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90. Integrated emission mitigation solutions through innovative housing and manure management systems in pig farming

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Introduction

Pig farming in the Netherlands is dominated by large-scale, intensive production systems (Willems et al., 2016). Intensive farming practices provide affordable food but are often criticized for their impact on animal welfare, and environmental problems (Ambrosius, 2022). To mitigate these impacts, new techniques are needed to minimize the negative effects of pig farming as much as possible (Mol and Ogink, 2004; Sefeedpari et al., 2024). This study evaluated the impact of an innovative weaned piglet housing concept, integrating manure separation and daily removal and reduction of the emitting surface by reducing litter contamination and a relatively small excretion area at a rooting house concept, for its effectiveness in mitigating emissions of ammonia (NH_3), methane (CH_4), nitrous oxide (N_2O), odour, and particulate matter (PM). Furthermore, the inlet air was conditioned by air tubes in the ground underneath the barn and Ionization lamps have been installed inside the pig rooms for PM reduction.

Methodology

Field measurements were conducted six times over one year following a standardized protocol in a case-control setup, complemented by continuous sensor-based monitoring on a pilot pig farm. Ammonia (NH_3), methane (CH_4), and nitrous oxide (N_2O) concentrations were measured in both the case and control rooms, while particulate matter and odour were assessed only in the case room. Additionally, sensors continuously recorded NH_3, carbon dioxide (CO_2), temperature, and relative humidity. The ventilation rate was calculated using the CO_2 mass-balance method (CIGR, 2002).

Results and discussion

Preliminary results showed a reduction of 70% for NH_3 emission compared to a reference system with no manure separation and reduced emitting area. Methane emission showed a promising reduction of around 95%, attributed to the prevention of anaerobic decomposition through effective urine-feces separation and immediate manure removal. This approach also offers high potential for biogas production. Odour reduction was measured lower than anticipated, averaging below 40%, while PM emission increased due to dry bedding material, both compared with previous measured reference levels. Adjustments, such as using low-dust sawdust, may help mitigate this effect. The case room exhibited lower and more stable temperatures and humidity levels, suggesting an optimized indoor climate. Minimal floor contamination further improved air quality and reduced ammonia formation.

Conclusion

These findings underscore the effectiveness of source-based mitigation strategies in reducing emissions, enhancing air quality, and ultimately improving animal welfare in pig farming. The concept presents a promising alternative to traditional air scrubbers, contributing to sustainable livestock farming while aligning with regulatory and climate goals. Further analysis will enable more precise conclusions to be drawn. Future research will refine the system to optimize odour and PM reduction.

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