OP-023 [Section II: Structures and Environment]
CONTINUOUS ON-FARM MEASUREMENT OF AMMONIA EMISSIONS IN DAIRY BARNS

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Accurate assessment of national gaseous emissions requires measurements from different practical situations. The measurements need to be done in a proper way so that the results represent the actual situations accurately enough.

In this study, measurements of Ammonia emissions were conducted in Finland at insulated and uninsulated stationary and loose-housing dairy barns that utilized different manure management and littering systems. The emission measurement instrumentation was done with a new setup enabling accurate results in both space and time. Finally, usability of the measurement results and instrumentation was assessed.

One-week measurement sessions were done in a total of 24 sessions, i.e. six barns during all the four seasons. Continuously measuring Dräger PAC 7000 Ammonia monitors with a range of 0 to 300 ppm and a resolution of 1 ppm were used. The detection rate was set to 2 minutes in order to better detect the dynamics of the emission. The Ammonia monitors together with CO2, temperature and RH gauges were placed inside the barns at three elevations (0.1, 1.0 and 2.5 meters) and in four to six locations, depending on the size of the barn. The ventilation rate in the barns was derived out of measured C02 balance. The Ammonia emission was then calculated based on the measured Ammonia concentrations and the calculated ventilation rate.

According to the emission measurement results the loose-housing barns had significant differences in Ammonia emissions both during the seasons and between the farms as well, the level being mostly under 5 g/cow/day. In stationary barns the emission was less, under 3.5 g/cow/day. The emission level for loose-housing barns is considerably lower than the figures that have been previously used in national calculations utilizing European models with correction coefficients. For stationary barns the situation is opposite. Loose-housing, however, is the dominant housing system in future. Consequently, the Ammonia emission level in Finland might be much lower than projected in the previous modelling.

The results concerning the implementation point out the importance of understanding the local circumstances and the ability to make the measurement design accordingly. Since there were several instrumentation locations the positioning of sensors could be evaluated. The dense detection rate could be used to reveal emission fluctuations and assess the effect of different detection rates on the reliability of measurements.

Instrument locations need to be derived from the barn layout and space. The continuous measurement principle with dense detection rate and relevant instrument locations allowed the researchers to find daily and momentous fluctuations in emission rate that were caused by the individual management practices on the farms and disturbances in them. These might explain the large variation in emission measurements that have been done before with inadequate instrumentation, i.e. using random locations or unsuitable detection rates.

The utilized principle of emission measurement enables a more precise analysis of the differences of barns. However, the price-quality ratio of instrumentation limits the practical usability of methods. Research and inspection have different requirements from those of farm level appliances, e.g. air conditioning control. Continued studies are needed to develop optimised methods for each use at farm level.

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