

Nitrogen Flagship

Newsletter 3 – April 2026

The Nitrogen Flagship aims to help countries to improve their national inventories reporting under the Paris Agreement, by developing Tier 2 (reflecting local soil and climate conditions) and Tier 3 (modelling based) emission factors for the use of N fertiliser, relevant for the estimation and reporting of direct nitrous oxide (N₂O) emissions from soils.

The activities of this Flagship are linked to the implementation of two pillar projects:

1. Refining Emission Factors for Inventory Reporting (REEFIR; 2022-NZIRL REEFIR-AGR), an Ireland (IE)-New Zealand (NZ) research initiative, and
2. Optimizando el Uso de Nitrógeno, Mayor Producción y Menor Impacto (N4R; ATN/RF-20641-RG and ATN/RF-20642-RG), a research initiative including activities in Chile, Argentina, Panama, Peru, and The Dominican Republic, supported by Fondo Regional de Tecnología Agropecuaria (FONTAGRO) and the Ministry of Primary Industries (New Zealand).

Over the last year, the REEFIR project has been busy on three fronts. The first relates to the gathering of data from fertiliser studies conducted across many different countries – data include emission factors, plus key soil and climate variables. This data will be used to develop revised emission factors. The database now contains over 800 emission factors, with the next phase focusing on completing the collation and quality control, followed by statistical analysis. Secondly, good progress is being made with employing process-based models (DNDC, DayCent, APSIM) to develop higher tier emission factors. The current work effort is focusing on ensuring the models describe key soil processes adequately before exploring the models' ability to simulate N₂O emissions from soil. Thirdly, field experiments have been completed in both IE and NZ (Photo 1), with the data now being collated for future modelling purposes. The REEFIR research team also met for a week in NZ in December 2025, where plans were made for the next 12 months. The research team is made up of PhD students, post-doctoral fellows, junior scientists and not-so-junior scientists (Photo 2).



Photo 1. View of REEFIR study sites, 2025 a) Johnstown Castle, IE, b) Ruakura, NZ, and c) Invermay, NZ.



Photo 2. REEFIR project team workshop, held in December 2025 (Hamilton, NZ).

The N4R project is in its second year of implementation. A unified Greenhouse Gas (GHG) measurement protocol was agreed upon following a kick-off meeting and hands-on workshop. Seven field trials have been established across Latin-America, three in Argentina (maize and perennial pasture), and one each in Chile (pasture, Photo 3a), Peru (potato), Dominican Republic and Panama (horticultural systems). These trials are assessing N fertilisation strategies, focusing on practical mitigation options to reduce gaseous N losses and provide emission factors for the countries involved. Results are expected to inform more efficient fertiliser use and support the development of evidence-based policies for climate-smart agriculture in the region. Outreach and capacity-building activities have included field days, and participation in scientific conferences, along with two conference abstract publications. A key milestone was a regional workshop and training on N gaseous emissions held in Chile (Photo 3b), with participation of project representatives from all participating countries.



a)



b)

Photo 3. a) View of N4R experiment implemented in Chile, and b) the N4R team at kick-off workshop held in January 2025 (Chile).

In addition to these research activities, during this year The Netherlands joined the N flagship through the participation of Wageningen University Research (WUR), providing data from experiments carried out locally. The Netherlands uses country-specific (Tier 2) emission factors for N₂O emissions from agricultural soils in its emission inventory. However, these factors are based on experiments conducted 15–30 years ago and do not distinguish between fertiliser or manure types. To address these limitations, multiple field experiments have been carried out on sandy, clay, and peat soils in both arable and grassland systems. The resulting data are now being collated for inclusion in the N flagship dataset. Preliminary results showed no consistent differences in emissions among mineral fertiliser types, with large variability between years, crops and locations; an example of these results is shown in Fig. 1. Rainfall

was the dominant driver of emissions, often overriding management effects. Application method had strong influence than fertiliser type, particularly for liquid fertilisers, where injection increased emissions. Inhibitors showed promising, albeit variable, mitigation effects. An update and refinement of Dutch emission factors for manure, mineral fertilisers, crop residues, and RENURE products is planned for 2027.

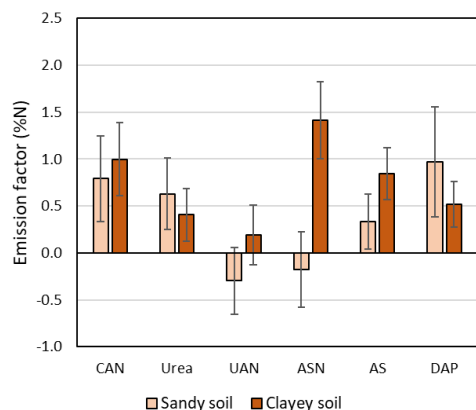


Figure 1. Average N₂O emission factors for Calcium Ammonium Nitrate (CAN), Urea, Urea Ammonium Nitrate (UAN), Ammonium Sulphate Nitrate (ASN), Ammonium Sulphate (AS), Diammonium Phosphate (DAP) applied to arable crops on a sandy and clayey soil in a two-year period.

The N flagship successfully held an online webinar on “Nitrogen mineral fertilisers, pathways for nitrous oxide mitigation” with participation of keynote speakers from the REEFIR (Dr. Dominika Krol, Teagasc IE and Dr. Tony Van der Weerden, BSI NZ) and N4R (Dr. Francisco Salazar, INIA Chile) pillar projects. They covered advances in N₂O mitigation in temperate grasslands and challenges for N₂O mitigation research in Latin-America. In addition, Dr. Mart Ros (WUR, The Netherlands) provided an overview of advances in N₂O mitigation in temperate cropping systems. The recording of the webinar is now available on the GRA website (<https://globalresearchalliance.org/n/recording-available-nitrogen-flagship-webinar-nitrogen-mineral-fertilisers-pathways-for-nitrous-oxide-mitigation/>). The N flagship also provided updates for the GRA Annual Council Meeting (May 2026).

If you are interested in the progress of one of these initiatives or you would like to contribute with data to the current work undertaken, please contact us through the GRA.

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