ESTIMATING ENVIRONMENTAL RISKS OF NUTRIENT LOSSES FROM AGRICULTURAL AND URBAN SOURCES

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Because animal agriculture frequently is criticized as being a threat to ground and surface water quality via animal manures, it is appropriate to try to determine if the risk is the same as perception. For example in the case of nitrogen, what are the relative contributions of dairy cattle, other food animals, forage and food crop production, and other societal components to the nitrogen (N)load that might affect Florida's ground and surface waters? Similarly, other nutrients, mineral elements, and manure constituents may be of concern. This is a question we have wanted to try to address for some time but we have not yet assembled all of the information that we think is available, or estimable, from various sources. If dairy, poultry, or other livestock units are primary threats to water quality, that needs to be known. However, the steps already taken in managing manure on dairy farms, poultry farms, and other intensive livestock units have gone a long way toward achieving nutrient accountability on those farms. But the question remains, what are the relative nutrient loads coming from such sectors as:

1) different agricultural enterprises,
2) suburban and small landowner uses of fertilizer and from septic tanks,
3) governmental uses of fertilizer for right-of-ways, parks, etc.,
4) municipal loads from sewage treatment plant effluent, sewage sludge disposal, land fills, etc.,
5) various industrial components, and
6) others we have not yet considered.

Certainly data have not been accumulated to prorate risk accurately to various sectors such as those listed. However, several in IFAS made a few preliminary calculations that may be a helpful start. Professors from Departments of Animal Science, Dairy and Poultry Sciences, Agronomy, Soil and Water Science, and Horticultural Sciences contributed estimates of manure N available for fertilizer application and estimated applications of N to various crops to compare with data on fertilizer N sales recorded by the Florida Department of Agriculture and Consumer Services. Estimates of N excretion by humans are included for comparison along with an estimated quantity of sewage sludge recovered. An estimate of fertilizer equivalent N from dogs is also relevant. Those numbers are in Table 1. The fertilizer N equivalent from manures was estimated at 50% of the amount estimated in original excretions because half or more of the manure N (feces N plus urine N) usually is lost to the atmosphere as ammonia. The biggest losses come from urinary N which is in the form of urea (mammals) or uric acid (birds) and is rapidly converted to ammonia by urease enzyme from microorganisms throughout the environment. Under some conditions, losses may be less than 50% but often losses are more than 50%.

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TABLE 1. Estimated land application of fertilizer nitrogen from manures and commercial fertilizers in Florida.

Category	Number	Manure N fertilizer equivalent (lbs/animal/yr or life of bird)[1]	Total N for fertilizer (lbs)
Dairy cows	180,000	100	18,000,000
Dairy replacements	35,000	60	2,100,000
Beef cows and heifers	1,230,000	60	73,800,000
Poultry broilers	150,000,000	.06	9,000,000
Poultry layers	11,000,000	.65	7,150,000
Horses	300,000	60	18,000,000
MANURE FERTILIZER N			128,050,000
OTHER EXAMPLES			
Humans (80 g protein intake/day),	13,000,000	5.1	66,300,000
Sewage sludge, 220,000 tons DM/yr, 2.6% N; approx. 47 lb/ person/yr on municipal systems			11,440,000
Dogs (50 g protein intake/day)	2,000,000	3.2	6,400,000
Rainfall and lightning			Appreciable

Agricultural fertilizer uses	Acres	Estimated fertilizer (lbs N/acre)	Total fertilizer N (lbs)
Agronomic crops			
Corn for grain	100,000	210	21,000,000
Cotton	52,000	60	3,120,000
Pastures			
Bahia	2,000,000	25	50,000,000
Improved	1,000,000	50	50,000,000
Temporary annuals	1,000,000	100	100,000,000
Tobacco	7,500	80	600,000
Wheat	25,000	80	2,000,000
Citrus			
Young groves	400,000	100	40,000,000
Older groves	400,000	200	80,000,000
Vegetables	400,000	140	56,000,000
TOTAL ESTIMATED AGRICULTURAL FERTILIZER N USE			402,720,000
TOTAL COMMERCIAL FERTILIZER NITROGEN SALES (lbs actual N) (From 1992-93 Summary of Fertilizer Consumption in Florida Dept. of Agric. and Consumer Service Summary)			508,594,000

[1]Fertilizer N equivalent from manures is estimated to be 50% of total N excreted; it is assumed that half of N is lost to atmosphere as ammonia N.

The public sector should recognize that waste nutrient flows from human activities are similar to waste nutrient flows from farm animals but, in agriculture, sufficient land and crop production suitable for recycling those nutrients exist. Agricultural soils contain many natural systems for processing organic wastes and intestinal microbes, largely through soil microbes, insects, etc. And harvested plant production offers the only mechanism to recycle elemental nutrients economically. Unharvested wetlands, an important part of the total system, serve as a sink to vent nitrogen and other volatile compounds such as methane to the atmosphere but accumulated storage of minerals may someday become a problem.

The urban population may benefit from an assessment of the ability of agriculture to process urban wastes. That avenue has potential to reduce costs of processing urban wastes and, at the same time, give better environmental accountability. This already is happening, with some municipalities managing agricultural land or contracting with farmers to utilize treated wastewater (reclaimed water) and sewage sludge (residuals) monitored to be free of heavy metals. If most consumers really understood and evaluated what is done with their own waste stream of sewage and solid wastes and the costs of processing, they probably would be much more open to discussion with agricultural planners about how to create a system that better serves all of us. Thus, a more sustainable Florida could be created.

Sales of commercial fertilizer are recorded by the Florida Department of Agriculture and Consumer Services. Their record of fertilizer N sales for the 1992-93 year is in Table 1. The difference between the estimated agricultural fertilizer N use (402,720,000 pounds) and fertilizer N sales (508,594,000 pounds) could be considered a crude estimate of commercial fertilizer use by urban households, golf courses, highway right-of-ways, etc., etc., etc. Direct estimates of these uses are needed.

The value of commercial fertilizer nitrogen sales (e.g., 508,592,000 lb N × estimated value $.30/lb N = >$150,000,000/yr), most of it apparently associated with agricultural use of fertilizer, represents a market opportunity for urban taxpayers to recover the resource value in urban wastes if they can be processed to be a safe and effective fertilizer and offered at a price attractive to fertilizer users. This value also represents an opportunity to livestock producers if they are not making full use of potential fertilizer value of manures now. If livestock producers must transport excess nutrients from their farms, they will need to produce a marketable fertilizer product. If urban taxpayers and farmers can reduce their net expenses in processing wastes by marketing fertilizer products economically, all will benefit.

Byproduct Feedstuffs. An important point to include in environmental considerations for animal food producing units, particularly dairies, is the positive contribution that animals make in providing cost-effective disposal of many wastes from other food and fiber industries. For example, citrus pulp, cane molasses, cottonseed hulls, soybean hulls, wheat middlings, rice bran, hominy feed, corn gluten feed, grain screenings, distillers' grains from the drinking alcohol industry, distillers' grains from fuel ethanol production plants, brewers' grains, corn gluten feed, blood meal, fish meal, meat and bone meal, feather meal, cottonseed meal, peanut meal, canola meal, soybean meal, yellow grease, tallow, and animal-vegetable mixed fats all are byproducts that some other industry at one time had to dispose of as waste products. These feedstuffs

probably contribute about half of the nutrients that lactating dairy cows in Florida consume. Forages produced in Florida, often with the required fertilizer coming from recycled manure nutrients, probably provide about 35% of the nutrients for lactating cows. Dairies and many other food animal producing units should earn "environmental credits" for providing environmentally sound, and sometimes profitable, waste disposal for many other industries. Additionally, these units are required to recycle the manure produced. Thus, dairy farms and other food animal production farms usually have a positive effect, environmentally, on statewide nutrient cycling rather than negative as many perceive.

How important is it for dairymen and all farmers to create a partnership with the public sector to participate in creating a sustainable Florida? It is more important to consider how agriculture can help Florida be sustainable than it is to worry about a sustainable agriculture. Perhaps we have an opportunity to plan educational programs that will help the public sector participate in an appraisal of the bigger picture regarding the statewide N budget and budgets for other critical elements. What information is needed for objective discussion of these issues? Where do N or critical element sources that contribute to the total originate? Where is there potential to recycle the excess in one area? What is the outline of sources that need to be recognized? Here is a start:

1. Agriculture

   A. Livestock manures

      Dairy cattle
      Beef cattle
      Poultry
      Swine
      Horses
      Others

   B. Field crop fertilization

      Corn
      Cotton
      Hay-Pasture
      Sugarcane
      Wheat
      Peanuts
      Soybeans
      Tobacco

   C. Horticultural crop fertilization

      Citrus
      Vegetables
      Pecans
      Ornamental nurseries
      Sod farms (turf)

   D. Forests

2. Small land owner and suburban fertilization

   Homeowner
   Golf course
   Septic tank loads
   Pets and companion animals
   Lawn trash
   Other solid wastes

3. Governmental uses

   Highway right-of-ways
   Parks and playing fields
   Other?

4. Municipal

   Sewage treatment plant incoming nutrient loads
   Sewage treatment plant effluent loads
   Sewage sludge disposition
   Solid wastes, e.g., materials now going to landfills
   Auto emissions

5. Industrial

   Manufacturing Plants
   Other?

6. Others?

   Natural systems such as mineralization of much soils or from organic soils in swamps.

What is missing? If you have suggestions or data send them to:

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We will appreciate your help and input as we expect to keep revising and updating this document as we get more information.