Nutrient Management Planning

A field-based nutrient management plan (NMP) is an integral component of a comprehensive nutrient management plan (CNMP). Development of a NMP requires integration of knowledge about soils, cropping systems, crop nutrient needs, nutrient sources, and field risk assessment. In this fact sheet we outline the NMP development process.

The Basic Planning Flow

The planning process begins by collecting information on manure, soil and crops as well as field risk factors (Figure 1). The information is used to calculate crop nutrient requirements, assess risk of nutrient loss and determine rate, timing, method and location of manure and fertilizer applications.

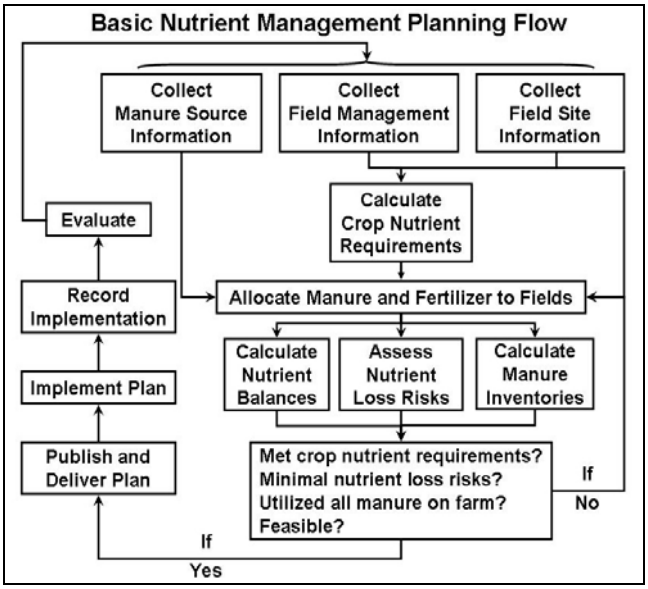

Figure 1: The Nutrient Management Planning flow.

Given complexities and the need for integration of a lot of information, software is often used for nutrient management planning. One program, Cornell Cropware (nmsp.css.cornell.edu/software/cropware.asp) can be downloaded and used free of charge. In some cases, farmers can prepare their own NMP, or they can obtain services from public or private sector planners.

Information Needed

Nutrient Sources

The NMP calls for nutrient analysis and quantification of all organic materials that will be land-applied. Nutrient analyses should be done at least once per year (twice in the first six months if no prior records exist). The analysis should include total N, ammonium-N, total P, total K, density and percent solids. Land application should be based on a running (multiple-year) average.

Quantity can be determined using past spreading records or by estimating manure produced based on animal type, size, and production level. Rainfall and other nutrient sources such as bedding, milk-house waste, and spoiled silage should be included in the quantity estimate. Accurate quantification of manure and other nutrient sources is needed to match nutrient supply, storage capacity, and cropland available for land application.

Field Management

Crop rotation and past manure applications influence nutrient needs. Accurately assessing nutrient needs requires information on the previous three years of field management in addition to current year crop and manure application. For example, the N need of first year corn following alfalfa-grass sods is limited to a small amount of N in the starter fertilizer (Agronomy Fact Sheet #21). Manure N is available over a three year period, so past applications need to be accounted for in the NMP.

Flooding frequency, artificial drainage, and soil type need to be documented for each field. Flooding frequency is important to determine environmental risk; the soil type and presence of tile drainage systems should be noted for each field because it impacts yield potential and nutrient requirements. Collecting this information requires an accurate map with field names.

Field Site

Although some information can be taken from maps, field visits are needed to take soil

samples (see Agronomy Fact Sheet #1) and determine slope, slope length, concentrated flows, flow distance to the nearest stream, locations of wells or other critical areas, and manure application setbacks.

Calculate Crop Nutrient Requirements

Nutrient and lime requirements are derived from soil test data (for P, K and lime) or yield potentials, soil type, drainage, crop rotation and manure application history (for N) as outlined in the N, P, K and lime guidelines for field crops in New York State (nmsp.css.cornell.edu/nutrient_guidelines).

Allocate Manure + Fertilizer

Once N, P, and K needs are known, manure and fertilizer applications can be initially planned (time, rate, method of application) to meet crop needs. All fields need to be balanced for N within 20 lbs/acre of the crop N need. Balancing for N either partially or fully with manure may result in extra P and K for that crop year. Fields with elevated risk of P runoff are identified with the P Index and manure application plans are adjusted to limit or eliminate P application to those fields (see below). Manure recommendations may also be reduced on fields used for growing low-K, dry cow forage. In such cases, supplemental N fertilizer can be substituted to balance for N.

Assess Field Specific Loss Risks

The Nitrate Leaching Index (N Index) is calculated based on the historical rainfall for the field location (township) and soil type. Best management practices, such as cover crops, are planned for fields with an N Index of 10 or greater. The N Index rating cannot be changed; it is a guide to indicate if best management practices should be implemented.

The P Index integrates information about P sources (soil, manure, fertilizer) and transport risk (driven by drainage class, flow distance, stream type, erosion rate, flooding frequency, and concentrated flow).

Adjust Manure and Fertilizer Allocations

The final P Index rating can require elimination of all P applications (P Index of 100 or greater), limit P application to no more than crop P removal (P Index of 75-99), or allow for N-based applications (P Index less than 75). Adjustments in timing, rate and method of manure application may need to be made if the initial plan for manure and fertilizer results in P Indices of 100 or greater. The goal in this part of the process is to lower P Index scores and adjust manure and fertilizer practices to minimize N and P losses while still meeting crop nutrient needs. This is a time-consuming process; even experienced planners generate multiple allocation scenarios and fine-tune allocations before the final plan is delivered.

Implementation, Record Keeping

Often, the planner and farmer develop quick reference tables, notebooks and/or maps to communicate the location, timing, rate, and method of manure and/or fertilizer application. Record keeping tools that track fertilizer and manure application are essential for plan implementation and future planning.

Annual Updates

Plans need to be updated annually to reflect changes in land base, animal numbers, rotations, as well as previous implementation challenges and successes.

Additional Resources

- Cornell University Agronomy Fact Sheet #1 (Soil Sampling for Field Crops), #18 (Manure Spreader Calibration), and #21 (N Needs for First Year Corn): nmsp.css.cornell.edu/publications/factsheets.asp.
- New York Phosphorus Runoff Index webpage: nmsp.css.cornell.edu/publications/pindex.asp.
- New York Nitrate Leaching Index webpage: nmsp.css.cornell.edu/publications/nleachingindex.asp.
- Nutrient/Lime Guidelines for Field Crops in New York: http://nmsp.css.cornell.edu/nutrient_guidelines/
- Cropware: A tool for nutrient management planning: nmsp.css.cornell.edu/software/cropware.asp.
- Nitrogen management for dairy farms website: www.dairyn.cornell.edu/.

Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

Cornell University
Cooperative Extension

Nutrient Management Spear Program
http://nmsp.css.cornell.edu

Patty Ristow, Quirine Ketterings, Karl Czymmek, Greg Albrecht

2007