Getting to the Root Cause of Phosphorus Losses From Farms

Here, we present our expanding body of evidence on P processes on farms, which has led to our holistic approach of analysing the full P cycle on each farm in order to identify the root causes and implement targeted measures to address all pollution processes.

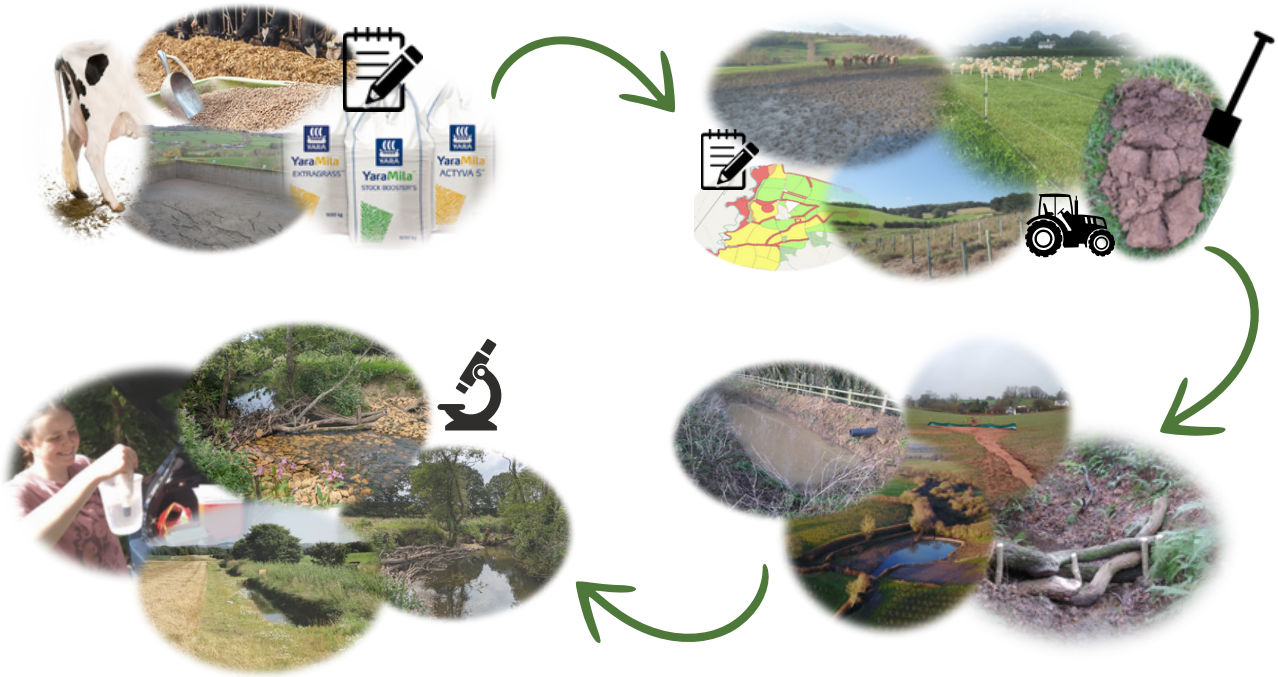
Compiled by our Devon Nutrient and Soils team: FACTS and Basis Soil & Water qualified advisers Samantha Read, Eve Halliday and Dr Sabine McEwan. Over the past four years, we have continually gathered data, experience and expertise. This has allowed us to identify new areas of exploration and refinement of our approach, based on valuable insights gained along the way.

It is essential to address every stage of the pollution process

Currently, most projects prioritise disrupting transport pathways, some projects focus on reducing mobilisation and protecting receptors, but minimal focus is on reducing the source of phosphorus (P) pollution.

Source: Identify and reduce the source of (excess) nutrients on farms

Mobilisation: Reduce (the risk of) mobilisation of soil particles and associated nutrients via runoff and erosion.



Receptors: Protect, restore and monitor waterbodies.

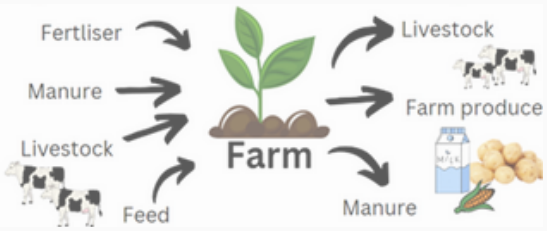
Transport: Disrupt transport pathways. Slow & filter runoff. Reduce connectivity.

P sources are the root cause of P losses on farm

Our data shows that tackling the root cause - high P sources on farms - offers the potential to reduce P losses. However, this approach is challenging:

- It impacts core farming operations and may risk profitability (though some of our farm business data suggests otherwise).
- Accurate data is hard to obtain due to limited farm record keeping and inadequate labelling of feed P content by suppliers.
- Farmers often lack the incentives or appetite to reduce P sources. To address this, we developed whole-farm P metrics and payments-by-results as part of the River Axe Landscape Recovery scheme.

Most farms import more P onto the farm than they export, thereby increasing the P source over time



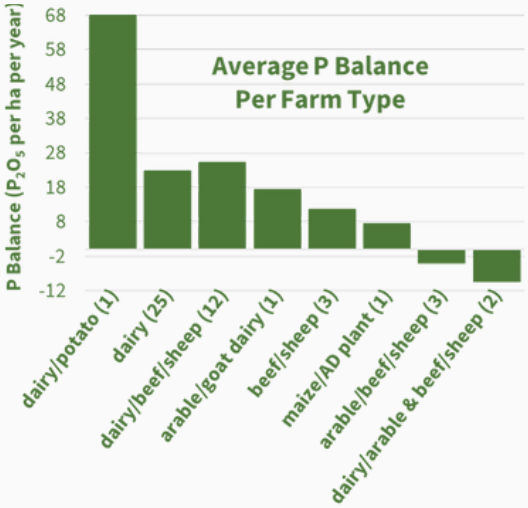
P balance/ha/year = P imports - P exports / farmed area

A positive a P balance is an indication of:

- suboptimal P-use efficiency on the farm
- a gradual accumulation of excess P on the farm.

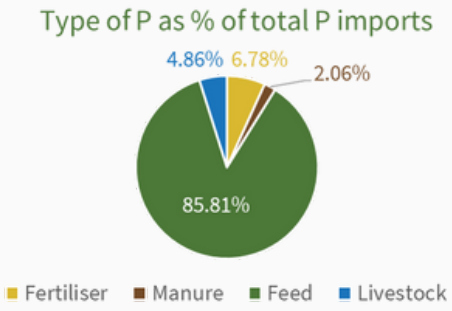
We calculated 48 P balances - a further 11 are in progress and will be finished by March 2025:

- 42 positive P balances, 6 negative or neutral P balances
- Livestock farms, especially dairy/beef/sheep have high positive P balances



If a farm has a positive P balance, we need to drill into the details to identify the main source of P.

P in livestock feed is the highest contributor to excess P on farms



- 85.8% of P imported onto farms is in form of livestock feed
- Through Triple Axe, we worked with specialist livestock nutritionists and learnt that feed often contains more P than necessary, against recent reductions in industry recommended P figures.
- 27% of farms import P fertiliser
- Only 4% of farms (3 farms) import manure, only one of which had a negative P balance
- 16.6% of farms export manure

Ways of reducing positive P balances

- Collaborate with livestock nutritionists and feed merchants to safely reduced excess P in feed.
- Enhance home-grown forage yield and quality
  We have developed payments for rotational adaptive grazing for the River Axe Landscape Recover scheme.
- Explore manure/slurry export options to suitable locations whilst considering TB risk.
- Require feed merchants to disclose detailed P content.
- Record farm data by enterprise for improved analysis, such as correlating milk yield with feed per cow.

Different P balance calculators each bring benefits and drawbacks

We compared calculator tools: Planet and the Northern Ireland Regulatory Tool.

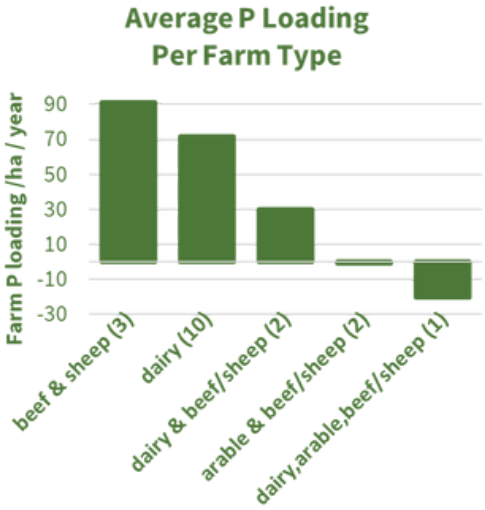
- Type of P - Planet uses Phosphate (P2O5), Northern Ireland tool uses Phosphorus (P). To convert to P205, multiple the amount of Phosphorus by 2.29.
- Inclusion of bedding - Planet includes bedding, providing a more holistic nutrient balance.
- Feed input methodology – Planet suggests standardised figures for simplicity, simpler process but risks being less accurate. Whilst the Northern Ireland tool allows for customised and potentially more precise inputs although it is challenging finding accurate feed composition data.
- Nutrient scope – Planet calculates N, P and K balances, providing a more holistic picture.
- Result interpretation - Both tools lack context on what an optimal or sustainable balance should be. The NI tool provides a maximum regulatory output, while Planet offers a benchmark range based on the average farm type.

Many livestock farms have excess P loading = they produce more P in manures than they can spread

We developed a new metric 'Farm P loading' which expresses P produced on farm in all manures compared to soil and crop P requirement.

$$\text{P loading/ha} = \frac{\text{P in manure - P crop requirement}}{\text{farmed area}}$$

- Assessing slurry and FYM production, then use the Nutrient Management Guide RB209 or analysis to calculate P content. Account for imported/exported manure.
- Determine P crop requirements using up-to-date soil data Be careful with total vs plant available P (as RB209 recommends) and consider spreading risk map, habitats, buffers and agri-environment schemes.



We calculated 17 P loadings - 13 more in progress.

A neutral or negative P loading is a proxy for compliance with Rule 1 of the Farming Rules for Water 'do not spread more than crop requirement'. However, detailed nutrient/manure planning is required to fully assess this.

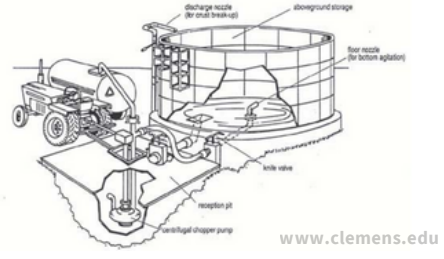
Nutrient/manure management planning often misses key considerations to work as an effective tool for reducing both P source and the risk of mobilisation

We have worked with >100 farmers and their agronomists, reviewing their existing plans. Whilst approx. 80% of farms have a nutrient/manure management plan, we found:

- Often, only arable and silage fields are soil tested and included in the plans.
- The plans are usually used for calculating how much fertiliser use is required for topping up beyond manures.
- Still, calculations are mainly focused on meeting crop N requirement, thereby overapplying P. Farmers are often not made aware of Rule 1 of the Farming Rules for Water within the plan.
- No assessment as to whether too much manure/slurry is produced for the available spreading area & soil and crop requirement.
- Slurry storage is often not assessed.
- The exact rate of application is not monitored throughout the year, therefore refinement of the plans are not possible.
- Don't include assessment of soil structure and health, which should be part of a spreading risk assessment.

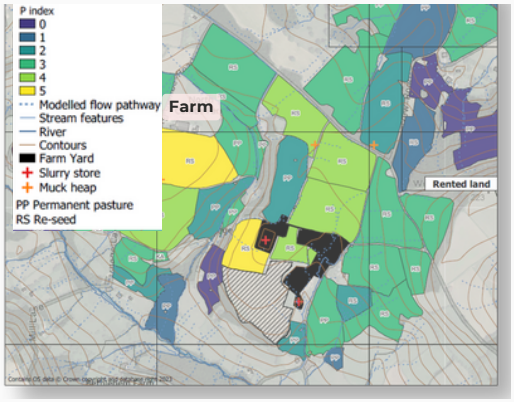
Prescriptions for SFI Num1 'Assess nutrient management and produce a review report' do not give detailed and clear enough guidance.
We have now delivered >15 holistic field-by-field nutrient/manure management plans, which include all those points above.

Insufficient slurry/manure storage limits matching applications with crop requirement and suitable conditions



We assessed SSAFO and Farming Rules for Water compliance on around 80 farms. Manure storage upgrades have significantly improved in the Axe catchment, but progress is hindered by planning delays, funding shortages, and inconsistent slurry wizard calculations.

Soil P indices and P crop requirement are very unevenly distributed – scope for better nutrient management planning



Here we present a summary of 10 selected farms where we have sampled every field (418 fields):

- 43% of fields were above target soil P index 2
- 29% of fields are at target P index 2
- 28% were below P index 2

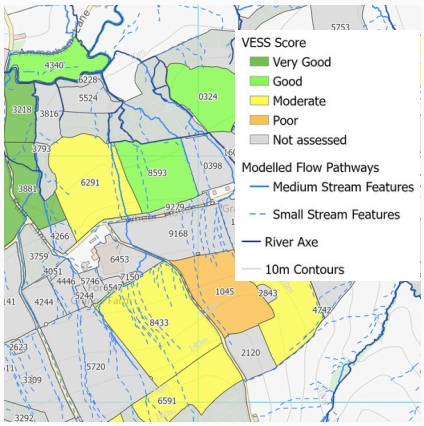
Identified drivers & solutions

- Fields closest to the yard & most accessible have highest soil P index. Improve access for spreading and grazing via livestock and machinery tracks.
- Rented land often has lower P indices than owned land. The perception often is that increasing soil P indices is an investment or an assurance policy.
- Large, flat, accessible fields (with inherently lower risk of runoff and erosion) have the highest soil P indices. This reflects following of spreading risk maps.
- Fields in agri-environment schemes and with priority habitats have lower soil P indices

Soil degradation limits effective nutrient cycling and increases risk of mobilisation

We have carried visual evaluation of soil structure (VESS) of >700 fields and developed an arable/cultivated land VESS score card.

- Permanent pasture often has good structure but with surface compaction by grazing
- Temporary grass had a tighter soil structure, along with poor surface cover and surface capping due to increased trafficking
- Maize fields had poor soil structure. Post harvest cultivation often caused just as bad degradation as leaving it as stubble. Undersowing Maize did show a benefit, but tramline issues remain - disrupt tramlines



Infiltration is limited across the catchment and therefore the risk of runoff is increased - structure risk assessments are required before spreading manure.

Avoiding 'sticky plaster solutions' and 'pollution swapping' through our holistic approach

- Care must be taken to ensure mitigation measures don't inadvertently increase pollution risk elsewhere on the farm or the wider catchment.
- Conventional methods, such as taking fields out of production, buffers, and wetlands, can reduce local P transport if well designed and managed—and we have delivered many of these. However, they don't address the source.
- Without also tackling P sources, excess P persists, often leading to concentrated applications on smaller areas.

FWAG South West work with farmers, using a holistic approach - identifying and addressing the root causes combined with implementing measures to tackle all pollution processes. This reduces P losses, improves farm sustainability and benefits the broader catchment area.

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Farming and Wildlife Advisory Group South West

FWAG SouthWest