FARMING PRACTICE
MANURE STORAGE TECHNIQUES

IMPACT: GHG EMISSIONS

Reference 10

Wang, Y; Li, XR; Yang, JF; Tian, Z; Sun, QP; Xue, WT; Dong, HM 2018 Mitigating Greenhouse Gas and Ammonia Emissions from Beef Cattle Feedlot Production: A System Meta-Analysis Environmental Science & Technology 10.1021/acs.est.8b02475

Background and objective

Beef cattle production systems are the largest contributors of greenhouse gas (GHG) and ammonia (NH_3) emissions in the livestock industry. Much work in literature has evaluated gas emissions or mitigations targeted at one specific gas or one emission stage, while little research has considered it in a comprehensive way. The objective of this meta-analysis is to quantify the mitigation efficiency of several mitigation strategies for manure composting and stockpiling to reduce GHG emissions (methane (CH_4) and nitrous oxyde (N_2O)).

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 datasets as of December 2017. Specific search terms were combined and used, including animal categories (beef, cattle, bull, steer, bovine, heifer, livestock), manure, manure management (feedlot, pad, yard, open-lot, pen, compost, stockpile), land application (surface spread, incorporation), gaseous emissions (NH_3, CH_4, N_2O, and GHG gas), and mitigation measures (diet, crude protein, additive, amendment, urease inhibitor, biofilter, biotrickling, cover, nitrification inhibitor, incorporation, reduce, mitigation, abatement). Literature sources used in this study were selected based on the following criteria: 1) the research object was beef cattle; 2) the study included at least one of the CH_4, N_2O 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 (ME) could be calculated.

Data and analysis

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

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
104	Cattle manure	Additives to stockpiles; Stockpile covers	No mitigation strategy	Metric: 1) CH_4 emission; 2) N_2O emission; Effect size: Ratio of the considered metrics in the intervention to the considered metrics in the control	62.5

Results

- The results showed that additives can be effective in CH_4 mitigation, with mitigation efficiency of -97.0% (p=0.102) but it may increase N_2O emission by 135.0% (p=0.109). In both cases, p value are above 0.05, so the results were considered as not significant.
- For beef manure stockpiling, CH_4 emission and N_2O emissions can be increased by 29.8% ($p<0.05$) and 13.0% (p=0.128) with straw or sawdust covering, respectively. In the case of N_2O, p value is above 0.05, so the result was considered as not significant.
- Incorporation can decrease N_2O emission by 65.0% ($p<0.05$) when compared with manure surface application.
- Manure additives such as biochar and nitrification inhibitor resulted an integrated N_2O mitigation efficiency of -28.0% (p=0.100). The p value was superior to 0.05 so the result was considered as not significant.

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

This study shows that the different tested mitigation strategies were not significantly effective in reducing GHG emissions. Stockpile covers had negative effect on CH_4 emissions.