Release Notes – for Overseer version 6.3.2

The next update of OverseerFM will include minor changes to some science modelling equations.

The release is planned to occur on: **9 September 2019**.

This note explains the changes and the impact of them on the modelled results – the changes include minor corrections to existing equations following science reviews and the inclusion of modelling to account for urease inhibitor properties of fertiliser products.

Contents

1. Animal metabolisable energy requirements

An independent expert panel was convened to review the current methodology used to estimate animal metabolisable energy (ME) requirements. As part of the review, a comparison was done between the current Overseer methodologies and the Agricultural Inventory Methodology (AIM). The finding of this panel was that the CSIRO (2007) methodology is the appropriate system, and variations from this methodology to provide site specific estimates were examined and documented. This resulted in recommendations for some changes to the Overseer methodology.

Changes have been made to the Basal Energy component of the ME model as a result of these recommendations. The equation below is reproduced from the Animal Metabolic Energy Requirements Technical Manual chapter to identify the changes made.

Basal Energy Component

Basal net energy requirements (MJ/day) calculation was based on the equation in *Nicol and Brookes (2007, equation 1)* and are consistent with the CSIRO equation and with AIM.

Equation 13 NEbasal = base * K * S * M * Agefactor * lwt0.75

- base (base metabolic rate or fasting heat production) is a constant value based on metabolic live weight at 0.28 MJ/kg $lwt^{0.75}$.
- K is the species/breed constant (changes were identified here).
- S is a factor to adjust requirements on the basis of sex [Equation 14].
- M is a factor to adjust requirements on the basis of milk in the diet [Equation 15].
- Agefactor is a factor to adjust requirements on the basis of age [Equation 17].
- lwt is the live weight excluding conceptus and, for sheep, fleece (kg).

No change has been recommended to the basal equation – but changes have been made to the factors used including: K factor, age factor and gestation length.

K Factor - which determines the maintenance requirements and hence nutrient intake over late autumn/winter specific to species/breeds.

- Dairy: Changed K from 1.4 to 1.5.
- Beef: K remains at 1.3 for British breeds. But changes to 1.5 for dairy breeds and 1.4 for dairy/beef crosses and large lean breeds.
- Sheep: Remains at 1.

This change will result in higher estimated animal ME requirements for dairy, dairy cross and large lean beef breeds. For dairy systems, the percentage change in a given month will be larger in winter than in summer. This is because in summer a higher proportion of intake is required to meet lactation requirements. The result of increased intake is likely to lead to higher N leaching, methane and nitrous oxide emissions, and more effluent, potentially resulting in higher P-loss.

Age factor – which determines the energy requirements relating to age.

Overseer uses a daily counter to estimate age as days since birth. This is represented in the Agefactor equation (#17 in the Animal Metabolic Energy Requirements Technical Manual chapter) as:

Agefactor = $\exp(-K_{age} * age)$

- age being the animal's age in days and K_{age} being a constant (previously 0.00008)

The CSIRO 2007 parameter value for K_{age} is based on years, and for consistency, the Overseer value is now estimated as the CSIRO (2007) value divided by 365 days to give 0.0000821918. Thus, the constant for K_{age} has been changed from 0.00008 to 0.000082.

The effect of changing k_{age} on estimated ME_m is minimal.

Gestation length

The following changes to gestation length have been made in line with recommendations:

- Gestation length for cattle changed from 285 to 281 days.
- Gestation length for sheep changed from 150 to 147 days.

Following full documentation of the CSIRO approach, further assessment is recommended for net energy requirements calculations for pregnancy and gestation and liveweight change.

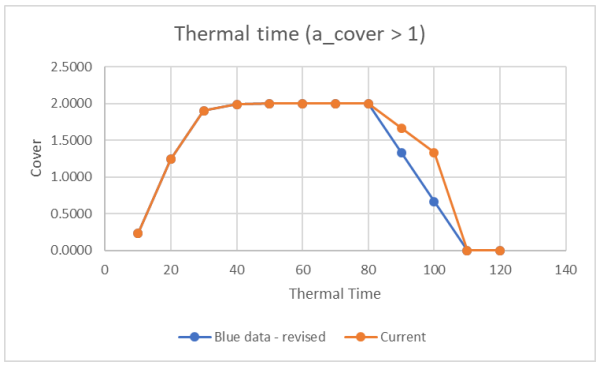
Work is still underway to adopt the CSIRO (2007) approach for Net energy value of milk for sheep and to assess the need for reconciling milk produced by animals with that consumed by suckling young.

2. Crop cover calculations

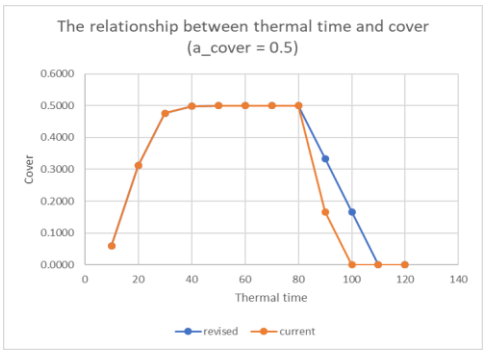
While working on new functionality to enable user-defined crops, we have corrected the way crop cover is calculated. This involves changing the equations for crop cover to ensure they are consistent with the original assumption that if the monthly thermal time is less than the thermal time to maturity, cover declines **linearly** with thermal time.

Defoliated crops generally re-establish cover quickly. Thus, it is assumed that the loss of cover following senescence will follow a similar pattern to that of a seedling crop. Therefore, this change has been applied to crop cover for seedling crops and defoliated crops.

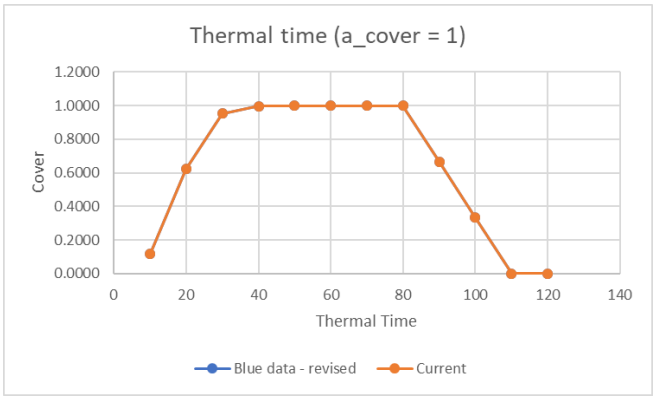
The graphs below show the change when the maximum cover (a_cover) is > 1, < 1 and = 1 for the crop.



Graph 1 - Cover with increasing thermal time when a_cover is >1 (2)



Graph 2 - Cover with increasing thermal time when a_cover is <1 (0.5)



Graph 3 Cover with increasing thermal time when a_cover = 1

There are four crop types affected by this change. These are autumn oats, autumn wheat, clover seed and ryegrass seed. The following table shows the parameters used in the equation for these crops.

Crop name	a_Cover	T_Senescence	T_Mature
Autumn oats	1	80	100
Autumn wheat	1	80	100
Clover seed	0.8	110	120
Ryegrass seed	1	75	90

This change to calculating crop cover is expected to make very minimal if any change to N-leaching results for arable farms. Of the 500 farms with crop blocks tested in OverseerFM only 9 farms recorded changes in N-leaching results, and all were within 1kg of N leaching per hectare.

3. Nitrous oxide modelling

Following work by the Biological Emissions Research Group to assess options for reducing agricultural emissions, an independent project was completed to review the current approach for estimating N_2O emissions in Overseer and propose recommendations for improvements.

The scope of this review was limited to pastoral systems and included assessment of the approaches to estimate N_2O emissions from; excreta (urine/dung) deposited onto paddocks, N fertiliser use and effluent and manure management systems. The project recommended some changes are made to the Overseer N_2O modelling.

Some of these have already been implemented, including setting annual average emissions factors as the temporary default ahead of changes to the farm specific setting and updating (where necessary) default emission factors to align with those used in AIM.

The following three changes are now implemented from the recommendations. Additional science research to address farm specific calculations and to include new research on slope is underway.

Fertiliser emissions

The fertiliser emission factor has been applied to the total amount of fertiliser N used rather than subtracting the amount of N lost through volatilisation first. This requires us to remove the FertVolat factor from equation 25 in the Nitrous Oxide Emissions Technical Manual chapter.

We have also implemented a previous recommendation that provides for different emissions factors to be applied to the different fertiliser types. Therefore equation 25 is changed from:

$$FertEmissions_{mon} = (FertN - Fertvolat) * MonEF1_{mon} + FertN0_3 * MonEF1_{mon} * 1.5 + FertMix * MonEF1_{mon} * 1.2$$

to

$$FertEmissions_{mon} = (FertN - ureaN - FertNO_3 - FertMix) * MonEF_{nonurea} + ureaN * MonEF_{urea} + FertN0_3 * MonEF1_{mon} * 1.5 + FertMix * MonEF1_{mon} * 1.2$$

where $MonEF_{urea}$ is 0.0059 and $MonEF_{nonurea}$ is 0.01, as per the AIM documentation in 2017.

This change will result in reduced nitrous oxide emissions where urea is the dominant form of N applied.

Emissions from bunkers

The denitrification and N_2O emissions rates for LBunkerlined have been updated to 0.10 and 0.01 respectively and for LBunkerrunlined to 0.02 and 0.0001 respectively.

This change will result in lower nitrous oxide emissions from farms with wintering pad/animal shelter systems that have bunkers.

Emission factor for excreta leaching

The Indirect N_2O emission factor for excreta leaching has changed from 0.025 to 0.0075 to align with AIM. This change will result in lower indirect nitrous oxide emissions.

Impact of model updates

To provide an indication of the impact of these model changes, we have assessed a sample of 500 farms in OverseerFM. Please note - all paid farms in OverseerFM will have individual analysis results presented as v6.3.2 and will see v6.3.1 results for comparison.

The following bar graphs show the change in N leaching, P runoff and greenhouse gas emissions for a sample of 500 farms in OverseerFM, grouped into different enterprises (Dairy, Beef, Sheep). Please note, because we are using real information, farms may have more than one animal enterprise operating and so the change presented will include any impact of this.

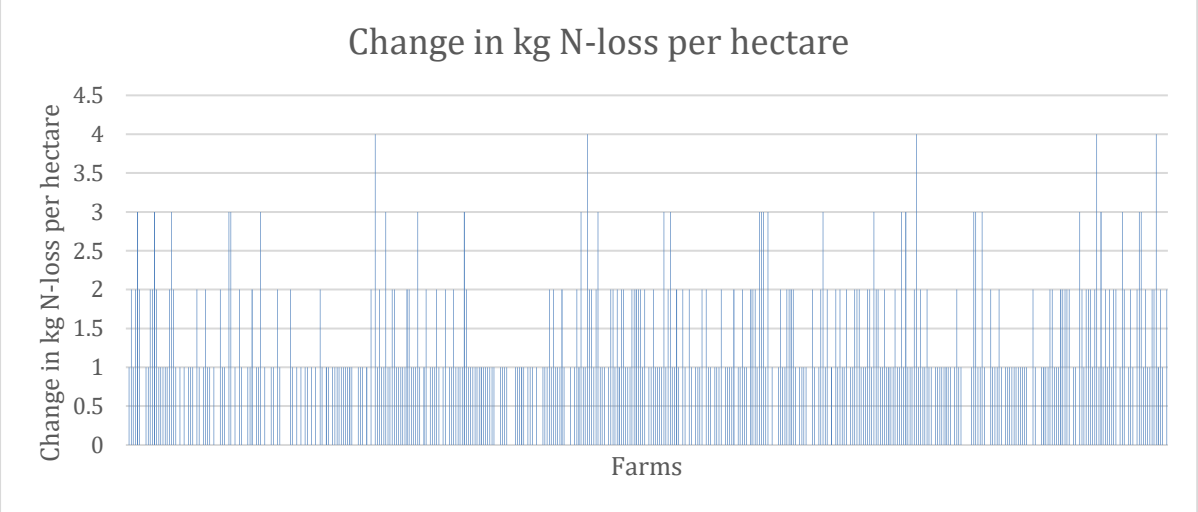
The X-axis shows the sample farms, the Y-axis shows the amount of change for each farm. A positive change means the value has gone up, while a negative change means it goes down. The gaps along the X-axis represent no change for that farm.

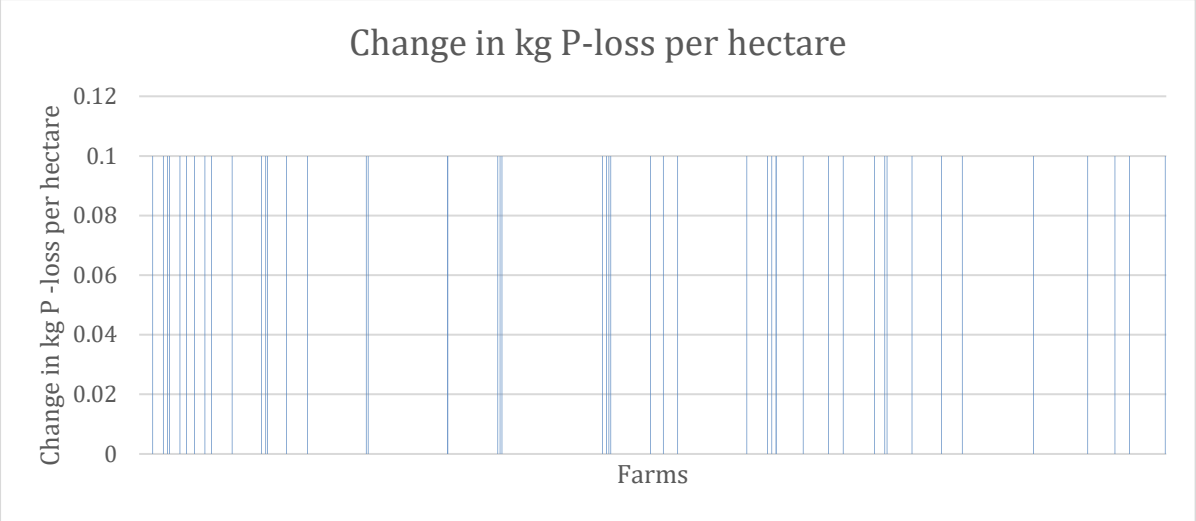
The changes that make the most significant impact on results are the increase in animal ME requirements for dairy and some beef breeds and the changing of fertiliser and excreta nitrous oxide emission factors.

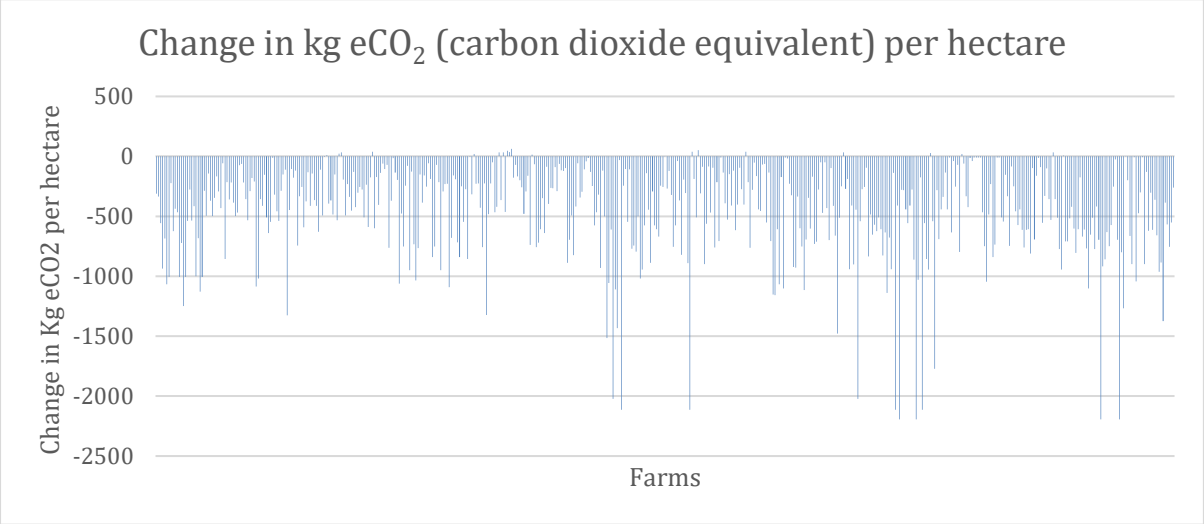
The increase in animal ME requirements increases intake and subsequently emissions of methane and nitrous oxide from excreta. The change in fertiliser emission factor results in reduced nitrous oxide emissions as urea is the normal form of N applied.

There is also a large reduction in nitrous oxide emissions from effluent where a wintering pad has a lined bunker defined.

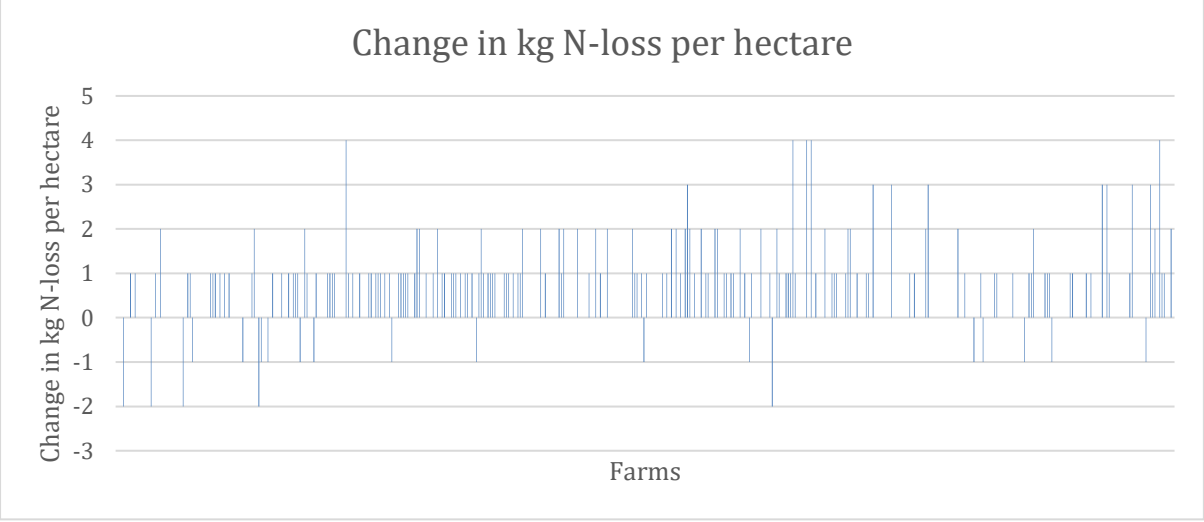
Farms with Dairy Enterprises

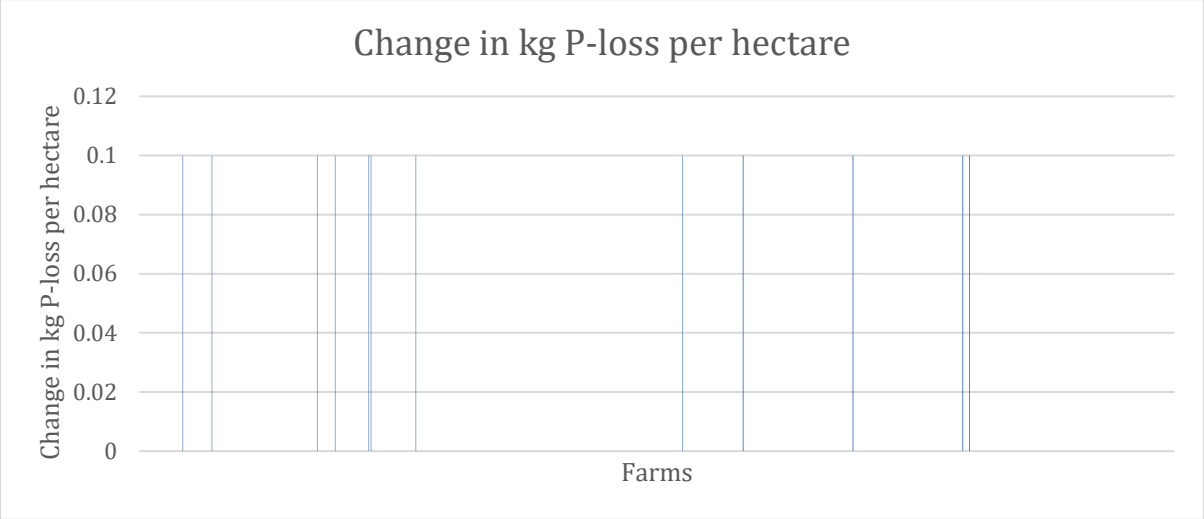


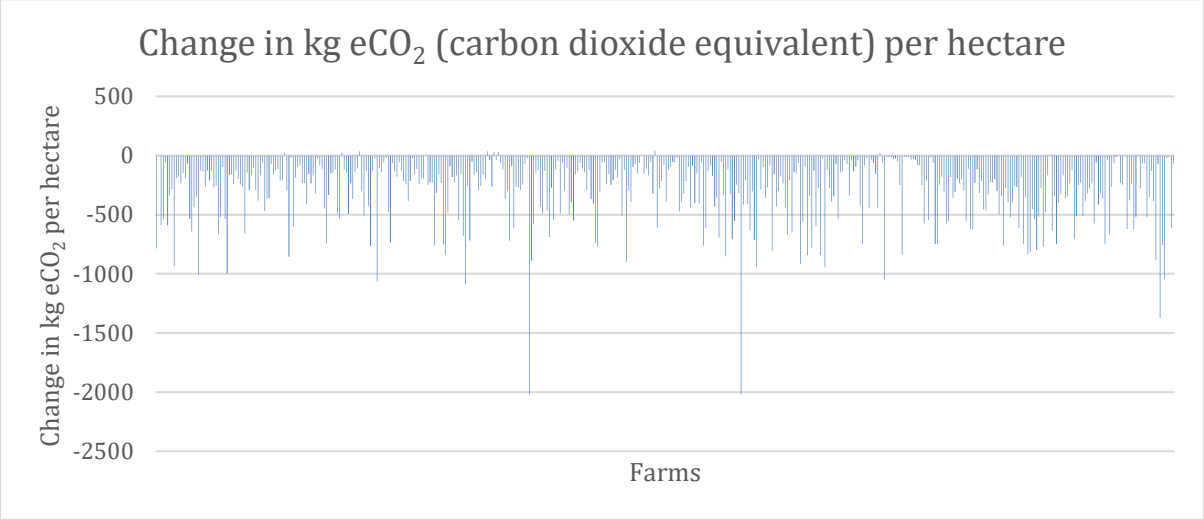




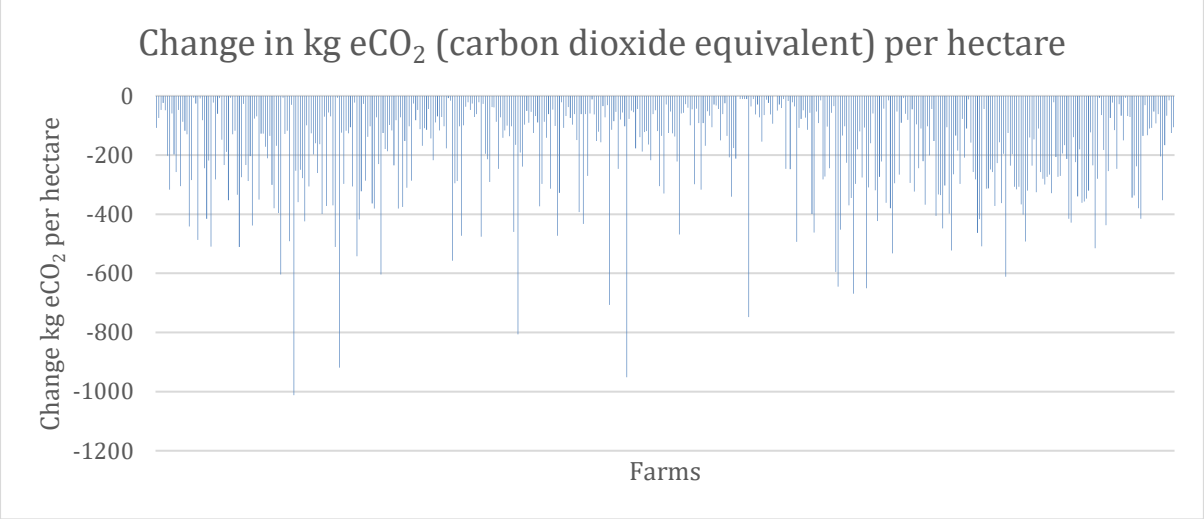
Farms with Beef Enterprises







Farms with Sheep Enterprises - There is no change in N or P loss for sheep enterprises.



4. Urease inhibitors

Support for urease inhibitors in certain fertiliser products has been added to OverseerFM.

The methodology used to model the impact of urease inhibitors is summarised in Adding Urease Inhibitors Methodology and Rationale (6 November 2018) and was confirmed through the Overseer Science Discussion forum on Loomio.

All existing analyses in OverseerFM that include use of these fertiliser products will have updated results.

The following is the list of products in OverseerFM that have urease inhibitors added.

Ballance

- Pasturemag Hay & Silage (With SustaiN)
- SustaiN
- SustaiN 15K
- SustaiN 20K
- SustaiN 25K
- Pasturemag
- Pasturemag 5K
- Pasturemag 10K
- Pasturemag 15K
- Pasturemag 12N
- SustaiN ammo 30N
- SustaiN ammo 36N
- PhaSed N
- PhaSed N QS

Ravensdown

- N-Protect
- N-Protect S

Terracare Product

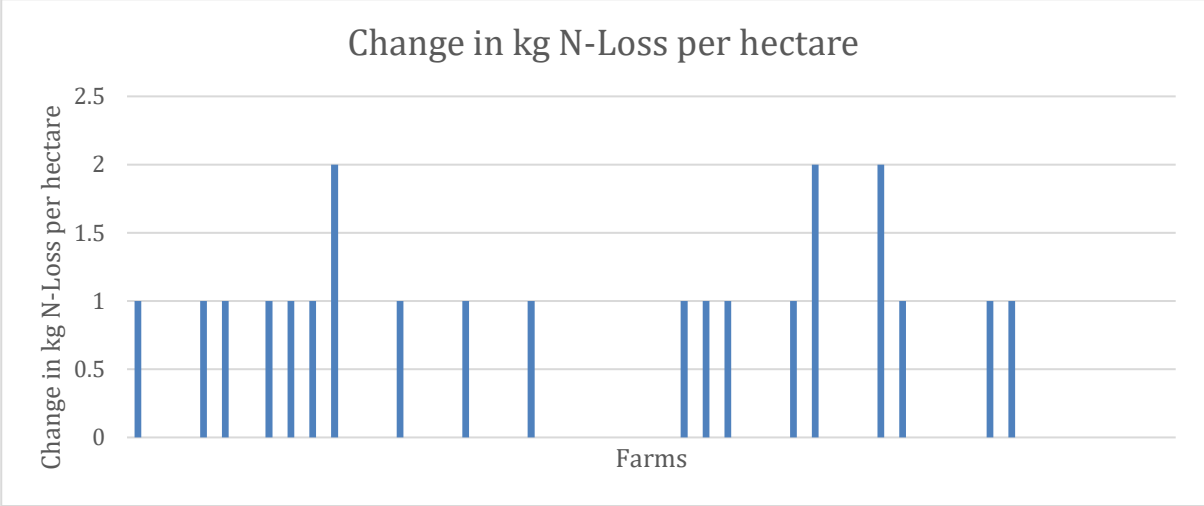
- extend

Impact of urease inhibitors

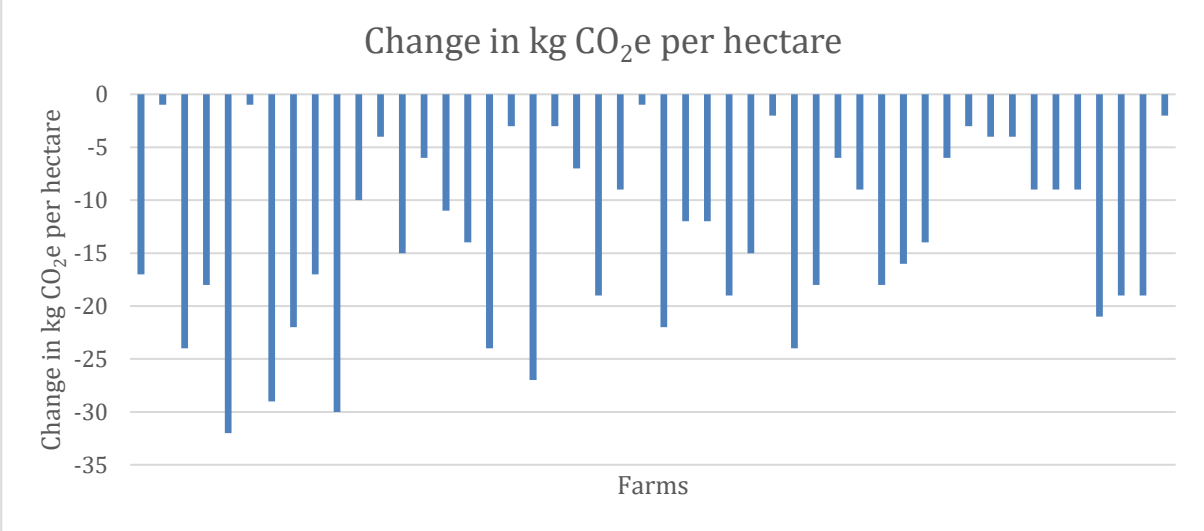
To provide an indication of the impact of including urease inhibitors, we have assessed a sample of 50 farms in OverseerFM that use at least one of the listed fertilisers.

As described above, The X-axis shows the sample farms, the Y-axis shows the amount of change for each farm. A positive change means the value has gone up, while a negative change means it goes down. The gaps along the X-axis represent no change for that farm.

The first graph shows the change in N-loss per hectare for farms using urease inhibitors. Urease inhibitors reduce the volatilisation from the surface providing more nitrogen in the soil for plant uptake. Applying urease inhibitors to existing analyses, results in more nitrogen being available in the soil. So, using existing production values results in a slight increase in N leaching numbers for some farms when soil drainage occurs.



This graph shows the change in kg eCO_2 (Carbon Dioxide equivalents) per hectare. The decrease in volatilisation creates a decrease in indirect nitrous oxide emissions.



5. Correction to Animal Distribution

Overseer provides three options for defining the percentage of pasture eaten by animals. When “Based on animals present on block” is used, the model was incorrectly allocating animals to blocks.

This has been corrected in 6.3.2, so that when an animal enterprise is not on a block it is not included in the pasture eaten calculations.

There are approximately 330 analyses effected by this change. While there can be a slight change in N loss, the main difference will be in the way the losses are attributed to blocks.