MANURE MANAGEMENT POLICY ISSUES[1]

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INTRODUCTION

Traditionally nutrient management has been concerned with optimizing the economic return from nutrients used to produce a crop. The main emphasis was on the expected crop response from adding nutrients. In practice however, manure is not always applied to optimize plant nutrient use. Historically, a common practice has been to apply commercial fertilizer without giving credit for nutrients already applied in manure. Applying manure in excess of plant needs, or at the wrong time, or handling it improperly may release nutrients into air and water, where they no longer contribute to the production of the crop. These same concerns are still important but in addition to these economic and agronomic concerns, we now must face concerns about the impact of these nutrients on environmental quality. Leaching of N through the soil can raise groundwater nitrate levels above the EPA drinking water limit, which can adversely affect the health of young children and livestock. Surface movement of N and P in runoff increases levels of these nutrients in surface waters which can lead to eutrophication and fish kills.

The problems that we have with nutrient pollution however are not generally the result of mismanagement by farmers but are a result of how our agricultural systems have evolved with no direct costs associated with environmental quality. For example, the field-based economic and agronomic incentives that can be effective incentives to manage nutrients on a cash-crop or nutrient deficit livestock farm, and that will also minimize negative environmental impacts, are not as significant on the intensive livestock production-oriented farm that is becoming more common today. Data from dairy farms in the northeastern US shows that as dairy herd size increases the purchased feed costs for the farm increase and the cropland acres per cow decreases (Figure 1).

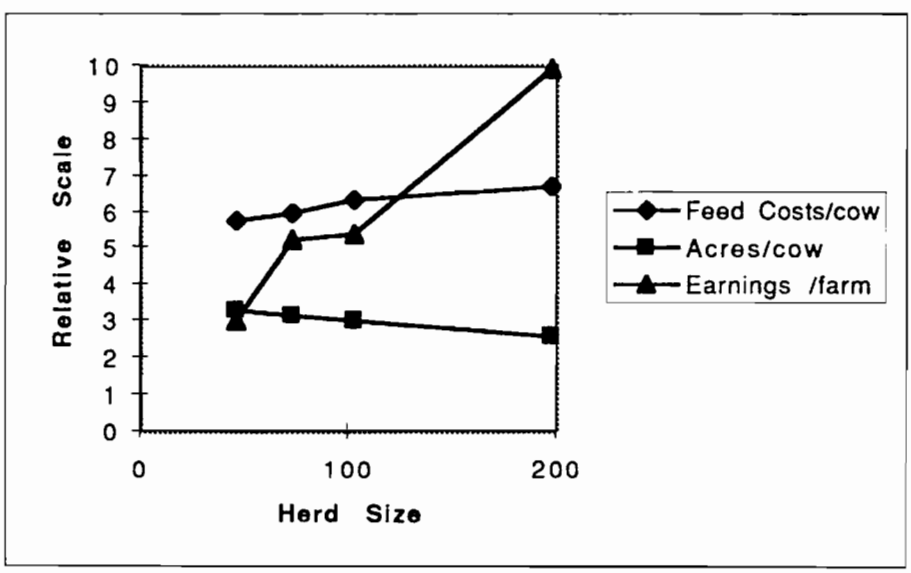

Figure 1. Trends in AgriFax dairy farm benchmarks for northeast US for 1991

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This raises a nutrient management concern because there is more feed imported onto these farms but fewer acres on which to spread the resulting increase in manure nutrients. This can result in nutrient imbalances and pollution. However, the driving force for this trend is the dramatic increase in net earnings per farm which do not include environmental costs. Thus, managing nutrients to address these additional environmental concerns is not a matter of eliminating bad management because most of these farmers would be considered good managers based on the economics parameters. Non-point source nutrient pollution from farms is not the real problem, but rather, it is a symptom of a more fundamental problem in agriculture. Solving these problems will mean changes in our agricultural systems well beyond on-farm management changes. To meet this challenge will require innovative policy and management approaches.

THE NUTRIENT MANAGEMENT PROCESS

Nutrient management generally involves decision-making about a wide range of farm operations. The decisions in this process are made as frequently as several times a day to as seldomly as once every five years or more. Decisions may deal with the day-to-day details of farm operations, such as spreading manure on a specific field on a particular day, or deal with the long-range future of an entire farm, such as the decision to build a manure storage. Nutrient management is an ongoing farm process with several key activities

An initial assessment of the farm and the potential environmental impacts of the existing farm operations is an effective starting place in many situations. In the assessment the approximate nutrient balance of individual fields, groups of fields that are treated similarly, or even the whole farm can be determined depending on the purpose of the assessment. The outcome of the assessment can be used to determine what options should be considered for farm nutrient management to protect the environment while producing crops and animals. The nutrient management options can be specific practices, such as incorporating field-applied manure soon after application, identifying other landowners who may be interested in having manure spread on their fields, or more far-reaching possibilities, such as postponing a planned expansion of the livestock housing facilities on the farm. The assessment and the options selected can be the basis for many decisions that will be made in the development of a farm nutrient management plan to allocate the manure and to determine any supplemental fertilizer requirements. Implementation of a nutrient management plan involves both the actual activities called for in the plan plus the appropriate recording of those activities so that the effectiveness of plan implementation can be assessed. The success of the management plan can be evaluated in a repeat of the assessment.

NUTRIENT MANAGEMENT DECISION MAKING

Decision making related to nutrient management occurs at the strategic, tactical and operational levels of management (Table 1). Management changes will need to be addressed at each of these levels. At the strategic level management decisions are made by the top management of the farm regarding long term goals and strategies for the operation. Examples of strategic decisions include: whether to expand the livestock operations or not; or whether to acquire more land or reduce livestock numbers to achieve nutrient balance on the farm. A very broad cross-section of information is used at this level of decision making. Most of the input for strategic decision making comes from outside of the farm operation. Information on markets for expanded production, availability of labor, or regulations regarding nutrient management would be examples of the type of information used in making strategic decisions.

At the tactical level, the emphasis is on implementation of the strategic goals. The time-frame for tactical decision making is usually from a few months to a few years and deals primarily with site specific information about the operation. The most common example of this level of management is the farm nutrient management plan, in which specific nutrient allocation decisions are made for the farm. This is the management level where most of the emphasis has been place in

Table 1. General description of various management levels.

Management Level	Description of Management Level
Strategic	Top management focuses on the goals of production using external information to make decisions for the future.
Tactical	Middle management develops implementation plans for annual or multiple year periods to allocate the available resources for meeting the strategic goals.
Operational	Supervisors and staff implement tactical management plans through daily to annual activities by using internal resources based on historically successful actions.

From: L. E. Lanyon. 1995. A Nutrient Management Approach for Pennsylvania: Exploring Performance Criteria. Agronomy Facts # 38D. College of Agricultural Sciences, Penn State University, University Park, PA 16802

the programs related to nutrient management for environmental quality. It must be recognized however, that unless this tactical management is guided by appropriate strategic goals, the desired performance in terms of environmental quality will not be achieved. For example, unless the strategic decision has been made to achieve nutrient balance on a high density livestock farm by reducing animal density or removing excess manure from the farm, repeated refinements in the tactical manure allocation plan will not result in an environmentally acceptable nutrient balance on the farm.

The final level of management is the operational level. This is where the tactical plan is actually implemented and decisions are made about specific tasks to be performed by the farm labor. This type of decision making is generally short term and requires in addition to a tactical plan, timely, very specific information such as weather forecasts, soil conditions and availability of labor and equipment.

If we are to be successful in addressing nutrient management issues we must work at each of these different levels of decision making. We must resist the urge to go directly to working at the tactical and operational level where we are much more comfortable before we have addressed the strategic issues of the problem. Also, it is important to remember that on many farms all of these distinct levels of management may reside within one person, the farmer. Thus, not only must those of us who work with farmers recognize the importance of these different levels of management, but the farmer themselves must also realize these differences.

APPROACHES TO NUTRIENT MANAGEMENT

The motivations for farmers to changes their practices are many. The reasons may be economical, social , or moral to name a few. As society demands more and more accountability from farmers there will also likely be regulatory motivations provided. There are two approaches to environmental regulation. One approach is to specify what should be done on all farms as a recipe for nutrient management. Lists of required standard practices (BMP's) such as specifying specific times, rates and methods of manure application for all farmers is an example of this approach. Although this approach is relatively simple to administer, it does not accommodate specific conditions of particular farming operations or the nature, interests, abilities, or local conditions of individual farmers. Neither does this approach address needed changes in the current structure of farming. Closely specifying particular farming practices can also limit innovation by farmers and farm advisors in finding ways to deal with new requirements for crop production and

environmental protection. Most innovation in this approach is focused on how to circumvent the standard requirements while technically complying with the regulations. Finally there is no direct linkage between the required practices and the desired environmental outcome.

Another approach to farm nutrient management is to establish performance criteria or goals for farmers to meet as part of their farm management. Performance criteria are outcomes to be achieved through nutrient management, such as meeting a discharge standard, achieving nutrient balance for the farm fields or maintaining soil tests below a certain level. This approach is that used in the Netherlands. In the Netherlands N and P applications to grassland in excess of outputs will be limited in 1998 to 300 kg/ha nitrate and 40 kg/ha phosphate. This performance objective is to be gradually reduced to the final goal of 180 kg/ha nitrate and 20 kg/ha phosphate by the year 2010. In the Dutch case, fines are levied for failure to meet the performance standard. Performance criteria are not lists of specific practices or BMP's that all farmers must follow, but rather they are goals that are established and farmers and their advisors are given the freedom to develop and implement a plan integrating any practices or BMP's that are appropriate. There would be no official list of standard BMP's but rather an extensive list of BMP's and assistance made available to the farmer. Carefully established outcomes can promote solutions to meet the environmental challenges faced by farmers based on local conditions while stimulating innovation at the same time. Clearly defined, measurable outcomes, or performance objectives are essential to this approach to nutrient management.

NITROGEN VS PHOSPHORUS PERFORMANCE CRITERIA

A major issue in manure management policy is whether performance criteria should be based on nitrogen or phosphorus. Both nitrogen and phosphorus can have a negative impact on water quality. A major concern with nitrogen is nitrate contamination of ground water by leaching of nitrate from the soil. High nitrate nitrogen in groundwater can have adverse health effects. The most practical methods of minimizing nitrate leaching from cropland are to balance rates as close to crop removal as possible and timing nitrogen applications to avoid times when loss potentials are high.

The major concern with phosphorus is eutrophication of surface waters. Biological activity of many surface water bodies is phosphorus limited. When phosphorus inputs are increased, algal and other plant growth is stimulated. The resulting eutrophication restricts the use of surface waters for aesthetics, fisheries, recreation, industry and drinking water. Because phosphorus movement within the soil is limited the major pathway for phosphorus loss is by surface runoff and soil erosion. Management practices to limit phosphorus loss focus on reducing soil erosion and runoff. Until recently, it was commonly assumed that phosphorus losses could be controlled solely by reducing erosion. However, runoff has been found to contribute significantly to highly bioavailable soluble phosphorus losses. This is especially true where conservation tillage systems are used for erosion control. Conservation tillage systems preclude deep incorporation of manure thus high nutrient levels develop near the soil surface. This means that runoff water is in intimate contact with highly nutrient enriched soil resulting in potentially high soluble phosphorus concentrations in the runoff water.

The controversy over nitrogen vs phosphorus performance criteria is based on difference between N:P ratio of manure and the ratio of N:P requirement of the crops it is applied to on the and fact that the nitrogen and phosphorus in the manure cannot be separated. Animal manures typically have an N:P ratio around 4:1 while crop requirements have and N:P ratio around 8:1. This means that if manure application rates are based on achieving a balance between the nitrogen applied in the manure and the nitrogen requirement of the crops excess phosphorus will be applied. While this may not be an agronomic concern, it raises an environmental concern with the fate of this excess phosphorus. If manure application rates are based on achieving a balance between the phosphorus applied in the manure and the phosphorus requirement of the crop twice as many acres

will be required for manure application and purchase of nitrogen fertilizer will be necessary to meet the needs of the crops. Many intensive animal production operations have less and less acreage per animal (Figure 1) and consequently a major practical problem is having enough acreage to properly utilize the manure even on a nitrogen basis let alone if they want to base their application rates on phosphorus. Basing manure application rates on phosphorus will often carry a significant cost to the operation for excess manure disposal off-farm and the expense of purchasing supplemental nitrogen.

In most states manure application guidelines and regulations are based on balancing nitrogen. This is driven by the practical and economic reasons discussed above and on the assumption that best management practices can be developed and implemented which will minimize phosphorus losses to surface water even when excess rates of manure phosphorus are applied. It is likely that some compromise will be necessary on this issue. Current thinking recognizes that not all areas on a landscape contribute equally to phosphorus losses. The emphasis is on identifying the critical source areas for phosphorus loss to surface waters and then applying application limitations and/or BMPs to those critical areas while allowing flexibility to apply manure based on nitrogen in non-critical areas. This would appear to be a much more rational approach to addressing the environmental concerns with phosphorus in an economically practical way than proposals to simply limit manure application across the board based on phosphorus.

IMPLEMENTING NUTRIENT MANAGEMENT POLICY

Successful implementation of nutrient management policy will involve full participation of a broad range of stakeholders. Key stakeholders include the farmers, allied ag-industry, allied public agencies, policy makers, regulators, environmental groups, and the consuming public. The public needs to be involved with the policy makers to establish the performance criteria. The farmers and allied groups need to work to assure that this be done in a fully informed manner and that all of the implications of a policy are clear. For example, the public must realize that a nutrient management policy may increase food prices or increase taxes if subsidies are to be used to maintain low food prices. Regardless of the approach, the cost of achieving the objectives must be clear to all.

Once reasonable and achievable performance objectives are set, the same group of stakeholders must be part of the implementation process. The traditional approach is that once policy is set, it is passed on to the regulators to establish a command process to impose the policy on the regulated community usually through a government agency. The new paradigm of involving all stakeholders in establishing agreed upon performance objectives and continuing this involvement into the implementation phase has a much greater probability of achieving the objectives than the traditional approach. In the traditional approach a nutrient management plan would be written by a government agency and given to the farmer with orders to implement the plan under penalty of law. In the new approach regulators would provide the regulated community with a clear representation of the agreed upon performance criteria and then support the development of a plan to achieve the objectives using the established public and private agricultural infrastructure. The regulators role becomes one of assisting with compliance rather than enforcing compliance. For example farmers could work with their normal advisors whether they be public agencies such as cooperative extension or private ag-dealers or consultants to develop a plan to meet the performance objectives. A plan developed in this way through traditional relationships is much more likely to be implemented and achieve the objectives than a plan handed down from a regulator.

Nutrient management problems are not simply a matter of on-farm mismanagement of nutrients. Rather they are a consequence of the evolving structure of our modern agricultural systems. Addressing this challenge will require innovative policy and management approaches.

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