Streams

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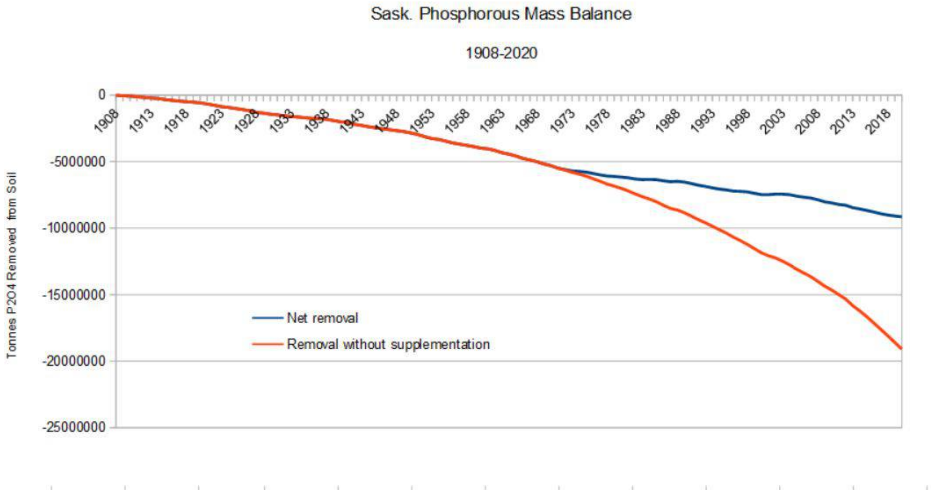
Phosphate Supplementation is Required for Sustainable Agriculture in Saskatchewan...

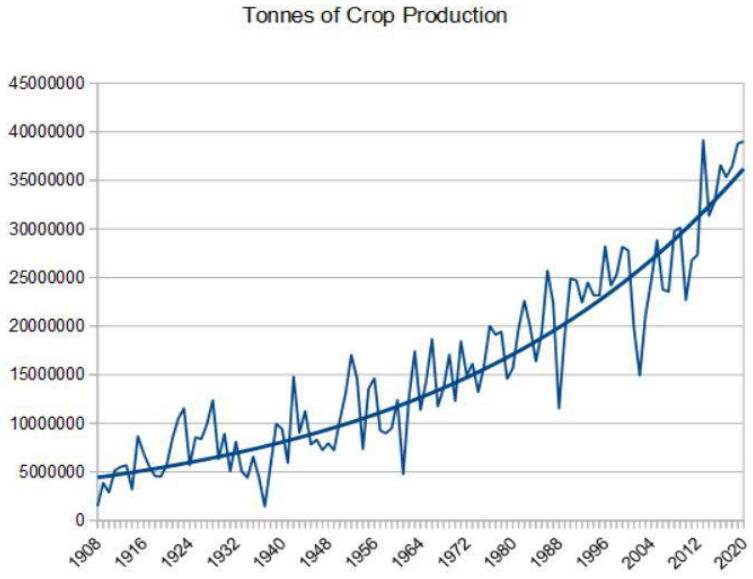
Saskatchewan soils contain very large amounts of phosphorous; anywhere from 30-60,000 Lb/ acre.[i] Despite being rich in this nutrient, very little is available to plants. It is estimated that 80% of Saskatchewan soils are deficient in available phosphorous (phosphate), containing less than the 15-20 ppm considered critical for most agricultural crops.[ii] Beginning in the early 1970's Saskatchewan farmers started supplementing their land with rock phosphate, but supplies of this product are finite and some project that the world could run out in a few decades time.[iii]

Saskatchewan Farmers Sequester ~100,000 Tonnes of Phosphate per Year...

Despite supplementation, Saskatchewan farmers are still removing phosphate at an average rate of 100,000 tonnes per year from the province's soils (Figure 1)[iv] This phosphate is taken up by the plants, most of which is stored in the seeds (75-90% depending on the crop)[viii], and subsequently exported out of the province.



In fact, farmers provide the ONLY way in which phosphate is removed from our environment. Since the advent of fertilization, Saskatchewan farmers have tripled the amount of crops grown on our land (Figure 2)[v], and as such phosphate removal has offset supplementation by a ratio of 2:1.



Most Saskatchewan Farmers use Phosphorous Responsibly...

Farmers of Saskatchewan are practising the 4 R's of nutrient management (right kind, right time, right place, right amount). Farmers primarily apply phosphate in the spring during planting and after the snow has melted (right time), they sub-soil band the phosphate next to the seed where it can't interact with surface water (right place) and they are increasingly adopting variable rate technology to place higher rates where it is needed and lower rates where it is not (right amount). Variable rate technology directed by geo-referenced prescription maps tend to decrease phosphate rates near larger wetlands and within areas of connectivity to wetlands.[vi] A recent report quantifying the success of these technologies suggests that fertilizer placement efficiency has increased 6% and productivity has increased an estimated 4% and has the potential to further increase 7% with broader adoption.[vii]

Saskatchewan Farmers are Not to Blame for Phosphate in Rivers and Lakes..

Despite their responsible use of fertilizer, Saskatchewan farmers are being blamed for increased phosphate levels in lakes and streams. The facts however, do not corroborate these accusations. Predictably, those groups most critical are also using their concerns as justification for strict limitation and reversal of future and existing agricultural water management works.

Although it is generally known that soil erosion is the most predominant contributor of increased water phosphate levels in many parts of the world, this is NOT the mechanism by which phosphate gets into lakes and rivers in Saskatchewan.[viii] In Saskatchewan, the majority of phosphate that enters the watersheds is comprised of soluble phosphate that has leached from plant vegetation through freeze-thaw cycles and is transported in the spring snow melt.[ix] This process occurs in ALL vegetation...leaves, grasses, forages, cattails, and crop stubble. Data collected from the Qu'Appelle River going back to 1975 show that despite a doubling of phosphate use by Saskatchewan farmers from 1977 until 2007, there was little to no change in either total phosphate load or volume weighted concentration.[x]

Wetlands do not "Filter" Phosphates from the Environment, They Only Delay its Release...

Wetlands do not remove phosphates from our environment, but rather they only temporarily store phosphates. The IISD (International Institute for Sustainable Development) located in Winnipeg Manitoba suggests harvesting the cattail vegetation from wetlands to mitigate nutrient loading to Lake Winnipeg.[xi] This is because the decomposition of cattails release phosphate into the water. More concerning is that the overland flooding of small wetlands increases dissolved phosphate concentrations in that water by up to 17 times more than runoff water.[xii],[xiii],[xiv] This means that during wet cycles, when these small wetlands fill-and-spill, that phosphate load can be up to 17 times greater than water running off of managed annual cropped land. This could explain why phosphate loads spike under conditions of exceptionally excessive rainfall[xv], and why they have otherwise remained the same under normal rainfall conditions (example 1977-2007, Qu'Appelle River)[xvi].

Well-Intentioned Practices Could be a Significant Source of Phosphate Contamination...

Millions of acres of land in Saskatchewan are set aside for Conservation and many are seeded down to forages which usually go unharvested. It has been found that that the melt water from forages increases the load of total dissolved phosphates by 221% over annual crops[xvii] Furthermore, snow melt from Winter Wheat, a crop heavily promoted for creating nesting habitat for ducks, contributes on average 5000% the load of total dissolved phosphates over annual crops.[xviii] This science has been published for several years now, yet these practices continue to be promoted. In Saskatchewan, strategies such as "buffer strips", which are meant to decrease the level of phosphates from entering our water by preventing erosion, may actually contribute to increased phosphate loads from the soluble phosphate released from the unharvested vegetation.

Cities account for the largest amount of phosphate load from unnatural sources...

Over 58 million acres of land are owned and cared for by Saskatchewan farmers. Of this, over 21 million acres (37%) are natural habitat...either wetlands, forest, or grasslands[xix]. The contribution of phosphate load to watersheds is equal or greater per acre in native habitat as it is in cropped land. This overall contribution on a per acre basis is quite small compared to the contribution by cities such as Regina and Saskatoon. These cities on average dump 30 tonnes of phosphate per year directly into our rivers and another 300 tonnes per year into landfills. The Qu'Appelle river sees a total annual phosphate load of 250-300 tonnes per year. It is believed that 10-11% of this total load is from cities and towns. As such, their contribution to the problem is 40-50X the level than if these urban centres didn't exist. Conversely, if Saskatchewan farmers disappeared and the land returned to native, phosphate load would likely not change.

i Ken Panchuk, Provincial Specialist, Soils, Crops, and Irrigation Branch, Saskatchewan Ministry of Agriculture.
ii Lisa Guenther, February 23, 2017, “Expert (Stu Brandt) Concerned About Low Phos Levels”, GrainNews.
iii Damian Carrington, September 6, 2019, “Phosphate Fertiliser 'Crisis' Threatens World Food Supply”, The Guardian.
iv Phosphorous Mass Balance Compiled from Stats Canada Data. Phophate Supplementation data provided by Ken Panchuk, Saskatchewan ministry of health. Phosphate removal calculated for each crop based on the average of high and low estimates from Grant, C. and Flaten, D. “4R Management of Phosphorous Fertilizer in the Northern Great Plains: A Review of the Scientific Literature”, July 3, 2019.
v Total crop production in Saskatchewan compiled from Stats Canada Data.
vi Pylatuik, J., Echelon variable rate results from three years of data on 4050 acres.
vii https://www.syngenta.ca/market-news/study-reveals-benefits-of-precision-agriculture
viii Grant, C. And Flaten, D. “4R Management of Phosphorous Fertilizer in the Northern Great Plains: A Review of the Scientific Literature”, July 3, 2019.
ix Salvano, E., Flaten, D. N., Rousseau, A. N. and Quilbe, R. 2009. Are current phosphorus risk indicators useful to predict the quality of surface waters in southern Manitoba, Canada? Journal of Environmental Quality 38(5):2096-2105.
x Water Security Agency. 2018. Qu'Appelle Nutrient Mass Balance 2013-2016, Figures 92 and 93
xi https:/www.iisd.org/sites/default/files/publications/cattail_harvesting_carbon_offsets.pdf
xii Jayarathne, P.D.K.D., Kumaragamage, D., Indraratne, S., Flaten, D., and Goltz, D. 2016, Phosphorous Release to Floodwater from Calcareous Surface Soils and Their Corresponding Subsurface Soils under Anaerobic Conditions. Journal of Environmental Quality, 45:1375-1384.
xiii Amarawansha, E.A.G.S., Kumaragamage, D., Flaten, D., Zvomuya, F., and Tenuta, M. 2015, Phosphorous Mobilization from Manure-amended and Unamended Alkaline Soils to Overlying Water During Simulated Flooding. Journal of Environmental Quality, 44:1252-1262.
xiv Flaten, D., 2019, Phosphorous: Refining Nutrient, Soil and Water Management for Cold Climates. Adapted from a presentation at the North Dakota Soil and Water Conference (January, 2016)
xv Water Security Agency. 2018. Qu'Appelle Nutrient Mass Balance 2013-2016, Figure 92
xvi Water Security Agency. 2018. Qu'Appelle Nutrient Mass Balance 2013-2016, Figure 93
xvii Liu, K., Elliott, J.A., Lobb, D.A., Flaten, D.N., and Yarotski, J. 2014, Nutrient and Sediment Losses in Snowment Runoff From Perennial Forage and Annual Cropland in the Canadian Prairies. Journal of Environmental Quality, 43:1644-1655.
xviii Elliott, J. 2013. Evaluating the potential contribution of vegetation as a nutrient source in snowmelt runoff. Canadian Journal of Soil Science 93(4):435-443.
xix Statistics Canada 2016 Census Data: 40.5 million acres cropland (36.7 million field crops + 3.8 million Hay) divided by 61.6 million acres farmers control and have stewardship over = 21.1 million acres idle or 85,537 km^2