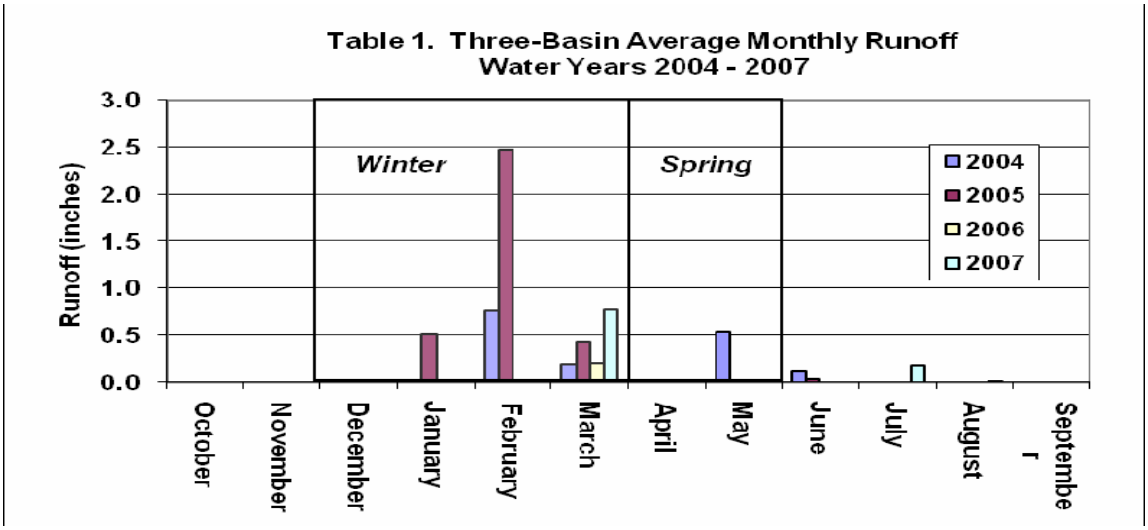
IMPACT OF LATE WINTER MANURE SPREADING ON SURFACE WATER RUNOFF QUALITY

Kevan M. Klingberg [1]

Four years (Nov. 03 – Oct. 07) of discharge and water-quality data were collected from three, adjacent, cropped basins on a private southwest WI farm. Field edge discharge through grassed waterways was monitored continuously and composite water samples for rainfall and snowmelt-induced runoff events were collected and analyzed for nutrients and sediment.

Farm management was no-till corn or soybean on 4-6% slope silt loam soil with terraces and grassed waterways in place. For study purposes, livestock manure was applied at typical rates in either fall or late winter, just before snowmelt.

Four years of field edge runoff water monitoring shows, 82% of annual surface-water runoff occurred between January and March, when ground was frozen. The remaining runoff occurred in spring when vegetative cover was minimal and soils were wet (Table 1).



Despite varying types, rates, and timing of manure applications, no significant differences were detected in the volume of runoff between basins in any frozen ground period.

Through the frozen ground period, suspended sediment loss ranged from 0 – 60 lb/ac/yr, less than 10 % of annual sediment loss (Table 2). Most total P lost through the frozen ground time period was dissolved; not associated with sediment loss.

Each basin with manure applied approximately 1 week before snowmelt had wintertime total P losses (1.9 – 3.7 lb/ac) that were higher than basins with fall applied manure (0.1 – 0.4 lb/ac). Through the study, over 80% of annual P loss occurred when the ground was frozen (Table 2).

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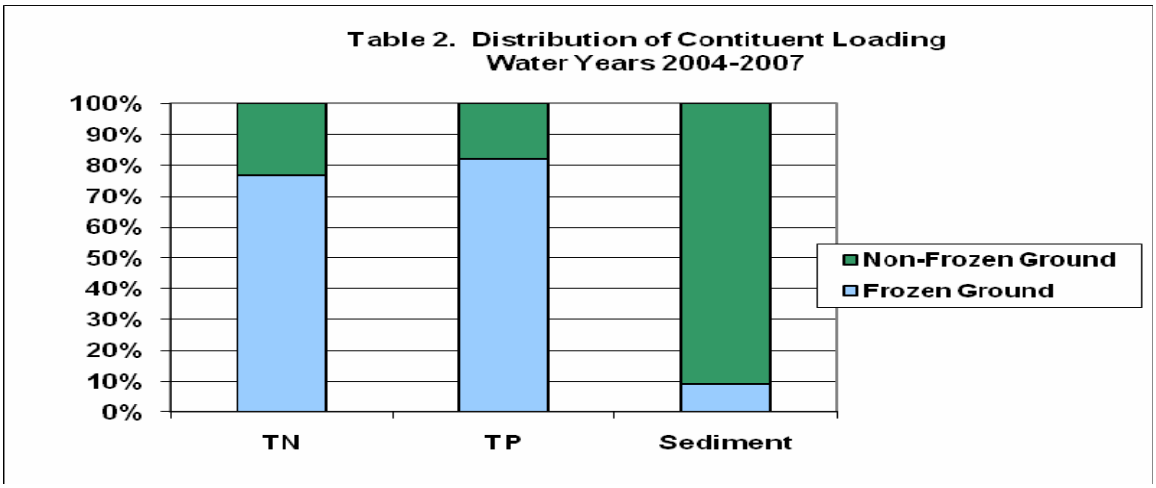
1 Sr. Outreach Specialist, Univ. of Wisconsin – Extension, Discovery Farms Program, P.O. Box 429, Pigeon Falls, WI, 54760.

Similarly, basins with manure applied approximately 1 week before snowmelt had wintertime total N losses (5.0 – 7.8 lb/ac) that were higher than basins with fall applied manure (0.1 – 1.0 lb/ac). In all cases, total N loss where manure was applied immediately before snowmelt was primarily in organic and ammonium forms. Through the study, over 75% of annual N loss occurred when the ground was frozen (Table 2).



Livestock manure applied to snow covered and frozen ground within 1 week before and during periods of surface water runoff caused a substantial increase in total P and N losses from these fields. The fact that these nutrients are mostly dissolved P and organic / ammonium N suggests their origin is from the manure. Both liquid and solid manure applications resulted in nutrient loss to surface water runoff. Livestock manure applied in late fall and early winter, even at higher rates, had less impact on P and N loss in snowmelt runoff. Fall and early winter applied manure likely had sufficient time and necessary conditions before snow melt and runoff to facilitate sorption, infiltration, volatilization and/or immobilization that provide alternate pathways for nutrient transport.

This study suggests that late winter in Wisconsin, especially the week before and during snowmelt, is a critical time to carefully manage field applications of manure to minimize off-site nutrient movement. When possible, manure applications should be timed to avoid periods right before significant late winter snow melts. On farms where manure must be spread during this critical time, farm managers should identify fields that are located high in the landscape with minimal contribution toward surface water runoff. When possible, save these fields by not applying fall and early winter manure, in the event that they are needed for late winter manure spreading.

Understanding the relationships between water quality and timing, rates, and methods of manure application, particularly in the winter, is a big step toward understanding the impact of livestock agriculture on the environment.

Further study is needed to understand surface water quality impacts of early and mid-winter manure applications. Similarly, for manure applications to frozen and/or snow covered cropland,

more research is needed relative to manure interactions with snow pack, ice layers, and the soil; nutrient transformations; soil biology; application distances from concentrated water flow paths; and differences between solid, liquid and animal species manure.

The team for this project includes the participating agricultural producer, UW-Discovery Farms staff, and U.S. Geological Survey (Middleton, WI) staff.