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Wang, Y; Dong, HM; Zhu, ZP; Gerber, PJ; Xin, HW; Smith, P; Opio, C; Steinfeld, H; Chadwick, D 2017 Mitigating Greenhouse Gas and Ammonia Emissions from Swine Manure Management: A System Analysis ENVIRONMENTAL SCIENCE & TECHNOLOGY 10.1021/acs.est.6b06430

Background and objective

Studies have been conducted to address manure-related emissions, and various mitigation measures have been tested and developed. However, most studies have focused either on one specific gas, one individual manure management phase or influencing factor, or mitigation practice. The objective of this study is to estimate the emissions mitigation potentials for ammonia, methane (CH₄), and nitrous oxide (N₂O) of different swine manure storage and treatment mitigation strategies. Here the results concerning ammonia emissions are reported.

Search strategy and selection criteria

The ISI Web of Knowledge database (www.isiwebofknowledge.com) and the Chinese journal database (www.cnki.net) were used to search all published data sets as of January 2016. Specific search terms were combined and used, depending on animal categories (swine, pig, livestock, animal), manure, in-house manure management (slatted floor, pit, bedding, litter, pull-plug, discharge, scraper, separation), outdoor manure management (lagoon, slurry pond, storage tank, compost, solid storage, stockpile), land application (surface spreading, injection, incorporation, band spreading), gaseous emission (NH₃, CH₄, N₂O, and GHG gas), and mitigation measure (diet, biofilter, biogas, additive, cover, acid, cooling, nitrification inhibition). Literature sources used in this study were selected based on the following criteria: (1) The research object was swine; (2) The study included at least one of the CH₄, N₂O and NH₃ gases; (3) Gas emission flux or gas emission factor was available; (4) For literature related to mitigation, only studies that reported at least one control group were selected so that emission mitigation efficiency could be calculated.

Data and analysis

The Wilcoxon Signed-Rank test was used to determine if the median mitigation efficiency was significantly different from zero when there were sufficient results for specific measures.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
142	Swine manure	Storage covers, Storage with acidification, Storage with additives	No mitigation strategy	Metric: NH ₃ emissions; Effect size: Ratio of the considered metrics in the intervention to the considered metrics in the control	62.5

Results

- For mitigation from slurry storage, almost all types of covers have proven to be effective in reducing ammonia emissions with median mitigation efficiencies of >75%. Floating plastic cover is the most effective option with a mitigation efficiency of 99.5% (P=0.039). Straw cover, oil cover, and granule cover reduced ammonia emission by 75, 85, and 87%, respectively (all P<0.05).
- Acidification is effective in ammonia mitigation, with a reduction efficiency of 56% (P=0.018).
- Cover the manure during composting reduced ammonia emissions by 14% (P=0.028). There was only one observation to estimate the mitigation efficiency of manure stockpile cover, showing that this mitigation strategy could reduce ammonia emission by 12%. As only one observation was reported, the Wilcoxon test was not applied in this case. The result was considered as uncertain.
- Slurry injection (-99%, p=0.001), slurry incorporation (-67%, p<0.001), and solid incorporation (-85%, p=0.012) were effective in reducing ammonia emissions, compared to surface spread of the manure.
- Application of digested slurry and addition of nitrification inhibitors to applied manure were not efficient in reducing ammonia emissions (p > 0.05).

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Overall, this study shows that all investigated mitigation strategies, with the exception of stockpile cover for which not enough data was available, were effective in reducing ammonia emissions. This study shows that injecting or incorporating swine manure was effective in mitigating ammonia emissions, compared to surface spreading.