A clear solution for farmers

CATCHMENT SENSITIVE FARMING

Reducing Ammonia Emissions from Slurry Storage and Application on a Dairy Farm

Image: Abbey

Why is ammonia a problem?

Ammonia is a key air pollutant that can affect both the environment and human health. Ammonia emissions are one of the largest contributors to acidification of soils and eutrophication of habitats and water bodies. Ammonia emissions combine with pollution from industry and transport (e.g. diesel fumes) to form very fine particulate matter ($PM_{2.5}$), which can then be transported in the air significant distances adding to background levels to which people are exposed. When inhaled, particulate matter can contribute to cardiovascular and respiratory disease.

In the UK around 87 per cent of ammonia emissions come from agriculture. The application of livestock manures accounts for 25 per cent of total agricultural emissions, and emissions from fertiliser applications for 18 per cent. This case study describes the adoption on a dairy farm of a low emission spreading technique and the use of GPS for precision fertiliser application.

Dairy farm details and measures adopted

This case study is centred on a 300 hectares (ha) dairy farm in Cheshire, with 500 dairy cows and 400 young dairy stock, comprising 205 ha of grassland and 95 ha of arable land (forage maize and wheat). Manure management is slurry-based. Slurry is separated, with the liquid fraction being applied to grassland at a rate of 25 cubic metres per hectare following grazing from mid-February onwards and after silage cuts, and the solid fraction applied to land for maize cropping. The main focus of emission mitigation was the slurry application operation, although reducing total fertiliser nitrogen use (and hence emissions from fertiliser) was also a key goal. For application of the separated slurry liquid fraction to grassland, the farmer now uses a trailing shoe slurry spreader (previously used surface broadcast application by splash plate). The farmer also invested in a GPS system to enable precision application of fertiliser.

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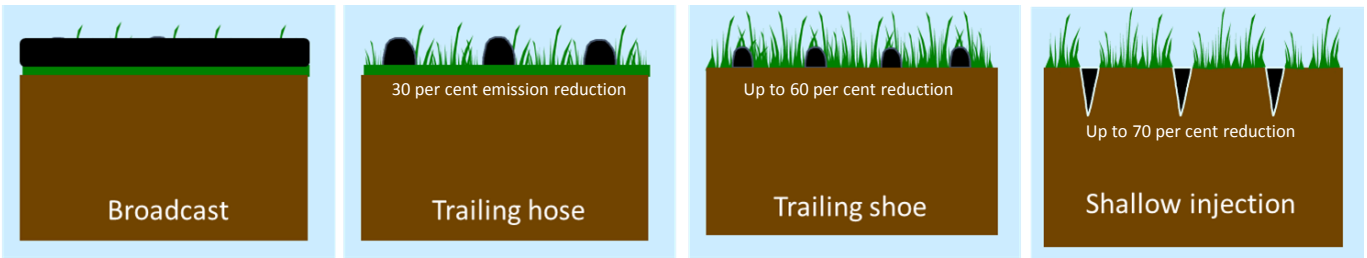
Low emission spreading options for grassland

Alternative slurry application methods for grassland that give lower ammonia emissions compared with surface broadcast application include trailing hose (often referred to as 'dribble bar'), trailing shoe and shallow injection. These greatly reduce the exposed surface area of the slurry by applying in narrow bands (see figure below). Trailing hose application will still coat the grass leaf surfaces to some extent and is therefore less effective in reducing emissions (typically by 30 per cent) than the other methods. It is more suited to application to growing arable crops, where the hoses can deliver the slurry between crop rows to the soil surface. The trailing shoe is specifically designed to deliver the slurry beneath the grass canopy to the soil surface, so there is much less contamination of the herbage and greater emission reduction (typically 60 per cent). Shallow injection places the slurry into slots in the soil, increasing infiltration and reducing emissions typically by 70 per cent.

The effectiveness of the techniques to reduce emissions will depend on slurry characteristics, application rate and the soil and weather conditions. At application rates above 40 m^3/ha, the slurry is unlikely to stay in narrow bands, as is the case with very dilute slurries. The trailing shoe will perform better if used following some grass regrowth, rather than immediately on silage or grazing aftermath. Slurry injection under hot, dry conditions can cause sward damage.

Precision fertiliser application

Minimising the overlap with fertiliser applications can be a challenge, particularly on irregularly shaped fields and as spreading widths have increased to improve work rate. GPS-guided control systems combined with specially equipped spreaders will give precision stopping and starting of fertiliser flow at field headlands, guide the tractor to ensure matching of subsequent passes and adjust spreading width, typically by changing disc spinning rate, to avoid overlap as appropriate. The implementation of GPS technology is estimated to save up to 10 per cent on fertiliser use on most farms, and therefore reduce the ammonia emissions associated with nitrogen fertiliser use on the farm. Systems are generally very straightforward to install and to use. Options exist to combine the precision application technology with on-board recording of amounts applied to each area, enabling fast and accurate recording of nutrient use across the farm.



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What influenced the farmer's decision?

The main objectives for the farmer were to improve the nitrogen use efficiency of the applied cattle slurry and nitrogen fertiliser on the farm, and also to achieve cleaner grassland after slurry spreading.

The farmer wanted a low emission slurry applicator that would fit with his grassland management regime. Separated slurry is applied to all the grassland on the farm at 25 m^3/ha and it was important that the slurry was not contaminating the grassland which would impact on grazing and silage management. A trailing shoe machine was therefore chosen to meet these requirements. The machine was purchased (under the Countryside Productivity Scheme) in 2013 and is still performing well.

The farmer was convinced of the benefits of the GPS-guided control system for precision fertiliser application through conversations with other farmers and reading articles in the farming press. This has also performed extremely well and the farmer would strongly recommend it as a relatively inexpensive measure that even small farms would do well to invest in.

What are the costs?

Costs for low emission slurry application machinery can vary greatly, but a trailing shoe applicator to suit a medium sized dairy farm is in the range £15,000 - £20,000 depending on size and specification. This could be retrofitted to an existing tanker (if structurally equipped to do so), used as part of an umbilical system, or purchased fitted to a new tanker (all at additional cost). Consideration should be given to fitting an additional macerator to the tanker inlet if slurry is not 'clean' to avoid blockage problems.

The cost of the GPS system will vary according to the sophistication and the additional equipment fitted to the fertiliser spreader, but required investment can be £3,000 or less.

What are the benefits?

The main benefit has been an increase in the nitrogen use efficiency of the slurry and fertiliser on the farm, with an estimated saving of 30 per cent in nitrogen fertiliser use since adoption of the trailing shoe and GPS, worth approximately £2,000 per year. Wider benefits which are difficult to quantify economically, include minimal odour nuisance at spreading, cleaner grass allowing grazing sooner after spreading and no grass scorching problems.

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Reducing ammonia emissions on dairy farms

The major sources of ammonia emission on a typical dairy farm are the cattle housing, manure storage and manure application to land. There are potential mitigation options that can be applied to all of these sources, but the most cost effective in the first instance are likely to be at the manure application stage, which was the focus for this case study farm.

The aim of the farmer was to improve the slurry nitrogen use efficiency, have cleaner grass with less scorching after application and minimal odour nuisance. Ammonia emission reduction, as a key environmental benefit, was an important side benefit of achieving these aims.

Application of ammonium nitrate fertiliser is a relatively small source of ammonia emissions (emissions are greater from urea fertiliser). However, the improvement in nitrogen use efficiency through adopting the GPS-control technology will reduce nitrogen pollution (to air and water) more generally and is worthwhile.

Total ammonia emission reduction on this case study farm was estimated at approximately 10 per cent. Consideration of feeding practices, housing design and manure storage with respect to reducing emissions can be made in the future, particularly when investment opportunities arise.

Three 'take-away' messages

1. Trailing shoe is an effective method for reducing ammonia emissions from slurry application to grassland, giving savings in fertiliser nitrogen use, cleaner grass and minimising odour nuisance.
2. If investing in a new slurry applicator, consider the options available and seek advice to what would suit your farm/system.
3. GPS-control systems for precision application of fertilisers can significantly reduce fertiliser use, giving financial savings as well as ammonia emission reductions.

Key contacts and information

Catchment Sensitive Farming (CSF) is able to provide events, tailored advice, individual visits and grant support to farmers on air quality measures and reducing water pollution on farm.

Agriculture and Horticulture Development Board (AHDB) provide advice on nutrient management through the series of RB209 booklets.

Department for Environment, Food and Rural Affairs (Defra) published a new Code of Good Agricultural Practice for Reducing Ammonia Emissions in 2018.

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