PROGRAMME 3
ENVIRONMENT – LAND USE AND RURAL STEWARDSHIP

Upscaling Nitrous Oxide (N_2O) emissions from land

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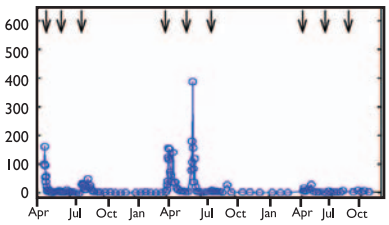
Why are nitrous oxide emissions important for Scotland?

- Nitrous oxide (N_2O) is a powerful greenhouse gas which has a global warming potential 300 times that of CO_2. Over half our emissions are from agricultural land and primarily depend on the amount of nitrogen applied to fields
- Our land use and management practices are valuable tools in meeting our international obligations to reduce greenhouse gas (GHG) emissions to below 1990 levels by 2010, which is an annual saving in Scotland of about 1.7 million tonnes of carbon equivalents per year

How land management contributes to N_2O emissions

- N_2O emissions from land are influenced by fertiliser application rates, grazing regimes, soil wetness and temperature and vary with soil type and land management (Figure 1)
- We developed a simple scaling framework (Figure 2) to bring together field measurements with soil, land use and climate maps to quantify how much N_2O is emitted from different soil:land use combinations in Scotland

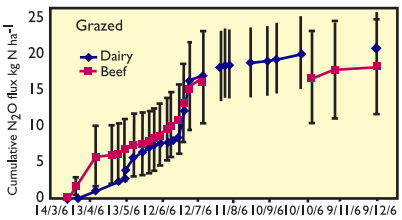
a) Nitrogen Additions



b) Temporally scaled annual N_2O emissions for different land uses and managements (kg N ha^{-1} y^{-1})

Dairy Cattle ungrazed	1.6 – 6.5
Dairy Cattle grazed	3.4 – 13.6
Beef Cattle ungrazed	1.0 – 3.8
Beef Cattle grazed	1.7 – 5.3
Spring Cereal	0.8 – 1.3
Winter Cereal	0.6 – 0.9
Potato/root crop	2.3 – 6.6

c) Land Management



d) Soil Wetness

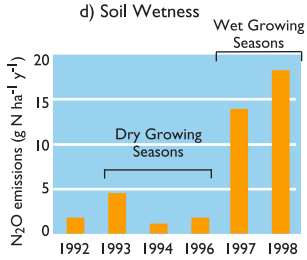


Figure 1 Variations in annual N_2O emissions from pasture due to (a) additions of NH_4NO_3 fertiliser where '↓' indicates fertiliser application, (b) cumulative emissions from adjacent dairy and beef grazed grassland in SW Scotland, (c) land management (d) annual emissions from un-grazed pasture in relation to soil wetness.

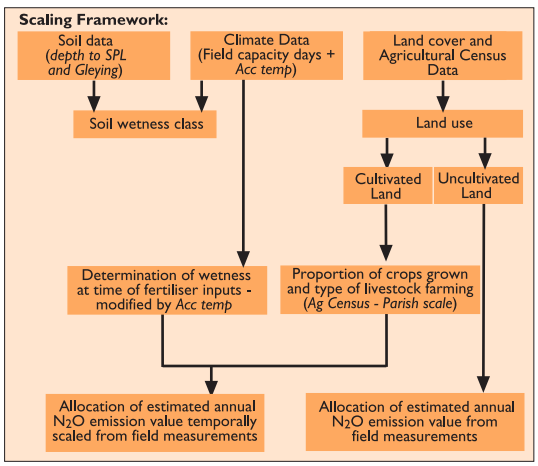
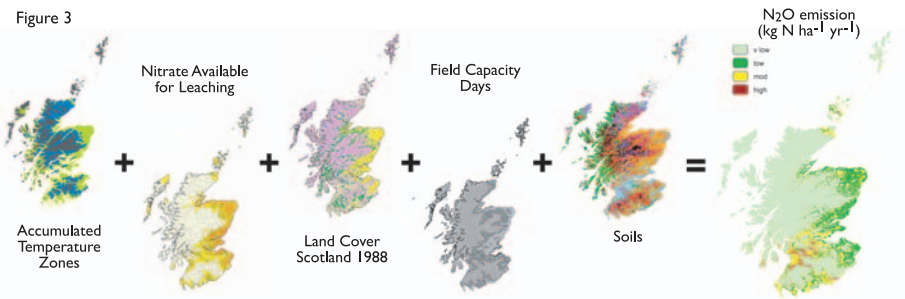


Figure 2

Upscaling to produce national estimates

By overlaying soil, climate and land use maps for the whole of Scotland, using a GIS system, we produced a national map of N_2O emissions and calculated national N_2O emission figures (Figure 3).

Figure 3



Ways to mitigate N_2O emissions

- We estimate a national emission of 6 million kg y^{-1} N_2O which equates to 0.72 Mt carbon equivalents per year
- This demonstrates the potential to use land to offset our GHG target using mitigation strategies to reduce field-scale emissions but these will be most effective in areas with highest emissions
- We are currently using the framework to target areas with high predicted emissions to investigate what the options are for reducing emissions under different land uses and management practices at the farm-level

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