Increasing stocking rate may not lead to greater nitrogen leaching on dairy farms

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It has been commonly accepted that more cows per pasture would lead to increased nitrogen leaching because of increased nitrogen excretion via urine; but, a new study discovered circumstances where a decline in leaching occurred with increased stocking rate, challenging assumptions about how best to reduce the environmental footprint of grazing systems.

An experiment in New Zealand found that more cows per grazing area led to less nitrogen leached to ground water, challenging assumptions on stocking rate, report investigators in the *Journal of Dairy Science*.

With population estimates of 9 billion people worldwide by 2050, the intensification of agriculture practices in recent decades has been necessary. Significant environmental concerns exist with the intensification of agriculture, however. In dairy farming, particularly on pasture-based dairies, leaching of nitrate-N (NO3-N) to groundwater is a primary concern, leading to certain countries placing limits on herd size on a fixed land area (i.e., stocking rate) to avoid loss of nutrients to groundwater. It has been commonly accepted that more cows per pasture would lead to increased leaching because of increased nitrogen excretion via urine; but, a new study discovered circumstances where a decline in leaching occurred with increased stocking rate, challenging assumptions about how best to reduce the environmental footprint of grazing systems.

The experiment was conducted in New Zealand over two years, with cows divided over ten farmlets with increasing stocking rates per hectare. The herds were spring-calving, nitrogen fertilizer use was

constant across the farmlets, and less than 5% of feed was imported onto the farms. To measure nitrogen leaching, 180 porous ceramic cups were installed in each farmlet at a depth of 1 meter, and samples were collected every 2 weeks.

Over the course of the study, total nitrogen consumed and total nitrogen output in milk and meat from the farm increased for every 1 cow per hectare increase in stocking rate. Fecal and urinary nitrogen excreted per hectare also increased. But, nitrogen intake and milk, fecal, and urine nitrogen output per cow declined with increasing stocking rate. This is particularly important during the autumn months, where urinary N has been implicated in N leaching. Furthermore, the measured amount of NO3-N leached per hectare declined with each 1 tonne of pasture harvested. Leaching also declined with increasing stocking rate, coinciding with a decline in the concentration of NO3-N in leachate.

The negative association between stocking rate and leaching was possibly due to a reduction in nitrogen intake per cow leading to less urine nitrogen output per cow, a greater spread of urinary nitrogen across the pasture with larger stocking rates, or an increase in pasture nitrogen harvest and an associated increase in milk and meat nitrogen exported and, as a result, less nitrogen available for leaching.

"Globally, dairy systems are being scrutinized for their environmental impact and many are calling for a reduction in cow numbers. What this new research shows is that grazing more cows per acre of pasture and the associated management strategies that go with this actually reduces any negative impact of grass-based dairies on water quality, provided no additional feed is imported" said *Journal of Dairy Science* editor-in-chief Matt Lucy. "The result is contrary to the commonly held perception that fewer cows per acre is friendlier to the environment and, instead places the focus on the importation of feed in a pasture system. The study underscores the need for research when developing recommendations

for environmentally friendly dairy production."

This conclusion, that a seasonal, spring-calving, pasture-based dairy production system importing less than 5% of feed with no change in N fertilizer use, had a decline in NO3-N leached per hectare with increasing stocking rate is a novel one. The authors could not support the idea that lowering stocking rate alone could reduce NO3-N leaching but encourage careful consideration of any changes in stocking rate as a means of changing leaching per hectare. Likewise, future studies should consider a full farm system-level analysis of changes to stocking rate to determine its effect on productivity and environmental outcomes.

More information: J.R. Roche et al. Increased stocking rate and associated strategic dry-off decision rules reduced the amount of nitrate-N leached under grazing, *Journal of Dairy Science* (2016). DOI: 10.3168/jds.2016-11024

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