FARMING PRACTICE
MANURE STORAGE TECHNIQUES

IMPACT: GHG EMISSIONS

Reference 11

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 NH_3, methane (CH_4), and nitrous oxide (N2O) of different swine manure storage and treatement mitigation startegies. Here the results concerning CH_4 and N2O 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 (NH_3, CH_4, 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 CH_4, N2O and NH_3 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: 1) CH_4 emission; 2) N2O emission; Effect size: Ratio of the considered metrics in the intervention to the considered metrics in the control	62.5

Results

- The results show that straw cover, oil cover and granul cover may decrease CH_4 emission by 14, 12, and 9%, however these reductions were not significant (P=0.49; P = 0.18, and P=0.36, respectively). Floating straw and granule covers may increase N2O emissions by 29 ($P<0.05$) and 2.7 (P=0.18) times.
- Cooling reduced the CH_4 emission by 38%, as compared with no cooling (P = 0.028). Acidification results in a high CH_4 mitigation efficiency, but the result was not significant (88%, P = 0.068).
- Covering manure compost might increase CH_4 emissions (+48%, p=0.145) while decreasing N2O emissions (-16%, p=0.348) but these results were not significant. There was only one observation to estimate the mitigation efficiency of manure stockpile cover, showing that this mitigation strategy could reduce CH_4 (-8.8%) and N2O (-99%) emissions. As only one observation was reported, the Wilcoxon test was not applied in this case. The result was considered as uncertain.
- Avoiding manure application to rice paddy fields is an effective GHG mitigation option, with CH_4 and N2O mitigation efficacy of 57% ($p < 0.001$) and 23% (p = 0.575), respectively.
- Slurry injection significantly increased N2O emissions (+84%, p=0.003), while addition of nitrification inhibitors mitigated N2O emissions (-28%, p=0.016). Other upland application strategies were not effective in reducing N2O emissions ($p>0.05$).

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Overall, this study shows that among investigated mitigation strategies, cooling and compost cover were effective in reducing CH_4 and N2O emissions, respectively. This study shows that avoiding to spread swine manure in rice paddies and adding nitrification inhibitors in the manure before spreading in upland were effective in mitigating CH_4 and N2O emissions, while slurry injection increased N2O emissions.