Environmental policy and factors that impact manure management on Wisconsin dairy farms

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Abstract

Current environmental regulations related to manure management are generally based on the number of livestock per farm, or a farm's position in a watershed. Such approaches often do not consider biophysical factors, such as soils and weather, and socio-economic conditions that affect farmer management of manure. Results from various studies of representative Wisconsin dairy farms show that policies based on farm size may not provide the desired outcome of improved manure management. For example, farms with small herd size collect less manure than large farms. Also, although most Wisconsin dairy farms operate sufficient cropland area for recycling manure, farmers use only a fraction of their cropland base to spread manure. Farmers in the northeast part of the state spread manure on 23% of their total cropland base verses 44% in the southwest region. Regional differences in soils and weather affect the number of days a farmer can spread or inject manure, and till the soil. Biophysical and socio-economic conditions that affect farmers' ability to collect and spread manure should be considered when formulating manure management policy aimed at improving the environmental performance of Wisconsin dairy farms.

Introduction

Federal and state agencies have increasingly focused environmental, animal agriculture regulations on the amount and timing of manure application to cropland. The current regulatory focus is on large livestock operations under the assumption that they produce the most manure, and therefore pose the greatest environmental risk. However, it is becoming increasingly evident that farms of all sizes can generate negative environmental impacts. It often has been suggested that economies of size, more modern technologies and potentially higher management skills associated with large-scale operations may put these operations at a decreased potential to pollute in relation to smaller, outdated facilities (Norris and Batie, 2000).

In October of 2002, the Wisconsin state legislature passed a set of eight administrative rules and performance standards directed at the control and prevention of polluted runoff (WDNR, 2003). Agricultural-related pollution abatement efforts are directed toward controlling nutrient losses through the implementation of nutrient management plans on all Wisconsin farms by the year 2008. Wisconsin and other states use watershed-based indicators to direct pollution abatement efforts. However, providing blanket cost-sharing coverage or technical assistance to farms within a watershed is likely to reward operators that already are doing a good job of managing nutrients. Public and private sector costs often increase as a result, which are not offset by the benefits of improving the impaired water resource (Shortle, 1999). Because funding is likely to become a limiting factor in implementing Wisconsin's non-point rules (Nowak, 2001), it is important that cost-sharing monies are directed toward operations most likely contributing to non-point pollution problems.

A recent compilation of environmental policy options for controlling agricultural pollution (Shortle and Abler, 2001) gives very little recognition to the diverse biophysical and socioeconomic conditions farmers face, and how these factors influence farmer ability to control pollution from their farms. It is often assumed that pollution is simply a matter of choice, and that policy should "examine the question of how to induce farmers who cause water quality damages through their choice of production practices to adopt pollution prevention and pollution control practices that are consistent with societal environmental quality objectives" (Horan and Shortle, p. 19 in Shortle and Abler, 2001). We contend that most livestock producers do not chose to adopt practices that pollute, but rather some find themselves in an environment that limits management choices. This paper summarizes recent findings related to manure collection (Powell et al., 2003), stocking density (Saam et al., 2005), feeding practices, soils and weather (McCrory et al., 2004), and socio-economic factors that affect manure management behavior, and how this information may be considered when formulating policy aimed at improving the environmental performance of Wisconsin dairy farms.

Manure Collection on Wisconsin Dairy Farms

Many Wisconsin dairy farms do not collect all their livestock manure. Lowest manure collection occurs on farms that allow their livestock regular access to the out-of-doors, generally farms with small and medium herd sizes (Figure 1), or farms that use stanchion rather than free-stall housing. Manure collection on farms in the hilly southwest region is significantly lower than in other regions of Wisconsin (Powell et al., 2003).

Figure 1. Relationship between dairy herd size and apparent manure collection on Wisconsin dairy farms (Powell et al., 2003)

Manure management, particularly in outside areas on small and medium size dairy farms might require particular attention. Most dairy farms of this size have been owned and operated by a single-family since their establishment generations ago. Many farmsteads were originally built close to streams or springs. Given their close proximity to surface water, increasing animal densities and manure production, many of these operations may have to meet regulatory nutrient management standards. The input of farmers that operate small- and medium-size dairy farms should be pursued to more clearly define the challenges and opportunities they face in improving manure management, especially manure deposited in outside areas.

Balancing Animal Numbers with Cropland Area for Manure Spreading

An alternative (or additive) to the current herd size or watershed indicators for targeting manure management policy is animal density, expressed in terms of the number of animals per unit area of cropland. Animal density is increasingly being used in Europe (Sibbesen and Runge-Metzger, 1995) and in certain parts of the U.S. (Ribaudo et al., 2003). The strength of using animal density as a regulatory standard lies in its ability to provide a relatively straightforward indicator of a farm's nutrient balancing potential. By characterizing the relationship of animal numbers (and the manure they produce) to the available cropland area for manure utilization, animal density addresses the core movement of nutrients within the farm nutrient cycle (Beegle, 1994). Without adequate cropland on which to recycle manure nutrients, farms of all size have an increased potential for nutrient loss.

Having sufficient cropland for agronomic manure application rates is a key aspect of nutrient management planning. There is a direct relationship between a dairy farm's ability to grow feed for its herd and the farm's manure recycling potential. A survey of 98 representative dairy farms in Wisconsin (Powell et al., 2002) showed that farms having stocking rates of less than 0.70 animal units (AU = 454 kg animal) per hectare (or 1.7 acres per cow) are self-sufficient in forage and grain production, and therefore have adequate cropland area for recycling manure phosphorus (P). Approximately 50% of Wisconsin dairy farms are self-sufficient forage/grain, 68% produce 90% of their forage/grain and 80% produce 80% of their annual forage/grain requirement.

Another study of approximately 800 dairy farms showed that 95 percent of Wisconsin dairy farmers have sufficient cropland for recycling manure according to a N-based nutrient management standard (Figure 2). Calculating animal density based on just the tilled portion of total cropland area decreases this value to 79% of dairy farms   Implementation of a P-based standard reduces the overall amount of cropland available for manure application, and a large proportion of Wisconsin dairy farms (37% based on total cropland and 75% based on tilled cropland) would lack sufficient land area for recycling manure P. When the area of cropland on which manure is actually spread is used to calculate animal density, it is clear that the majority of farms do not currently meet either manure N- or P-based land application standards.

Figure 2. Distribution of Wisconsin dairy farm abilities to meet manure nitrogen and phosphorus standards based on cropland used for manure spreading (Saam et al., 2005).

Linkage Between Feeding Practices and Manure Nutrient Recycling

While the concept of using animal density as an indicator of nutrient balancing potential is fairly transparent, certain assumptions about feeding practices and the land base available for manure application need to be considered. For example, feeding practices can have a dramatic effect on manure P levels and the amount of land needed to recycle manure P (Powell et al., 2001). Research shows that excessive P feeding to dairy cows increases total and water-soluble P in manure and the amount of P in runoff after manure has been land-applied (Ebeling et al., 2002).

Over the past 2-3 years, many Wisconsin dairy farmers have reduced the dietary P content of their dairy cows' diet without sacrificing milk production, milk quality, or the herd's reproductive performance. Further reductions in dietary and therefore manure P can be attained by restricting the use of mineral P supplements, and encouraging the use of protein supplements that have a more favorable crude protein:P balance. The drawback to this approach may be cost. Since environmental improvements do not currently have direct economic benefits, it is continues to be rational for farmers to select protein supplements based on least cost, regardless of their P content.

Regional Differences in Manure Management

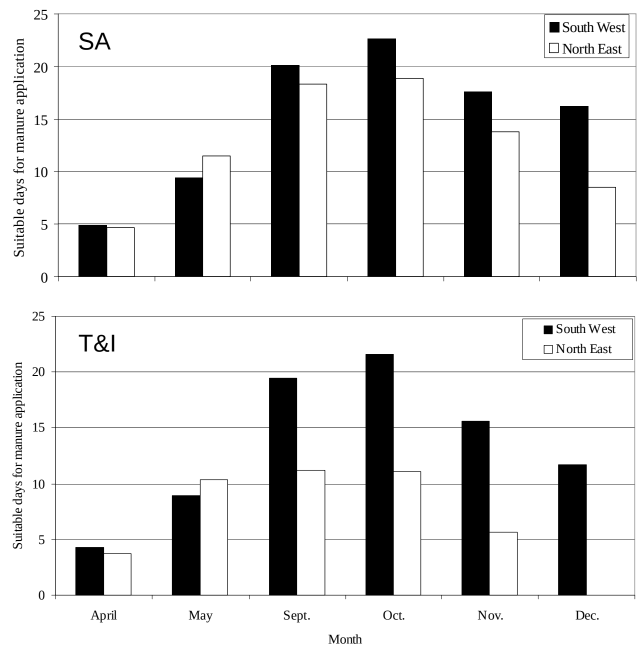
Although most Wisconsin dairy farms have sufficient cropland for spreading manure, there is a large "manure gap" between cropland areas available for manure application and the cropland area that actually receives manure (Figure 1), and this "manure gap" varies depending on the region of the state. For example, dairy farmers in the northeast spread manure on only

23% of their total operated cropland area versus 30% in the central and 44% in the southwest regions of the state (Saam et al., 2005). Farmers' inability to use a greater proportion of their cropland area for manure spreading may be due to various factors, such as (1) the presence or absence of manure storage facilities; (2) labor availability and machinery capacity for manure spreading; (3) the amount of manure actually collected, and therefore that needs to be spread on cropland; and (4) variations in the manure "spreading window", or days that manure can be spread given regional differences in weather and soil conditions. Manure spreading is also related to distances between where manure is produced and fields where manure is applied (Nowak et al., 1997) and to land ownership; as the percent of land owned increases so does percent of total cropland that receives manure (Saam et al., 2005).

The ability of farmers to utilize as much of their cropland as possible for manure application is likely to be crucial in complying with future state-wide nutrient management regulations. Inherent regional soil and climate differences may exist which hider farmers from one area in achieving this goal as readily as those in another region. In the study of manure spreading differences between the northeast (NE) and southwest (SW) regions of Wisconsin (Saam et al., 2005), it was postulated that regional differences in soil type and weather may affect manure spreading behavior. The SW region is characterized by silt loam soils of relatively high permeability and drier field conditions in the spring and fall. In contrast, the NE is characterized by more finely textured and less permeable clayey and red loam soils.

A recent analysis (McCrory et al., 2004) of the impact of regional differences in soil type and weather conditions on the number of suitable days for manure application via surface spreading and tillage and/or manure injection indicated that farmers in the SW may have approximately 28% more Fall days for surface application of manure and 60% more days available for tillage and injection operations than the NE region of the state (Figure 3). This may enable them to access greater portions of their cropland and more readily comply with manure management regulations than their NE counterparts. The major reason for differences was due to soil type, rather than weather.

Figure 3. Suitable days for manure surface application (SA), tillage and injection (T&I) for the southwest (SW) and northeast (NE) regions of Wisconsin (McCrory et al., 2004)



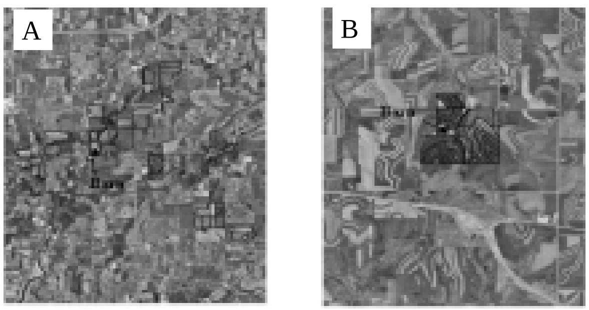
Spatial Arrangement Between Barns and Fields

The spatial arrangement between where the animals are housed (and where the manure is produced) and the location of fields can greatly affect manure management. Farmers apply manure more often to fields that are close to the barn, than to distant fields (Nowak et al., 1997), which are often rented land (Shepard, 2000). Spreading on distant fields may be very time and energy consuming, and hence not an economically viable option.

As dairy farmers expand herd size, access to close-by or contiguous rented land parcels is becoming increasingly difficult. This appears to be particularly true in the NE region of Wisconsin where farmers have greater difficulty than in other regions in finding access to close-by rented land parcels (Figure 4). Farmers in northeast Wisconsin spread manure on a much smaller fraction (23%) of their total cropland base than farmers in the southwest region of the state (44%; Saam et al., 2005).

Evidence from several on-farm follow-up visits suggest that farms in the NE are more likely than farms in other regions of the state to be renting fields that are more distant from the barn and more difficult to access without transporting manure on heavily traveled commuter roads. This could create additional disincentives for farmers in this region to spread on their rented cropland, compared to areas with lower development pressure. Policy can create incentives that promote closer linkages between crops and livestock. For example, manure contracts among crop and dairy farmers can reduce manure hauling distances. Such area-wide integration of crops and livestock is the most energy and nutrient efficient form of crop and livestock production (Stienfeld et al., 1997).

Figure 4.Fragmented dairy farm (A) in the northeast and consolidated farms (B) in the southwest region of Wisconsin



Conclusions

This report provided a brief synopsis of some biophysical and socio-economic factors that may not be appreciated fully in the formulation of policy aimed at improving manure management on Wisconsin dairy farms. The willingness and ability of policy makers to incorporate such information into workable manure management guidelines and regulations should be evaluated through discussion and negations involving research, extension, producers, agribusiness and policy communities. A few general conclusions from this synopsis can be drawn.

Current policy approaches do not fully consider the environmental implications of important manure management options, such as the balance between cow numbers and cropland available for manure land-spreading, optimal feeding, and farmer ability to collect and land-spread manure under the diverse biophysical and socioeconomic conditions they face. Being able to match livestock numbers with an adequate land base for manure application is an integral part of good nutrient management. It creates a balance between livestock numbers, the amount of forage and grain they need and the amount of manure produced, thereby reducing the need for off-farm feed purchases, manure exportation, and the overall likelihood of nutrient accumulation and loss. From a policy perspective, unlike water quality-based indicators that are difficult to measure and attribute to farm practices, animal density can be accurately assessed on each farm at low costs.

Animal density may provide a useful, and size-neutral indicator for targeting regulatory oversight in Wisconsin, and perhaps be an effective way to target limited cost-sharing monies toward high-density operations situated in landscapes that are at greatest risk for nutrient loss. These high-density operations will likely require the greatest assistance in adhering to nutrient management standards. An animal density standard would also provide a much-needed framework for planning dairy herd expansions.

Manure management issues on dairy farms that have small and medium herd size may require a particular focus. Given their close proximity to surface water and increasing animal densities and manure production, many of these operations may have to meet regulatory nutrient management standards. Although typical dairy herds in Wisconsin are too small to be considered a large CAFO (>700 mature dairy cows), many dairy farms in the state may be designated as a medium-sized CAFO (200-699 mature cows) if manure or waste water is directed towards surface water and/or animals come into contact with surface water, or a small CAFO (<200 mature cows) if they are found to be a significant contributor of pollutants to surface waters (USEPA, 2003).

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