A Response to the National Clean Air Strategy

Teagasc submission to the

Department of Communications, Climate Action & the Environment

Prepared by the Teagasc Greenhouse Gas Working Group

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1. Introduction

Teagasc is pleased to avail of the opportunity to make a submission to Department of Communications, Climate Action and Environment (DCCAE) on the National Clean Air Strategy and in particular on the potential for ammonia abatement within the Agriculture sector. The objective of the analysis is to quantify the extent and costs associated with meeting future proposed ammonia emission targets that were negotiated as part of the amended Clean Air Policy Package.

This submission details the mitigation potential of agriculture published in 'An Analysis of the Cost of the Abatement of Ammonia Emissions in Irish Agriculture to 2030' prepared for Department of Agriculture, Food and the Marine (DAFM) in order to a) assess FoodWise 2025 impacts on ammonia emissions and b) assess the potential for sectoral abatement potential.

2. The Policy Context

Foodwise 2025: The Food Harvest development plan has been further extended under the Food Wise 2025 Strategy, which envisages a further increase in dairy production as well as significant expansion of the arable, pig, poultry and forestry sectors. The principal targets include a) increasing the value of agri-food exports by 85% to €19 billion, b) increasing value added in the agri-food, fisheries and wood products sector by 70% to in excess of €13 billion, c) increasing the value of Primary Production by 65% to almost €10 billion and d) creating an additional 23,000 direct jobs in the agri-food sector all along the supply chain from primary production to high valued added product development. However, this expansion will have to be carried out whilst maintaining environmental sustainability. Indeed, the strategy has adopted as a guiding principle that "… environmental protection and economic competiveness will be considered as equal and complementary, one will not be achieved at the expense of the other." Sustainability is understood to encompass economic, social and environmental attributes and the subsequent strategic environmental assessment of FW 2025 proposed the need for a Sustainable Growth Strategy (SGS). The definition of this sustainable growth scenario recognises the need to achieve a balance between economic, environmental and social objectives. The SGS should seek to increase the value added by the sector per unit of emissions (GHG or ammonia) produced.

EU Ammonia Legislation: Ireland's target for ammonia emissions under the current (revised Gothenburg) NECD is a 0.5% reduction on 2005 levels by 2020. Under the amended National Emissions Ceilings Directive (NECD) of the Clean Air Package (Dec 2013), the Commission initially proposed a reduction for Ireland of 10% to 98.8 kT NH_3. This was later amended by EU Directive 2016/2284 to a 5% reduction in ammonia to 104 kT NH_3. In the context of the proposed 2030 NECD targets, cost-effective abatement of ammonia will be vital to maintaining this strategic vision.

2. Irish Ammonia Emissions

2.1 Historical Emissions Profile

Irish agriculture contributes virtually all (98%) of Ireland's national ammonia emissions (Hyde et al., 2003; Duffy et al., 2015). Historical Irish emissions are shown in Figure 1.1. Agricultural ammonia emissions reached a peak of 130 kT NH_3 in 1998 but have since declined to 105 kt in 2014, due to a decline in the ruminant livestock population and reduced use of fertiliser nitrogen (N). In 2014 dairy and non-dairy bovines comprise 76.9% of agricultural ammonia, with these emissions arising principally from animal housing and storage (41.4%) and the landspreading of manures (28.6%). Manure emissions from pig and poultry systems comprise the bulk of the remaining emissions, followed by fertiliser-based emissions. These fertiliser emissions have declined over the period 1990 to 2013, due to a combination of reduced fertiliser use and a lower proportion of urea within total fertiliser use.

Irish agriculture is dominated by pastoral bovine livestock production, with approximately 90% of the utilisable agricultural area in Ireland comprised of permanent grassland. This dictates the farming system and also defines to a large extent the ammonia abatement practices available. Typically livestock in Ireland are fed a grass based diet (grazed grass and grass silage) and spend about 60% of their time on pasture. As a result N excreted on pasture accounts for 61% of total N excretion, compared to 8% for Denmark, 10.6% for Germany and 13.6% for the Netherlands.

This has resulted in comparatively low Irish national emissions both in absolute terms and in terms of applied agricultural N (8.8%) lost as ammonia, comparing favourably with other large EU agricultural producers (Figure 1). This arises due to the fact that the ammonia emissions factor associated with grazing is 6% of applied ammoniacal N compared to housing and the storage of livestock slurries where N losses range from 3 to 60% of initial total N (Muck and Steenhuis, 1982, Hartung and Phillips, 1994). Indeed, grazing has been classified as a cost-effective Category 1 abatement technique in the Guidance Document For Preventing and Abating Ammonia Emissions from Agricultural Sources (Bittman et al. 2014). In order to further illustrate this point, if Ireland were to have grazing levels similar to Denmark (8%) or Germany (13%), ammonia emissions would be between 27 – 30 kT NH_3 higher than current emissions.

However, this high proportion of grazing results not only in low existing ammonia emissions, but a somewhat challenging task to achieve further ammonia abatement.

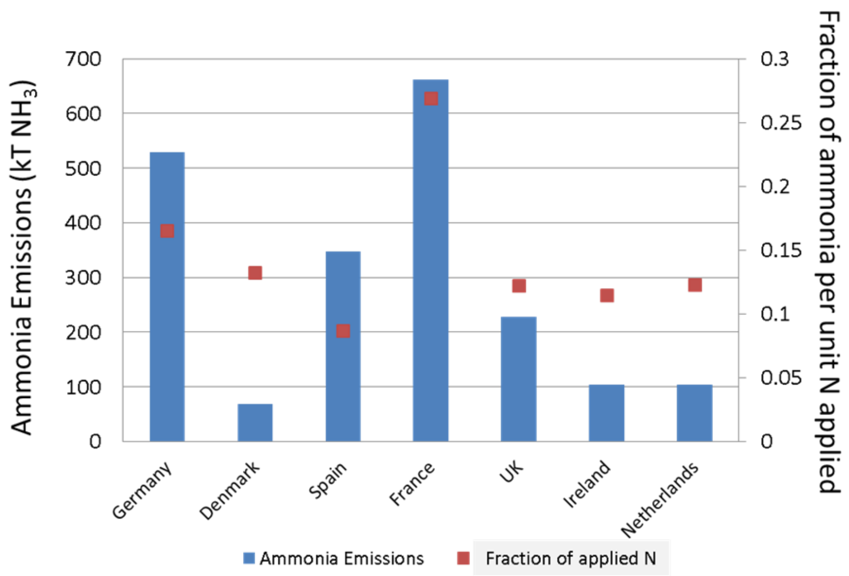

Figure 1: Irish National ammonia emissions and the fraction of N lost as ammonia for several EU countries.

2.2 The Impact of Foodwise 2025 on Ammonia Emissions

The FAPRI-Ireland model (Donnellan & Hanrahan, 2006; Binfield et al., 2009) has been used extensively in the analysis of agricultural and trade policy changes in Ireland over the last 15 years. In this analysis, the model was used to assess the impact of the Sustainable Growth Scenario on levels of agricultural production and to determine the associated level of input usage. In this scenario, production increases over the period to 2025 to give higher levels of production by 2025 than previously projected under Food Harvest 2020 scenarios analysed (Donnellan and Hanrahan 2015). The activity data was inputted into an ammonia inventory model in order to quantify the impact of this altered activity on national ammonia emissions from agriculture up to 2030.

The increase in agricultural production under the Food Wise 2025 results in total NH_3 emissions of 113.8 kT by 2030 (see Figure 2). This represents an 8.9 kT NH_3 increase relative to 1990 and a 6.6 kT NH_3 increase relative to 2005. This increase is principally due to a 16.8 kT NH_3 increase in dairy emissions and 0.7 kT NH_3 increase in pig-sourced emissions by 2030 relative to 2005. In contrast, non-dairy bovine and sheep emissions are projected to decrease by 11.5 and 0.9 kT NH_3 respectively by 2030. Aggregate fertiliser use in 2030 is lower than in 1990. This is not surprising given that usage per hectare has fallen sharply over the last 15 to 20 years, while agricultural production has remained relatively unchanged in volume terms.

However, the overall increase in emissions under FoodWise 2025 is less than proportionate to the increases in agricultural production in these sectors. This is due to the fact that some measures, such as increased animal efficiency, nutrient efficiency and extension of the grazing season are already taken into account in the national inventory. Although fertiliser application increases, it is still 3.8 kT N lower than 1990 levels and marginally lower than 2005 with a diminished proportion being comprised of urea, resulting in lower than expected impact on ammonia emissions.

3. Ammonia Abatement Potential

The cumulative maximum ammonia abatement potential under the Food Wise 2025 sustainable growth strategy was calculated to be 12.05 kT NH_3 by 2030 (Figure 2). This maximum abatement assumed a 50% adoption of trailing shoe and represents a 5.1% reduction relative to 2005. If trailing hose is adopted instead, there is a 1 – 1.5 kT NH_3 reduction in total abatement. Under the SGS scenario, total emissions would be reduced to a minimum of 103.2 kT NH_3, which represents a 3.8% reduction in NH_3 relative to 2005 levels (Figure 2). This incorporates inventory modification to include reduced yard emissions which were not previously captured in the inventories (Figure 2).

It should be noted that these reductions represent the maximum biophysical abatement potential and achieving this level of reductions (for example replacing urea with urease-stabilised urea) could prove extremely challenging in the context of a) incentivising farmer uptake and b) verifying the emissions reduction inside the farm gate (eg. verifying the early spreading of slurry) or the practicality of using the trailing shoe or trailing hose across 50% of the slurry applications. Indeed, significant policy measures would have to be implemented to achieve these levels of uptake. The total costs associated with these reductions are €24.9 million and €35.6 million per annum (for SGS with bandspreading and trailing shoe application respectively) by 2030. These costs neither include pricing in labour costs (the farmer's time) to implement measures, nor the cost of education and advisory services.

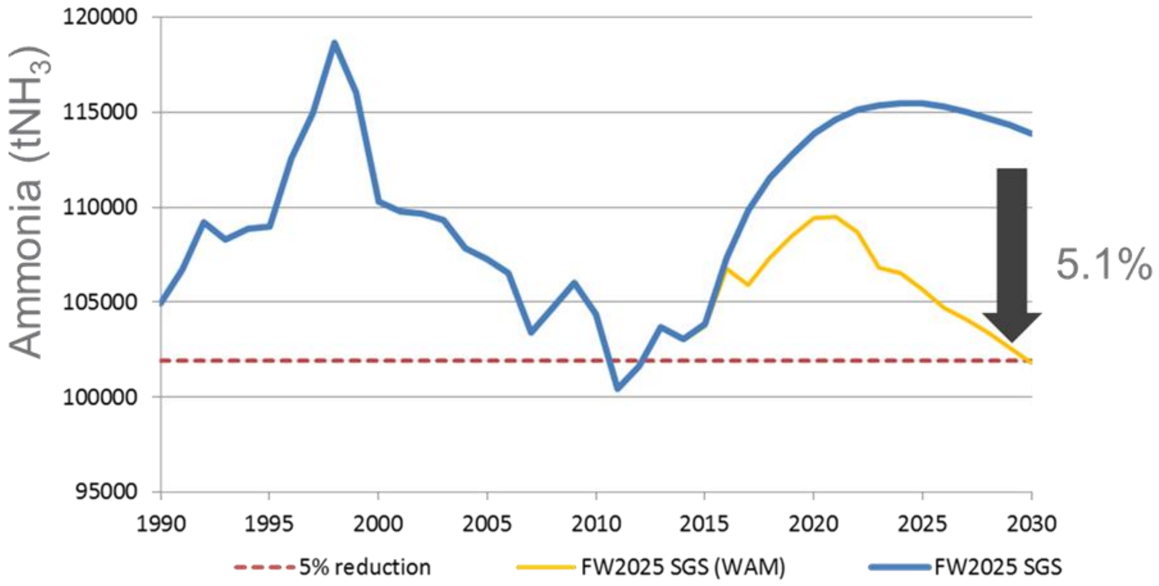

Figure 2: Estimated ammonia emissions under Food Wise 2025 Sustainable Growth Scenario without (blue line) and with (gold line) ammonia abatement measures (WAM).

The cumulative abatement and costs are shown in Figure 3. Two abatement scenarios are shown: the first (red line) where 50% of pig and bovine slurry is band-spread and the second where 50% is applied by trailing shoe. A maximum abatement potential of 10.6 and 12.0 kT NH_3 is possible under the bandspreading and trailing shoe projections respectively, at a total cost of €24.9 million (bandspread) and €35.6 million per annum (trailing shoe). However, some of the measures (particularly measures associated with pig production) are less cost-effective. If we define cost effective ammonia abatement as abatement costs of circa. €5,000 per tonne NH_3 abated (Reis et al. 2015), then 8 – 9.2 kT NH_3 could be abated at a total cost of €14-€25 million per annum for the bandspreading and trailing shoe scenarios respectively (Figure 3). Also when measures are applied in sequence along the entire manure management system, N that is abated cascades down into the subsequent N pool. So, for example, if N is abated during storage, this results in higher available N pools for volatilisation upon landspreading.

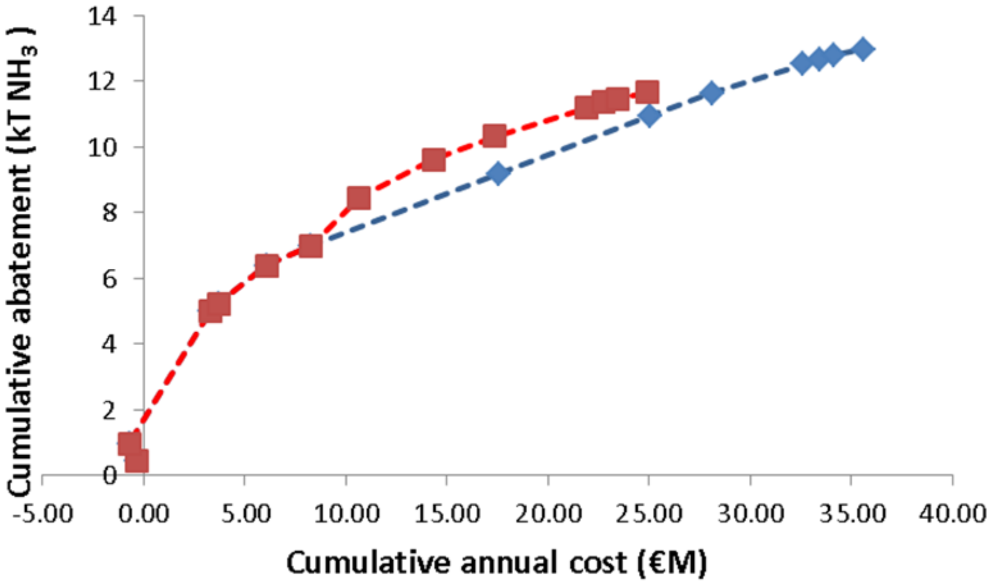

Figure 3: Cumulative costs and abatement for the Food Wise 2025 Sustainable Growth Scenario. The blue line indicates abatement with trailing shoe included, whilst the red line includes bandspreading as a landspreading abatement option.

The most cost-effective measures (apart from timing of application) were incorporation of urease inhibitors, the use of trailing hose for bovine slurries, reducing poultry pH with alum amendment and the reduction of crude protein in pig diets. It should also be noted that the costs associated with crude protein supplementation could be cost-neutral depending on the relative costs of soy bean meal and supplemental amino acids. These measures accounted for 60% of the mitigation for less than 40% of the total cost. There are some major caveats to the quantification of this mitigation value. First, 100% replacement of urea by urea+urease stabilisers was assumed. This would require financial incentivisation and there are currently only one or two manufacturers, although several fertiliser companies are engaged in product development in this area. Secondly, while these products are on the recommended fertiliser lists, the detection of these compounds in vegetation or animal products is still unknown. Indeed, previous negative publicity surrounding detection of the nitrification inhibitor DCD in New Zealand has made farmers and food companies wary of using some of these compounds. However, the concentration of urease-inhibiting compounds in fertiliser is much lower than for DCD and the product is directly sprayed on the granule, not on the sward. It should also be noted that there is a possibility of urea+urease stabilisers displacing calcium ammonium nitrate (CAN). Indeed, Teagasc and AFBI research has demonstrated that there are substantial benefits in terms of reducing N2O emissions when urea+urease stabilisers replace CAN (Zaman et al 2013). If this occurred, there could be an increase in ammonia emissions as the emission factor for urea+urease stabilisers is higher than that of CAN. Similarly, a campaign to reduce urea use could result in more farmers using CAN. Other things being equal, a shift to CAN would increase agricultural GHG emissions, as N_2O loss from CAN is 30% higher than for urea.

Reductions in pig crude protein content (4%) reduction should be achievable and also have co-benefits in terms of reducing N2O and leached N emissions. The abatement value of covering pig stores is highly uncertain as data on the total configuration of outdoor storage was scarce. Alum amendment of poultry litter may also have added benefits for landspreading emissions if the pH effect persists until the litter is applied to land.

It should be noted that three of the four most effective methods in terms of ammonia abatement were also amongst the most expensive: trailing shoe (dairy and non-dairy) and the covering of external bovine slurry stores. Trailing shoe is more effective at reducing emissions than trailing hose. However, increases in nitrogen fertiliser replacement value are not enough to offset the increased costs, which were calculated for contractor spreading. The use of trailing shoe could be made more cost-efficient by targeting spreading using this technique to summer months. An analysis has previously shown that May to August are the most high risk months for ammonia emissions in Ireland (Lalor & Lanigan 2010). Targeting abatement to this period would reduce abatement from 3.3 kT NH_3 to 1.8 kT NH_3, whilst reducing costs from €8.7 million to €4 million.

The potential mitigation figures quoted above may alter into the future and we envisage the need for another iteration of this analysis prior to 2030. This due to a) new technologies that will come on-stream, b) changes in emission factors currently being proposed by the Task Force on Emissions Inventories and Projections (TFEIP) and c) proposed new emission sources from industry that will lessen agricultures share of total ammonia emissions.

Finally, it should be noted that the cost of advice and education for farmers and the cost of farmers' time (which is particularly important for part-time farmers working off the farm) has not been factored into this analysis.

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