REDUCING AMMONIA EMISSIONS
Managing trade-offs

Ammonia emissions from milk production is an increasing area of focus for their negative impact on sensitive habitats, and production of particulate matter (PM) through reactions with other compounds in the atmosphere, which can have adverse effects on human health.

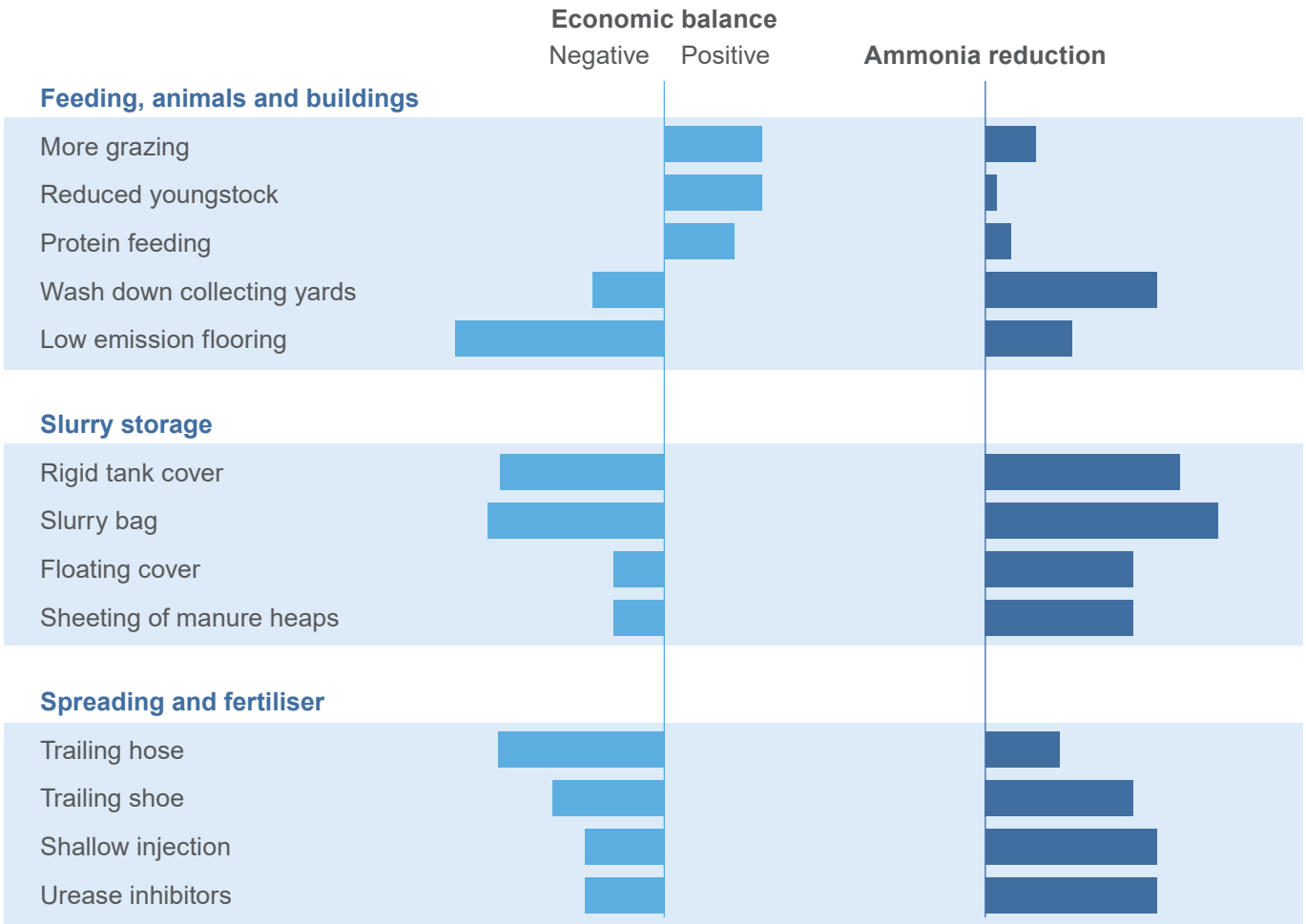
Agriculture is responsible for over 90% of EU ammonia emissions. Each member state will have to reduce emissions towards progressively tightening reduction targets by 2020 and 2030 respectively[1]. This impacts on how farmers manage their systems and plan for their future development, within the framework of agricultural policy and environmental regulation.

The challenge of reducing ammonia emissions from dairy farming involves a number of trade-offs which have to be successfully resolved e.g. reducing protein in the ration vs. optimising health and productivity; reducing losses during manure application vs. the additional cost of low emission spreading techniques; reduced emissions from housing or manure storage vs. the cost and practicality of adjusting farm infrastructure. Fortunately, science and practice can be combined to address these issues, with measurable improvements evident on implementing dairy farms.

1 Driven by the National Emissions Ceilings (NEC) Directive (2016/2284/EU)

Practical strategies to reduce ammonia emissions

An integrated approach is required, focussed on improving protein use efficiency in the cow, care in how manures are handled, and optimising the use of applied artificial nitrogen fertilisers.



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- **Balance diets for protein content**, to reduce nitrogen excretion. This may require a knowledgeable nutritionist to fine-tune the diet (frequent analysis, focus on metabolisable protein rather than crude protein, balancing energy and protein inputs, and potential supplementation with synthetic amino acids), to make the most of home-grown protein sources, and to avoid drops in production especially in high yielding cows. This will help to save money, as purchased protein is expensive. Research commissioned by AHDB (UK) demonstrates that, in maize silage-based diets, crude protein levels in milking cow diets can be reduced to 15% with no detrimental effect on milk output or fertility. Similar results have been obtained in four farms involved in the Life+Aqua project (Table 1).

- **Scrape or flush frequently the floors to keep the area clean.** More frequent scraping will help reduce losses to the atmosphere. Use of automatic and robotic scrapers, rather than manual cleaning, can save time and labour and will keep a consistently good level of cleanliness, with benefits for hoof health as well. However, initial costs can be high.

- **Increase grazing.** Ammonia losses are lower for cows at grass, due to rapid infiltration of urine into soil. This approach is not feasible for all, as it requires available land suitable for grazing and good grassland management.

- **Adopt ammonia-reducing floorings**, such as grooved floors or urine drainage systems. This highly effective option has positive effects on cleanliness and also on hoof health. However, as costs can be substantial, it is more suited to new buildings, rather than retrofitting to an existing building.

- **Cover slurry stores, muck heaps and open lagoons.** The associated benefit is to limit increases in the volume of slurry due to rainwater, which can help offset the additional cost. Cost will depend on the type of cover chosen. Allowing formation of natural crusting, by reducing mixing and adding manure below the slurry surface can significantly reduce ammonia emissions at little or no cost.

- **Use low emission spreading techniques.** The most effective options are shallow injection, trailing shoe or dribble bar, or fast incorporation of manure. There is a significant capital cost associated with buying the equipment, often making these techniques more suited to a contractor. However, more nitrogen is available for the crop, making fertilisation more effective, as well as reducing gaseous losses.

- **Actively implementing a sound crop nutrient plan**, maximising the efficient use of organic manures, managing soil health and fertility, carefully choosing the form and timing of artificial fertiliser application, will reduce gaseous losses and maximise crop dry matter yield per unit of Nitrogen input.

A reduction of nitrogen excreted by livestock may be achieved by reducing dietary protein and increasing conversion efficiency. In lactating dairy cows, efficiency is measured as the percentage of consumed nitrogen that is transformed into milk protein (N yield).

There are a number of tools available which are designed to calculate nitrogen use efficiency, e.g. ANCA (The Netherlands), Calcola N (Italy). These may be used by farmers or advisors to estimate ammonia emissions, identify ‘hotspots’, quantify the impact of farm specific best practice measures, and demonstrate this to regulators.

FARMER CASE

Practice examples ITALY

The **Life+ Aqua project** involved four Italian farms which, in successive years, adopted different dietary protein levels for milking cows. The common goal was to decrease CP in the diet, but the four farms followed different strategies to achieve this, based on the working context of the farm.
The **Calcola N tool**, an application for the calculation of the nitrogen balance in cattle and pig farms, was used for follow-up of the farms.

Pinotti farm (PDO Grana Padano)

The reduction of the protein supplement in favour of cereals produced a balanced diet which maintained productivity at about 35 kg of milk per day per cow. The nitrogen balance shows an improved transformation of feed protein into milk.

Mori farm (PDO Parmigiano-Reggiano)

Following a small modification of diet, production was maintained (28 kg of milk per day per cow), N yield remained almost constant, and excreted nitrogen was reduced.

Sgambaro farm (liquid milk)

After the dietary change the average milk production increased (27.4 kg vs. 29.7 kg). The actions taken, and the increased production, led to improvements in overall nitrogen yield.

Bolzon farm (high quality liquid milk)

The reduction in dietary protein in the concentrate feed was balanced with the addition of lysine and rumen protected methionine. Milk production was stable over the two periods (25 kg), while nitrogen balance showed an improved transformation of feed protein into milk, even in a breed (Italian Red pied cow - Pezzata Rossa) less specialised for milk production.

Table 1: Improvement in N use efficiency on four dairy farms (Life+ Aqua project)

Farm	Pinotti		Mori		Sgambaro		Bolzon	
	Before	After	Before	After	Before	After	Before	After
Crude Protein in diet (%)	16.0	15.2	14.8	14.2	14.6	14.3	15.5	14.8
Nitrogen yield<?> (%)	24	25	23	23	20	22	19	20
N excreted per t of live weight (kg)	193	182	187	174	177	179	197	193

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FARMER CASE
Practice examples THE NETHERLANDS

Listen here to dairy farmer, Rudie Freriks, share his knowledge and practical experience in reducing ammonia emissions on his 37.4-hectare farm in the Netherlands. Initially, Rudie evaluated the sources of ammonia emissions on the farm, set targets for reduction, tested out and refined management approaches, and continues to monitor performance against the Key Performance Indicators set.

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Picture Bolzon farm: courtesy of CRPA.

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Resource Efficiency