Whole Farm Nutrient Management - A Dairy Example

by Joe Harrison and Rebecca White
Washington State University

Disclaimer
This fact sheet reflects the best available information on the topic as of the publication date.
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This project is affiliated with the LPELC www.lpelc.

USDA United States Department of Agriculture

NRCS Natural Resources Conservation Service

Introduction

This fact sheet has been developed to support the implementation of the Natural Resources Conservation Service Feed Management 592 Practice Standard. The Feed Management 592 Practice Standard was adopted by NRCS in 2003 as another tool to assist with addressing resource concerns on livestock and poultry operations. Feed management can assist with reducing the import of nutrients to the farm and reduce the excretion of nutrients in manure.

Introduction to Whole Farm Nutrient Management

Whole farm nutrient management (WFNM) includes the consideration of import of nutrients to the farm, movement and transformation (including losses) of nutrients within the farm operation, and export of milk, meat, crops, or manure.

In order to understand WFNM, it is necessary to consider all sources of nutrients, their movement within the farm, and how they might move to the environment. On most dairies, feed represents the largest import of nutrients, with fertilizer as the second largest import of nutrients. Feed Management practices currently exist to reduce imports of nutrients (particularly nitrogen and phosphorus) or decrease their excretion. Many of these specific practices and management considerations will be outlined in two assessment tools (see fact sheets- Opportunity Checklist and Feed Management Plan Checklist) as part of the implementation process of the Feed Management 592 Practice Standard.

Nutrient Utilization by the Dairy Cow

Nitrogen (N) is used for milk production in the dairy cow with an efficiency of ~ 25 to 35%. The remaining 65 to 75% of nitrogen consumed by the dairy cow remains in the initial manure (feces and urine). However, N is lost to the atmosphere via volatilization.

Phosphorus utilization by species varies from approximately 20 to 50%. The 50 to 80% not utilized is excreted in manure. A dairy cow uses approximately 27% of dietary P for milk production and thus approximately 73% of dietary P is not exported as milk from the farm.

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Whole Farm Nutrient Balance

The goal of whole farm nutrient management is to achieve "zero farm balance" through the adoption of a variety of management practices, including Feed Management (see Figure 1). The practices and the relative positive or negative balance (balance = anything that remains or is left over) will be unique to each farm.

It is important to acknowledge that due to biological processes, there will be losses to the environment even when all the best management practices are adopted. Therefore, "zero balance" is difficult to achieve while maintaining high crop productivity.

The concept of Whole Farm Nutrient Balance has been described in different ways progressing from simple to more complex approaches. First, consider various approaches using nitrogen as the nutrient of interest.

1st Approach -The first approach is to estimate Mass-Balance uses the concepts of import and export of managed resources (see figure 2) at the farm boundary. This approach measures only those nutrients that cross the boundary of the farm and does not directly track nutrients flows within the farm or nutrient losses from the farm. The difference between inputs and managed outputs can be used to calculate a positive or negative balance. This positive balance represents nutrients that will be lost to the environment by both air and water pathways as well as those nutrients that accumulate on the farm (e.g. increased soil nitrogen levels). The positive balance provides an estimate of environmental risk.

2nd Approach - The second approach takes into consideration the import-export of nutrients as well as losses due to volatilization of nitrogen from manure during collection, handling, storage, and application (see figure 3). This approach would include the Mass-Balance approach, plus estimates of volatile nitrogen losses. This approach is commonly used for development of Nutrient Management Plans (NMP) and Comprehensive Nutrient Management Plans (CNMP) in many states.

3rd Approach - The third approach takes into consideration the losses of volatile nitrogen as well as leached nitrogen (see figure 4). This approach is also common to NMPs and CNMPs when leaching index tools and soil nitrogen indices are utilized in NM planning.

In contrast to nitrogen, phosphorus (P) is not lost to the atmosphere and therefore, what is not exported from the farm remains within the farmstead or possibly lost due to transport. Thus, the 1st approach (mass-balance) and 3rd approach (mass-balance plus surface and leaching loss) are the approaches that are more common for P based nutrient management planning.

Checklist Tools

The "Opportunity Checklist and Feed Management Plan Checklist" summarize the common Feed Management practices that can be adopted to assist with reducing the import of nutrients to the farm in the form of feedstuffs or reduce the excretion of nutrients in manure (see Figure 4). The opportunity checklist includes Feed Management practices or concepts that usually have the greatest initial impact. These include but are not limited to:

1) formulation of diets to meet animal requirements,

2) grouping animals according to nutrient needs,

3) determining dry matter routinely and adjusting rations accordingly, and

4) analyzing diet ingredients routinely.

Additional Feed Management practices and strategies that can further assist with reducing the importation of nutrients to the farm are outlined in the Feed Management Plan Checklist.

Spreadsheet Based Whole Farm Nutrient Management Tools

Several spreadsheet based tools are available to estimate the nutrient balance at the whole farm level. The name of these tools and where a copy can be obtained are:

1. Whole Farm Balance Nutrient Education Tool – Washington State University

http://www.puyallup.wsu.edu/dairy/joeharrison/software.asp

2. Whole Farm Nutrient Balance – University of Nebraska

http://cnmp.unl.edu/cnmpsoftware2.html#WholeFarmNutrientBalance

3. Whole Farm Nutrient Balance Spreadsheet – Cornell

http://nmsp.css.cornell.edu/projects/massbalance.asp

Summary

Whole farm nutrient management should include the consideration of import of nutrients to the farm, movement and transformation (including losses) of nutrients within the farm operation, and export of milk, meat, crops, or manure.

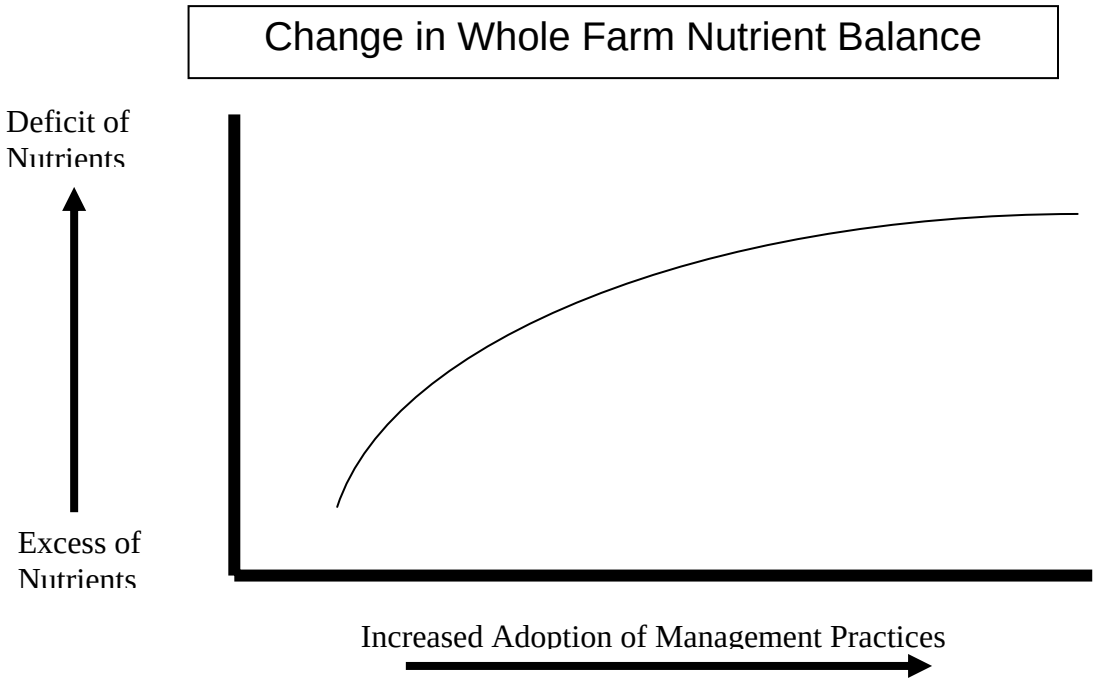

Figure 1. Change in Whole Farm Nutrient Balance with increased adoption of management practices.

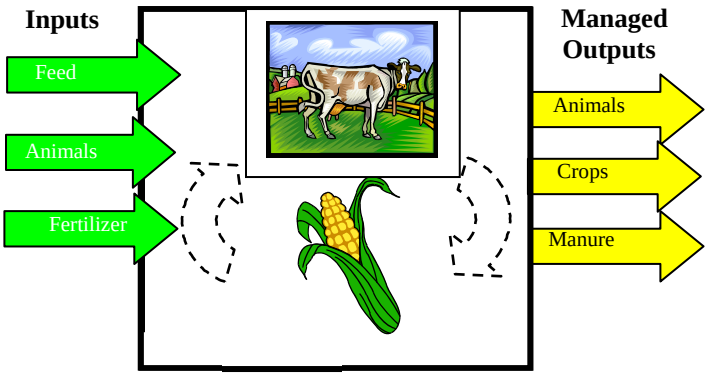

Figure 2. Major imports and exports to the farm.

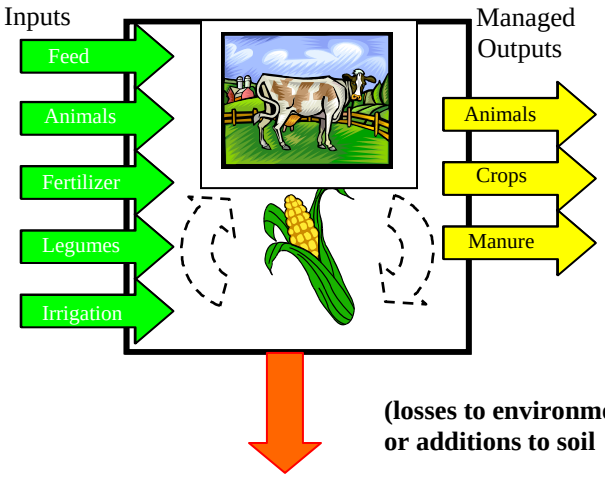

Figure 3. Major imports and exports to the farm with losses noted.

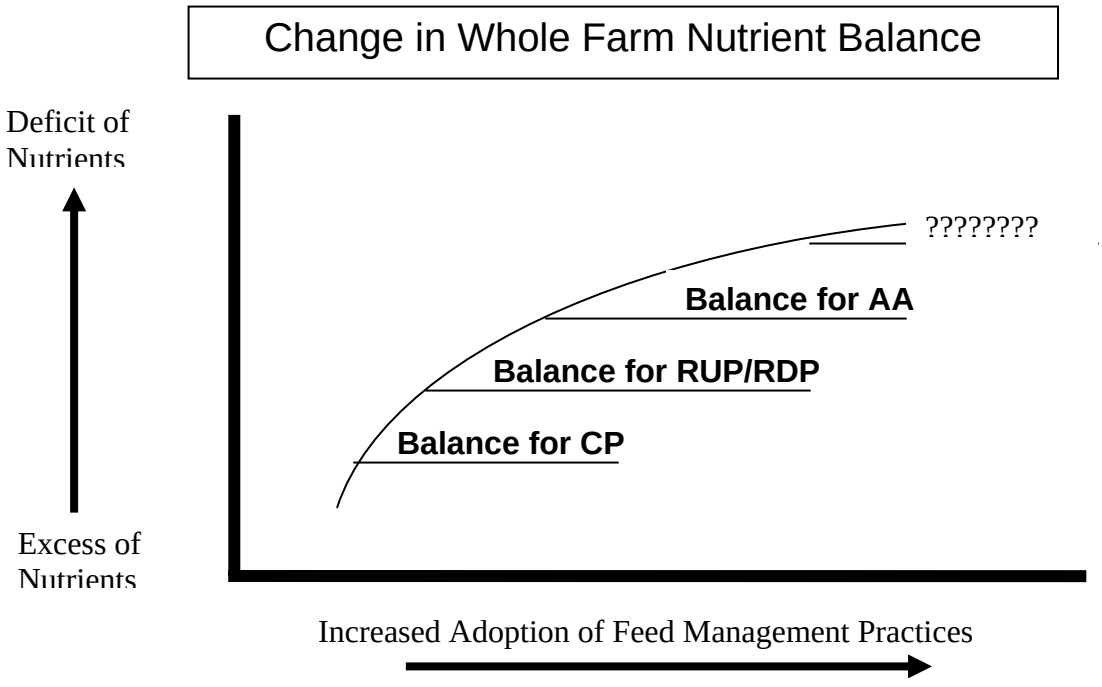

Figure 4. Change in Whole Farm Nutrient Balance with increased adoption of Feed Management practices. This is a theoretical example, actual farms will have their own unique set of solutions.

Project Information

Detailed information about training and certification in Feed Management can be obtained from Joe Harrison, Project Leader, jhharrison@wsu.edu, or Becca White, Project Manager, rawhite@wsu.edu.

Author Information

Joe Harrison is a Nutrient Management Specialist located at WSU-Puyallup. jhharrison@wsu.edu or 253-445-4638

Rebecca White, Feed Management Educator, rawhite@wsu.edu