Toward better agricultural fertilization management

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A new study led by researchers from UPM shows that ammonia emissions associated with crop fertilization could be reduced by up to 82% with a minimum impact on agricultural production.

The research findings, conducted by several universities, national and international research centres and led by the School of Agricultural Engineering from Universidad Politécnica de Madrid (UPM), show the possibility of achieving an effective reduction of ammonia emissions caused by the fertilization of agricultural soils. This decrease can be achieved by combining strategies that can optimize the livestock manure management and the non urea synthetic fertilizers. All this would allow us to reach a compromise between environmental protection and food safety.

Agriculture was the sector responsible for 94% of ammonia emissions in Europe during 2011 and responsible for the use of nitrogenous fertilizers such as urea and manure in agricultural soil. The ammonia released into the atmosphere can be deposited in adjacent ecosystems or travel tens of kilometers away, causing environmental problems such as soil acidification and eutrophication.

Because of these environmental problems and boosted by community legislation, numerous strategies to reduce ammonia emissions in European agriculture have been implemented in recent years. However, in most cases, these strategies are limited due to adverse and indirect effects on implementation, such as reduction in crop yields or nitrogen

efficiency loss when applying fertilizer. All this has negative consequences for farmers, consumer and for food safety.

In this context, a recent study published in the *Environmental Research Letters* journal suggests mitigation strategies using a combination of measures that can optimize the use of nitrogenous fertilizers at provincial level in Spain. Spain was selected for this study due to its high levels of ammonia emissions duringrecent years and because it is the third largest producer of agricultural goods in the EU.

Researchers assessed the capacity of eleven scenarios of ammonia emissions mitigation in order to make reductions. They also assessed its effect on agricultural production and nitrogen surplus (the remaining nitrogen on the soil after mitigation and susceptible to be released as other contaminating compounds such as nitrates or nitrous oxide). These scenarios included diverse choices of fertilization as well as a combination of strategies.

They highlight the incorporation of manure into the soil to depths of 10 cm, the addition of urea up to 5 cm, the reduction of applied fertilizers (possible removal of urea fertilization). The impact of these scenarios was compared with the Spanish situation in 2008.

The results showed that all scenarios caused an effective mitigation of the ammonia emissions compared to the situation in 2008. The most effective measure was the scenario that reduced emissions by adding manure with a mitigation of 57% increasing the production to 8%.

Only four of the eleven scenarios showed an effective reduction of emissions and a significant increase in yields. The most promising results were achieved by combining the addition of manure and the removal of urea fertilizers. In this case, emissions decreased up to 82% while yield did not differ significantly from the baseline scenario.

The types of soils and the environmental conditions affecting ammonia emissions can vary among the Spanish provinces. Therefore, the study was carried out at provincial level. As a result, researchers suggest that the application of the most effective individual measures to each province could reduce the total emissions up to 67%.

This study has shown that effective reduction of the ammonia emissions due to fertilization of agricultural systems can be achieved without compromising production.

More information: "Yield-scaled mitigation of ammonia emission from N fertilization: the Spanish case". *Environmental Research Letters* 9 (12). DOI: 10.1088/1748-9326/9/12/125005 . DEC 2014.

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