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11. Determination of gaseous emissions from naturally ventilated housings in the absence of animals

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Introduction

Gaseous emissions from livestock houses have negative effects on biodiversity (ammonia) and climate change (methane). To lower the negative effects of the food production system, these emissions should be minimised. Measurement strategies (systems and protocols) have been developed (Werkgroep richtlijnen emissies veehouderij, 2024) to enable farmers to monitor and thus manage their emissions. However, these protocols mainly focus on mechanically ventilated housings even though a major part of the emissions originates from naturally ventilated housings (NVH). The reason for this is that it is difficult to determine the ventilation rates in NVH which are needed to quantify emissions. As a solution, the produced CO_2 from animal respiration and manure storage is used as a tracer gas to determine the ventilation rate. However, this requires a continuous presence of animals which is not always the case (e.g. during grazing). Therefore, the aim of this research was to estimate the emissions from NVH without using an external tracer both in the presence and in the absence of animals.

Methodology

Between 2018 and 2024, 15 Dutch dairy NVH have been continuously monitored on ammonia (NH_3), methane (CH_4) and carbon dioxide (CO_2) concentrations as well as on the presence of animals. In 10 of the NVH, animals were partly outside for grazing. Based on the available data, scenario analyses have been performed on 5 NVH in which animals were continuously present. The absence of animals was simulated to estimate the measurement error when animals are absent. Next to that, different gap-filling methodologies have been applied to predict gas concentration levels during animal absence. The resulting emissions were compared with the emissions as calculated when the animals were continuously present.

Results and discussion

Preliminary results from this study show that gaseous emissions can be determined at satisfactory accuracy levels even though the animals were partly not present in the NVH. Next to that, gap filling based on the concentration ratios between ammonia, methane and carbon dioxide appears to have potential to improve the emission estimation. Applying these methodologies will improve emission estimations as well as enabling the farmer to continuously monitor the emissions from the NVH. The remaining challenge is the determination of the fraction of the animals not being present in the barn as this is not systematically monitored in practice.

Conclusion

Based on the preliminary results, it appears to be possible to make a proper estimation of gaseous emissions from NVH while animals are partly not present in the NVH. These methodologies are expected to enhance the current protocols for emission measurement in NVH and to facilitate the implementation of mitigation strategies. Additional analysis will bring further insights on these conclusions.

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References

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