

Want to be better than average? Use dairy farm nutrient mass balances to improve performance

By Mart Ros, Karl Czymmek and Quirine Ketterings

With so many challenges in the dairy industry today, farm managers realize they need to be “better than average” to be in business for the long-term. Running a whole-farm nutrient mass balance (NMB) can help achieve this. The NMB assessment software and interpretation of results developed by the Cornell University Nutrient Management Spear Program can quickly evaluate a farm NMB. Tracking trends in NMBs for farms over the past 10 years in New York shows that farmers who calculate their whole-farm NMB each year tend to improve their balances over time. More farms meet the feasibility benchmarks now than in early years, illustrating that improvements can and are being made. Given the harsh reality in recent years with low milk and commodity prices, improving NMBs can provide profitable opportunities to improve operational efficiency.

By calculating their NMB using the Cornell University software (available at nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/MassBalances.html), farm managers are able to assess nitrogen (N), phosphorus (P),

and potassium (K) use in a way that measures farm production performance and also serves as a key whole-farm sustainability indicator. A farm’s year-on-year performance can be assessed to track progress and compare nutrient use efficiency to other farms. It is especially instructive when comparing with direct peers, such as farms with similar milk production levels or animal densities.

The NMB assessment tracks nutrient purchases through feed, fertilizer and other sources, as well as nutrient exports such as milk, feed and manure, and reports N, P, and K balances per acre and per hundredweight of milk produced. The software then calculates the whole-farm NMBs by subtracting the annual sum of nutrients exported from a farm from the nutrients imported onto the farm (Figure 1). The difference between these imports and exports is called the balance, and this is a measure of how many nutrients (in lbs) remain on the farm or are vulnerable to loss. The balance per tillable acre is a measure of the environmental impact of a farm (nutrient loss or accumulation per acre of cropland). The nutrient

balance per cwt of milk sold is a measure for the amount of nutrients “used” to produce a unit of milk. This tells us something about the production efficiency at which the farm operates (in many cases equated to money left on the table).

The whole-farm NMB estimates a solid key performance indicator from a relatively small amount of data. To conduct a NMB assessment, participants fill out four sheets of paper with information on the size of the farm (number of acres and number of cows) and quantities of nutrient-containing imports and exports that entered or left the farm during a calendar year. These numbers are entered in the Cornell Nutrient Mass Balance software, which calculates the N, P, and K balances for the farm.

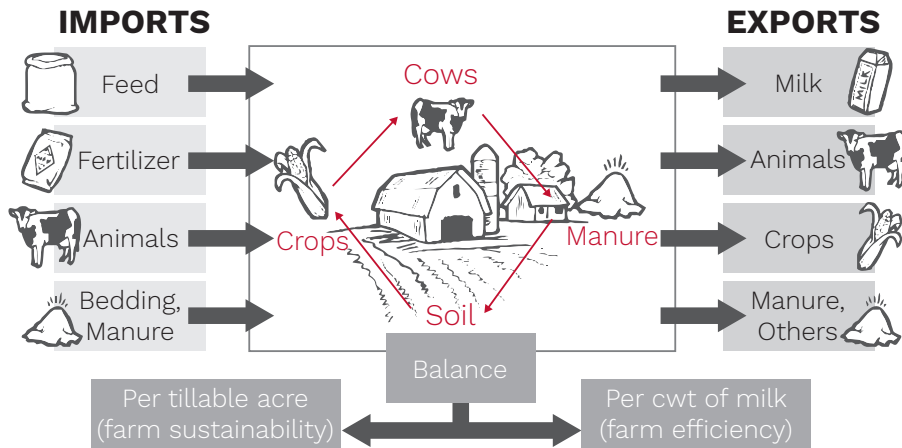
For imports, the NMB distinguishes between feed imports, fertilizer imports, purchased animals and bedding/manure. For exports, nutrients sold in milk, animals, crops and manure or other products are considered. Information on the quantity and the nutrient

Continued on back

Want to be better than average? Use dairy farm nutrient mass balances to improve performance, cont'd from front

FIGURE 1

Overview of farm imports and exports included in a nutrient mass balance (NMB). Only easily measurable components are considered. The nutrients in the resulting balance either remain on the farm system or are lost to the environment.



content of these items is needed to calculate the total amount of N, P, and K that enters and exits the farm. Using farm-specific nutrient analyses is preferred, but for several crops or products, book values are included in the software, and can be used as a substitute.

In addition to the imports and exports listed above, information is gathered on the forage and grain crops grown for feed on the farm itself. Although homegrown feed is not an import or an export, and therefore does not contribute directly to the balance, it allows calculation of other crop and ration performance indicators that can tell us more about the efficiency of the farm and opportunities to improve over time.

There are three general types of nutrient balance: negative

balances, slightly positive balances and largely positive balances. It is important to understand that in terms of balances, “positive” and “negative” have unexpected meanings. Negative balances have higher exports than imports, which means that there is a net outflow of nutrients from the farm. In the short-term this may be desirable, for example when P levels in the soil are really high. However, if negative balances are sustained over a long time, soil mining of nutrients (such as P and K) will occur and when soil fertility levels drop below optimal, crop yields will be impacted. Slightly positive balances are desirable, as biological processes always need inputs that are a little larger than the outputs. It is therefore expected that nutrient imports will be larger than the exports, and as long as the difference

remains small enough, this is a sustainable practice. However, when the nutrient imports are a lot larger than the exports, risk of environmental losses is increased. Although the difference can be temporarily stored in feedstocks on the farm, some portion of the remainder is often lost (this is mainly the case for N) or stored in the soil and slowly lost over time (for P and to a lesser extent for K). The ideal level of a NMB is thus larger than zero, but not so large that the nutrients are used inefficiently, as this costs money and is potentially harmful to the environment.

Feasible (target) balances were established for N, P, and K in collaboration with farmers and farm advisors in New York and are shared in the companion article “Better than average: Feasible balances for dairy farms that produce most forage needs.” ■

Mart Ros (mr2249@cornell.edu) is with the Cornell Nutrient Management Spear Program.

Karl Czymmek (kjc12@cornell.edu) is with the Cornell Nutrient Management Spear Program and Cornell CALS PRO-DAIRY.

Quirine Ketterings (qmk2@cornell.edu) is with the Cornell Nutrient Management Program Spear Program. More information is available about the program and the NMB software at nmsp.cals.cornell.edu.