



# Adaptive Nutrient Management Process

Although land grant university (LGU) guidelines are a good first step in determining manure and fertilizer application rates for field crops, there is both the need and the opportunity to refine management of nutrients on a field or sub-field basis over time. Adaptive nutrient management (ANM) is a process where farmers can test input response and adjust field management over time. The ANM process is based on a recognition that optimizing both yield and input levels will help maximize return per acre and minimize the overall environmental footprint of crop production. This is a very useful concept for all farms, but especially for those that want to optimize yield and that need to comply (e.g. CAFO's in New York and other states) with the Natural Resources Conservation Service (NRCS)-590 Nutrient Management Standard. The process promotes ongoing refinement of nutrient application emphasizing the use of "the right nutrients, at the right rate, timing, and placement" to minimize nutrient losses to the environment (4Rs). The ANM process requires the use of assessment tools (measurements) combined with learning and adapting management over time. In this factsheet we introduce the NRCS definition of ANM and outline key elements of the process.

## NRCS Definition

It is recognized that nutrient applications and other field operations conducted in appropriate areas of fields for the purpose of planned and documented research trials may vary from the requirements of the NRCS-590 Nutrient Management Standard.

"Adaptive nutrient management is a process used to evaluate and adjust nutrient application and utilization strategies over time (multiple seasons). The process allows for continued adjustments of the NRCS-assisted Conservation Practice Standard (CPS) Code 590, Nutrient Management, to achieve better nutrient use efficiency. Adaptive nutrient management promotes the coordination of amount (rate), source, timing, and placement

(method of application) of plant nutrients to minimize nutrient losses. State-approved adaptive nutrient management activities are considered in compliance with the operation and maintenance requirements of the CPS Code 590, Nutrient Management, and step 9 (plan evaluation) of Title 180, National Planning Procedures Handbook (NPPH), Part 600 (Subpart A, Section 600.11)." (NRCS Technical Note #6; See Additional Resources).

## Five Basic Steps

The ANM process includes five basic steps:

1. Characterize the current condition.
2. Develop a plan for evaluation of an alternative practice.
3. Implement a comparison of the current practice and a management change.
4. Evaluate results, learn and identify potential management changes.
5. Adjust management based on lessons learned.

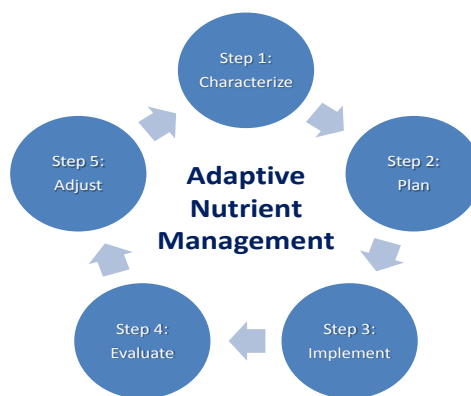


Figure 1: The adaptive nutrient management process has five major steps.

## Step 1: Characterize the current status

Current farm management and conditions are the starting point for ANM. For example, if ANM is applied to a nutrient management decision, the starting point relates to farm's current application rates, methods and timing of various nutrient sources. Annual mass balance assessments (see Agronomy Factsheet #25) can be used to monitor progress in nutrient use efficiency at the whole farm level.

## Step 2: Develop a plan for evaluation

In this step, a solid research question needs to be developed. This is where management alternatives are discussed and 2-3 comparisons are selected for evaluation; for example, a comparison of different starter N rates, or a comparison of manure application methods. The exact comparison needs to be decided (rates, timing, sources etc.) and a design for the comparison needs to be developed. It is important that the different treatments are replicated within the field (at least 4 times) and that within each replication, each treatment is randomly assigned. See Agronomy Factsheet #68 for more details on setting up practical on-farm trials. It is also important to decide what to measure. In addition to yield and dry matter, regular soil, tissue or forage quality tests may be advisable. Other potential measurements include the corn stalk nitrate test (CSNT) and Illinois soil nitrogen test (ISNT).

## Step 3: Implement a comparison

Before an on-farm trial is implemented, it is important to decide trial location(s). Practical considerations that affect suitability are distance to farm scales, size, field uniformity, management history, and nutrient status. For example, to test 2-3 different P fertilizers for their impact on yield a low P field should be used as high P fields will not respond to extra P no matter what the source is. Keep good records as the season goes along as records will be needed to try to learn from the results.

## Step 4: Evaluate and learn from results

The review of the data is to evaluate how well the alternative practice worked, and to make adjustments as needed to improve nutrient use efficiency and reduce nutrient losses in future years. For replicated on-farm trials, rely on university staff to help with statistical analyses. Trials are important for individual farmers, but there is great advantage of being part of a larger group of farmers who all conducted similar trials. The latter has the advantage of discussing results as a group, the data can be used to improve Land Grant University guidelines, and with a larger number of trials, we can build confidence in the results much quicker. Keep in mind that often multiple years of data are needed for a reliable answer so the same research should be repeated until the farmers are comfortable with the results under varying conditions.

## Step 5: Adjust management

Once the farmer is confident that a management alternative is improving the farm's profitability, productivity, and/or environmental stewardship, it is time to implement the new management. In addition to an individual practice evaluation, a whole farm nutrient balance (see Agronomy Factsheet #25) can show the impact of the management change on the farm's nutrient use efficiency while also allowing for tracking of milk production and other farm productivity indicators.

### In Summary

Adaptive nutrient management is a process that allows farmers to adjust management over time while still complying with the NRCS-590 Nutrient Management Standard. A successful ANM process requires careful planning and multiple years of investment but can lead to great improvements in nutrient use efficiency over time.

### Additional Resources

- Nutrient Management Spear Program Agronomy Fact Sheet Series: [nmsp.cals.cornell.edu/index.html](http://nmsp.cals.cornell.edu/index.html).
- New York On-Farm Research Partnership: [nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/](http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/).
- USDA-NRCS New York State 590 Standard: [ftp://ftp-fc.sc.egov.usda.gov/NY/eFOTG/Section\\_4/Practice\\_Standards/nyps590.pdf](http://ftp-fc.sc.egov.usda.gov/NY/eFOTG/Section_4/Practice_Standards/nyps590.pdf).
- USDA-NRCS Agronomy Technical Note #6: [directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=30618.wba](http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=30618.wba) (Adaptive nutrient management).

### 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



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