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15. Impact of manure separation techniques in dairy houses on environment, fertilization and economics

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Introduction

Dairy cows produce feces and urine several times a day but at different moments and places. However, housed in slurry based cubicle systems as the majority of dairy cows in The Netherlands, both fractions end up together in a slurry. When both fractions were kept separated as good as possible and removed from the surface of the walking floor or from the housing at all, this would probably reduce the slurry related emissions of methane and ammonia. Carbon rich feces is one of the sources of methane production and ammonia N rich urine is the source of nitrogen losses as ammonia, nitrous oxide and other nitrogen emissions. Both fractions individually could also contribute to more efficient use of nutrients for plant growth and soil fertility than the mixed slurry would do. Finally a well separated urine fractions could meet the EU RENURE (REcovered Nitrogen from manURE) criteria and replace part of the use of mineral fertilizer. The goal of the project was to evaluate three source segregation techniques that keep the urine and feces separated in dairy houses on the effect on ammonia and methane emission, nutrient losses during storage, the use as fertilizer and the economic implication.

Methodology

Three source segregation techniques were installed and investigated from the end of 2020 to the end of 2023 at research farm Dairy Campus in the Netherlands using three units of 16 lactating dairy cows each and compared to a conventional cubicle barn with slatted floor that acted as a reference. Emission of methane, ammonia, carbon dioxide and nitrous oxide were measured in all four units semi-continuously. The three techniques were:

- CowToilet (Hanskamp BV). The CowToilet is an automatic urinal combined with a concentrate feeder that cows use voluntarily. The urine collected is stored separately and feces and the remainder of the urine production is stored in the slurry pits under the slatted floor
- Permeable tiles floor (Zeraflex floor by A&S Techniek). Urine is drained by the permeable tile on the slatted floor into the pit. Feces is removed from the floor with a manure scraper and stored outside.
- Rubber floor (V17 Agro). A new type of a grooved rubber floor with drainage holes for liquid fraction and feces removal with a scraper.

Besides the effects on housing emissions, separation efficiency and of N, P, K and C-balances, measurement of nutrient losses during small scale storage of fractions and an economic analyses of the whole manure chain were performed.

Results and discussion

- CowToilet. The CowToilet collects around 35% of total urine production. Emissions of ammonia and nitrous oxide was reduced by 33% and 18% respectively, compared to the reference unit. The urine collected meets the RENURE criteria.
- Permeable tiles floor. Only combined with urine acidification the emissions of ammonia and nitrous oxide was reduced by 62% and 9% respectively compared to the reference barn. While total urine production is collected more fertiliser is replaced and slurry disposal costs decrease, but only when RENURE criteria are met.
- Rubber floor did not reduce ammonia and nitrous oxide emissions.

Results of methane emissions and economic analyses will be presented at the conference.

Conclusion

Both CowToilet and Zeraflex floor reduced ammonia emission but the latter only after additional acidification of the urine fraction. When RENURE criteria are met installation of these techniques is profitable

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