Applying knowledge to improve water quality

National Water Program

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Managing Dairy Manure in Central California

There are approximately 1.7 million lactating dairy cows in California. Sale of milk from these cows is estimated at $4.6 billion of the state's $30 billion agricultural market. Nearly 73% of the cows are located in the San Joaquin Valley. There, dairies have been found to be a potentially significant threat to groundwater quality. We investigated and reviewed key aspects of dairy farms and their management practices to provide an overview of the dynamics of the nitrogen and salt cycle in a dairy's various operational units as potential sources of groundwater pollution. Nitrogen excretion rates are found to vary sharply among dairies but techniques are available to make accurate site specific estimates of nitrogen excretion rates. Manure distribution patterns vary depending on the facility infrastructure and operational and managerial decisions. The amount of manure collected in liquid will vary from 8% to 100%. Solids removal from mechanical and gravity flow separation systems range from under 25% to consistently over 50%. However, soluble nutrients and salts predominantly remain in the liquid system. Overall atmospheric N losses from liquid manure in the production area (i.e., freestalls and flush lanes and lagoons) are considered to generally range between 20% and 40%. Use of a universal animal "emission factor" for reactive N compounds (e.g., ammonia) from commercial dairy lots is not possible because of the wide emission variability among and within dairies. N input requirements for forage crops will generally be in the range of 140% to 165% of the crop N harvest removal. The combined evidence from laboratory, field, and modeling studies indicates that precise nutrient management, while plausible in principle, may be problematic when implemented in full-scale production systems, as it requires careful timing of the N applications, close monitoring of the amount of N and water inputs, and best management of crop production. Analysis of manure data, geochemical modeling, and observations of groundwater recharge quality in the San Joaquin Valley dairies suggests that the salinity contribution (defined as the mass of total dissolved solids) from manure, under proper nutrient management practices that seek to maximize the use of lagoon water as a source of fertilizer, is on the order of 2000 – 4000 kg ha^{-1} yr^{-1}.