Whole-farm nutrient balances are an important tool for California dairy farms

by Alejandro R. Castillo

Modern dairy farms are more complex than ever before. They have become more concentrated in recent years, with cows producing more milk, and more feed purchased from off-farm sources. Feed is the primary nutrient input into the average California dairy farm. Improving the efficiency of nutrient utilization presents important economic and environmental challenges. The relationship between nutrient balances and how nutrients are utilized on the farm is not well understood. This article discusses the concept of nutrient balances and variables affecting the improvement of nitrogen imbalances in California dairy systems.

Dairy operations in California are becoming more concentrated, with more cows, more milk produced per cow, and more feed purchased off-farm. In order to limit pollution from nutrient-laden runoff, California dairies in the Central Valley face new water-quality-related rules.
Most studies that estimate whole-farm nitrogen utilization express balances as a proportion. For example, Koelsch (2005) reviewed information from different dairy whole-farm balances in the United States, and found imbalances or direct losses of nitrogen value ranging from 59% to 84%. Researchers from Cornell University did whole-farm balances on 24 dairy farms in northern New York, and the average nitrogen remaining (imports-to-exports) was 46% (Larry E. Chase, Professor, Cornell University, personal communication). Castillo et al. (2000) analyzed information on whole-farm nitrogen balances from European dairy farms, including high and low nitrogen inputs, and estimated that harvested nitrogen in the outputs ranged from 44% to 84%. Likewise, Spears et al. (2003) found that in whole-farm nitrogen balances carried out on 41 Western dairy farms, on average 36% of the inputs were accounted for in the outputs.

All the research cited was carried out with different methodologies and situations. No scientific information has been produced specifically for California dairy systems to indicate an average or an optimal value for the efficiency of whole-farm nitrogen utilization.

### Adjusting nitrogen balances

Strategies to improve nitrogen utilization include decreasing inputs, increasing outputs, or both. In practical terms, if the objective is to maintain the number of animals and acres, reduce inputs and/or increase outputs, improvements should be based on (1) the efficiency of feed and feeding management and (2) manure management practices.

The following examples, based on Spears et al. (2003) (table 1), analyzed the impact of several strategies to improve average nitrogen balances and present achievable goals for California dairies.
Whole-farm nutrient balances provide a general indicator of whether a farm is at risk of building up nutrients and releasing them into the environment.

Decreasing inputs 20%. To decrease nitrogen inputs by 20%, nitrogen intake in feed by dairy cows could be reduced by 10% (NRC 2001; Broderick 2003; Olmos Colmenero and Broderick 2006) and the on-farm growing of crops that take up nitrogen could be increased by 10%. To this end, UC Cooperative Extension researchers are currently evaluating on-farm data using triple-cropping on a minimum tillage system.

Increasing outputs 20%. Increasing milk output and the resulting levels of nitrogen in the milk was estimated to increase the nitrogen output to 5 tons per year, which may be obtained by increasing milk yields by about 10% (Wang et al. 2000). Also, to increase outputs by 20%, it would be necessary to increase the export of nitrogen in manure from 15.5 to 19 tons per year.

Reducing nitrogen intakes and increasing crop production — thereby increasing the nitrogen harvested (see total outputs, fig. 1) — represent a lower proportion (less than 30%) of the total nitrogen-balance improvement (54-45/81-47 = 0.26).

Dairy farm strategies

Whole-farm nutrient balances are an important tool for understanding and evaluating the economic and physical viability of each dairy farm, improving nitrogen imbalances and complying with environmental regulations. Strategies to improve nitrogen balances for the average California dairy farm include adjusting diets according to animal requirements in order to decrease nitrogen input in feed, increasing on-farm crop production and milk yields per cow per day, and exporting manure to cropping and/or other production systems.

References


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