Animal Grouping Strategies, Sources of Variation, and Economic Factors Affecting Nutrient Balance on Dairy Farms

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ABSTRACT

Increasing environmental concerns are forcing animal industries to reevaluate current feeding practices and their relationships to nutrient excretion. Previous modeling efforts have used simple budgets of nutrient flows through animals, assuming a constant productivity level. This assumption is not valid if animals are not in a steady state. A response model of dairy cow production to levels of net energy for lactation (NEL) and crude protein (CP) was derived from an abrupt threshold and plateau model of individuals. Monte Carlo techniques were used to simulate populations of cows fed diets of various NEL and CP concentrations, to derive the optimum allocation of NEL and CP, and to estimate how the optimum is affected by herd production potential, prices of inputs, and uncertainty of parameters. The simulation showed that a 25% increase in milk production reduced N excretion per kilogram of milk produced by 8%. Improved knowledge of the biology involved and feed composition can reduce N excretion by an additional 8%. Grouping strategies and number of groups used affect optimum allocation of nutrients. An optimum of six milking groups per production unit was derived from the simulation and would reduce N excretion by 8% compared to herds fed in one group.

INTRODUCTION

Over the last three decades, point sources of pollution have been aggressively regulated. Reducing pollution from nonpoint sources is perhaps the major remaining challenge for clean water policy in the United States. Agriculture is believed to be the leading source of impairment in the nation’s rivers and lakes (5–8). In agriculture, animal production has been a main focus of environmental concerns because of its visibility and the increased concentration of animal production units (42). In response to public concerns, numerous states have passed legislation regulating manure and nutrient management (17, 23, 24, 44). The debate is still open on the costs and benefits of environmental regulations for the animal production industries (3, 40, 66). It is clear, however, that regulation and enforcement will intensify in years to come as a consequence of mounting evidence of the contribution of agriculture to environmental problems, especially in environmentally sensitive areas (10, 27, 31, 50).

Various farming practices have been proposed to reduce field erosion and N and P losses (59). Those practices, such as no-till, do not generate economic benefits of sufficient magnitude to adequately compensate farmers who adopt and use them (8, 13, 37). Consequently, the rate of adoption is still relatively