# Nitrogen use efficiency (NUE) indicators for the arable sector

## Why is FAR developing NUE indicators?

- There are no simple metrics for quantifying nitrogen (N) management under arable farming in New Zealand.
- Nitrogen use efficiency (NUE) indicators (*N output & N input (fertiliser) relationships*) have been used successfully overseas.

## What NUE indicators did we test and how did they perform?

FAR research showed three out of more than 20 NUE indicators in use around the world were appropriate for use in the New Zealand arable sector. These three indicators were tested for use in maize silage, feed wheat and perennial ryegrass seed crops. Following testing, the partial N balance (**PNB**; *N yield of product (kg/ha)/applied N fertiliser (kg/ha*)) indicator was selected as the most appropriate for the New Zealand arable sector.

- The **PNB index** shows the position of the paddock or farm in a continuum of N availability (low—high); showing under-, optimum or over-supply of N.
- The PNB index does not work for perennial ryegrass seed production.

**How can arable farmers use the PNB index?**
Practical PNB ranges (Table 1) have been developed to guide farmer decision-making and promote the effective use of soil N, with PNB values for maize silage and irrigated wheat.

**These ranges are:**
**Below 1.2** High N supply [soil N + N fertiliser], an indication of over-application of N fertiliser, exceeding crop N requirements. Values indicate high residual soil N (orange/ red), therefore increased potential for environmental risk.

**Above 1.5** Inadequate N supply and reduced yields. Values indicate inadequate N supply with intensity increasing from orange to red.

**1.2 — 1.5** The sweet spot; a 'balanced N fertilisation band' (green), where soil N supply was effectively utilised and supplemented with N fertiliser without compromising yield. Values indicate optimum N supply, resulting in favourable economic and environmental outcomes.

A 'traffic light' system has been developed for use by maize silage and irrigated feed wheat (Table 1a) growers using these ranges. Similarly, a corresponding system was developed for non-irrigated feed wheat (Table 1b). To confirm the actual amount of N fertiliser required when PNB values are high or low (Table 1), soil testing for mineral and mineralisable N is recommended.

**Table 1.** Partial nitrogen balance (PNB) 'traffic light' table for: (a) maize silage and irrigated wheat and (b) non-irrigated feed wheat. Nitrogen (N) supply is made up of total soil N + N fertiliser. Total soil N is soil mineral N and potentially mineralisable N (PMN).

| | PNB | N supply | Recommendation | Outcome |
|---|---|---|---|---|
| **(a) Maize silage & irrigated feed wheat** | | | | |
| | ↑ >1.5 | Low | Soil mineral N & PMN test | Enter soil mineral N and PMN results into the FAR N Calculator to determine how much **additional N** to apply to achieve target yield. |
| | 1.2-1.5 | Optimum | Monitor crop | |
| | <1.2 ↓ | High | Soil mineral N & PMN test | Enter soil mineral N and PMN results into the FAR N Calculator to determine potential fertiliser N reductions to cut costs and minimise environmental risk without compromising target yields. |
| **(b) Non-irrigated feed wheat** | | | | |
| | ↑ >1.12 | Low | Soil mineral N & PMN test | Enter your soil mineral N and PMN results into the FAR N Calculator to determine how much **additional N** to apply to achieve target yield. |
| | 0.88-1.12 | Optimum | Monitor crop | |
| | <0.88 ↓ | High | Soil mineral N & PMN test | Enter soil mineral N and PMN results into the FAR N Calculator to determine potential fertiliser N reductions to cut costs and minimise environmental risk without compromising target yields. |


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