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# New framework for estimating agricultural emissions

**Agriculture is a significant source** of greenhouse gas (GHG) emissions. Researchers have developed a framework for estimating emissions of methane and nitrous oxides from agriculture, by updating the International Panel on Climate Change (IPCC) approach, which captures more detail about differences between locations.

**As parties to the UNFCCC**[1], which came into force in 1994, EU Member States are required to publish national inventories of GHGs, which need to be comparable, transparent and relatively easy to calculate. These are the benefits of using the inventory-based framework developed by the IPCC[2] to estimate agricultural emissions, in comparison with more complex methods, which model the detailed physics and chemistry of agricultural processes.

Emissions from crops and animals depend on many factors, for example, animal type, sex, weight, age, manure storage, weather and soil type. The IPCC framework averages emission factors (EFs) for different crop and livestock categories, which can hide significant differences in time and location. For instance, crop growth, animal diet and agricultural practice can change seasonally. A framework should aim to capture process detail but retain simplicity, so the research suggests updating the IPCC method to capture local variability.

The study's aim was to construct and test an easy-to-use inventory framework for GHG emissions using the IPCC framework method. The UK was used as a case study. The framework combines local and national emissions models with submodels to account for different emission pathways of methane (from digestive gases and manure) and nitrous oxides (from animal excretion, fertiliser and soils). Input data for the model follows international inventory formats.

Animal inventories are grouped according to the main production system into 34 types (various types of cattle, pigs, sheep, deer and poultry, plus goats and horses). Crop inventories are similarly split into 36 types. The remaining data sets are manure management systems, emission factors, and 'other factors' (such as emissions from fertilisers, leaching, livestock excretion rates). Emission factors were averaged separately for regions - England, Northern Ireland, Scotland, and Wales, and calculated local emissions were then summed to derive a UK total. The model can be used at higher resolution without significant modification and is easy to update when more detailed information becomes available.

The new framework identified geographic variations and large differences between the regions. Many sources of uncertainty remain in the modelling - including animal and crop census data, emission factors, farming practices, general data quality and other variables, such as meteorological conditions, whose inclusion is not required under the IPCC framework. Census data, statistics and emission factors are entered into the model separately and so are easy to update independently when more specific information becomes available. Soil emission factors were found to have most influence on the model output and this suggests that IPCC default values may be overestimates, compared to those of the process-based model for the UK, as they are based on generalisations. The accuracy of estimates may be greatly improved, without altering the framework, simply by applying more specific emission factors and more agricultural classification categories.

The framework can resolve local differences and regional variety and corresponds well with the IPCC's methodological tiers. Local-level EFs can be replaced easily using either local-specific EFs (Tier 2, which uses IPCC default equations but requires country-specific parameters that better account for local climate, soil, and management) or more complex ones from process-based models (Tier 3 – methods based on more complex models and inventory systems, typically using more diverse livestock and vegetation data that better capture differences in local conditions).

1. http://unfccc.int/essential_background/convention/items/2627.php
2. www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

**Source**: Wang, J., Cardenas, L.M., Misselbrook, T.H. & Gillespy, S. (2011) Development and application of a detailed inventory framework for estimating nitrous oxide and methane emissions from agriculture. *Atmospheric Environment*. 45: 1454-1463.
**Contact**: junye.wang@bbsrc.ac.uk
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