FWAG Summary of Lancaster Study on Phosphorus (P) Dynamics in Somerset Catchments

Lancaster University studied P dynamics in Somerset for the Somerset Catchment Partnership. The issue of legacy P was already known, but Lancaster University's research quantifies and demonstrates it more clearly than ever before. Very useful learnings for how we best advise farmers and how we best monitor improvements.

UK-Wide P Trends

- P balances (the balance between inputs or imports and exports or crop offtake) are improving across the UK, with a notable reduction in P fertiliser use.
- England is approaching a P balance, but:
    - Livestock areas still have an excess of P.
    - Arable areas are experiencing P drawdown.

P Trends in Somerset Catchments

- River P concentrations are declining.

- Historical P surpluses are reflected in high soil P concentrations.
- P inputs have significantly decreased over the last decades.
- Current P surplus is small but still contributing to legacy P reserves.
    - This means that despite reduced inputs, excess P in soils continues to accumulate over time.
- Olsen P (the measurement we use to determine soil P index) only represents about 2.5% of total P in the soil.
    - This is considered the crop-available P. Well-structured and biologically active soils can still release additional P over time.

Legacy soil P reserves pose the main pollution threat form agriculture P.

- The study identified sources of P loss in rivers:
    - 60% from agricultural diffuse pollution
    - 40% from wastewater point-source pollution
- Over 80% of P lost from agriculture comes from legacy P, not new P inputs.
- 50% of all P in the river originates from agricultural legacy P.
- Fields with soil P >15 mg/L (equivalent to the high end of P index 1) are at higher risk of P loss.

Can Legacy P Be Used for Crop Growth?

- Lancaster University's grass plot experiments (only grass) on different soil types found:
    - No yield penalty when no P is applied until P index 1.
    - Below P index 1:
        - Light soils experience stronger yield penalties.
        - Clay soils experience weaker yield penalties.

- Well-structured, biologically active soils enhance P recycling, making legacy P more available to crops.

Implications for Reducing Agricultural P Losses to Rivers
To minimize P pollution, particularly in livestock-dominated catchments in the South West, strategies should focus on:

1. Reducing Legacy P by Cutting Farm P Surplus
    - It takes 5-10 years of no P inputs to lower the P index by one level.
    - Focus on P mg/L measurements rather than P indices (as reported by NRM) for tracking progress.
    - Help farmers quantify and reduce key P metrics:
        - Farm P balance (P imported vs. P exported)
        - Soil P balance (P applied vs. P removed by crops – RB209)
        - Farm P loading (FWAG metric: manure P production vs. crop requirements)
    - Improve soil structure and biological health to enhance natural P cycling.
    - Conduct half-field trials with no P inputs to determine yield thresholds for P deficiency.
2. Preventing Mobilized Legacy P from Reaching Rivers
    - Implement structures to trap mobilized P, but be aware that these can become saturated and turn into P sources over time:
        - Wide vegetated buffer strips
        - Sediment traps
        - Wetlands

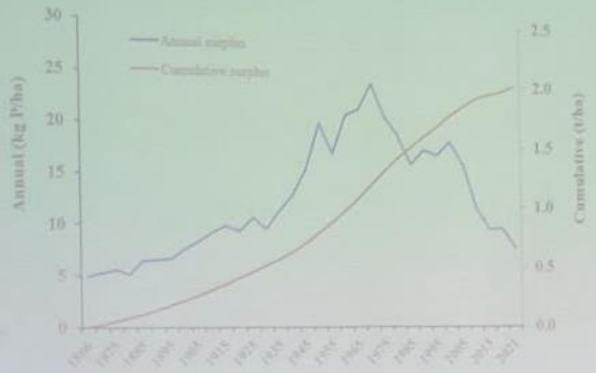
Proposed Approach to Measuring Project Success

- Water quality monitoring will primarily reflect legacy P losses, making it unreliable for detecting the impact of recent management changes.
- Instead, success should be measured using farm- or field-level P metrics (such as P balances and soil P levels). These metrics demonstrate reduced risk of P loss by showing progress in slowing the cumulative buildup of P in soils.

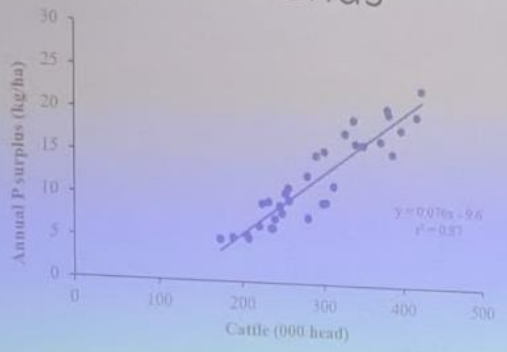
More useful information on this website **Resilience Phosphorus UK – Re-focusing phosphorus use in the UK food system**

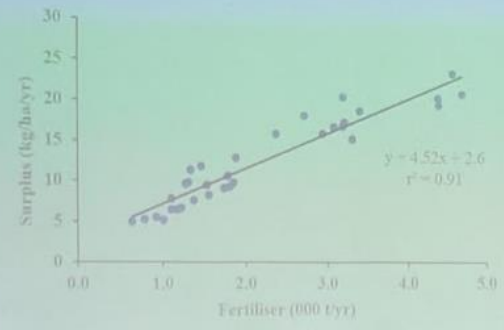
Historic P surpluses in Somerset

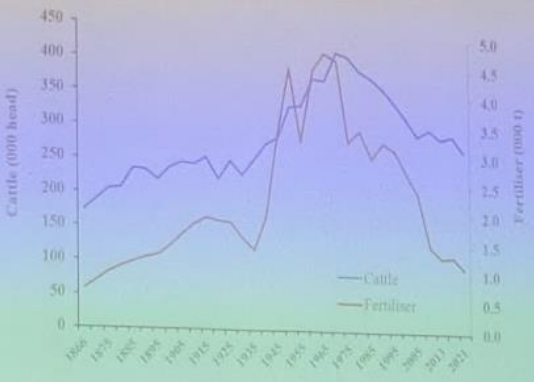
- Historic P surpluses can be quantified by a soil P balance (P inputs/P outputs)
- Quantified fertilizer/manure P inputs against crop P offtake every 5 years from 1870 - 2021
- Estimated annual and cumulative P surplus



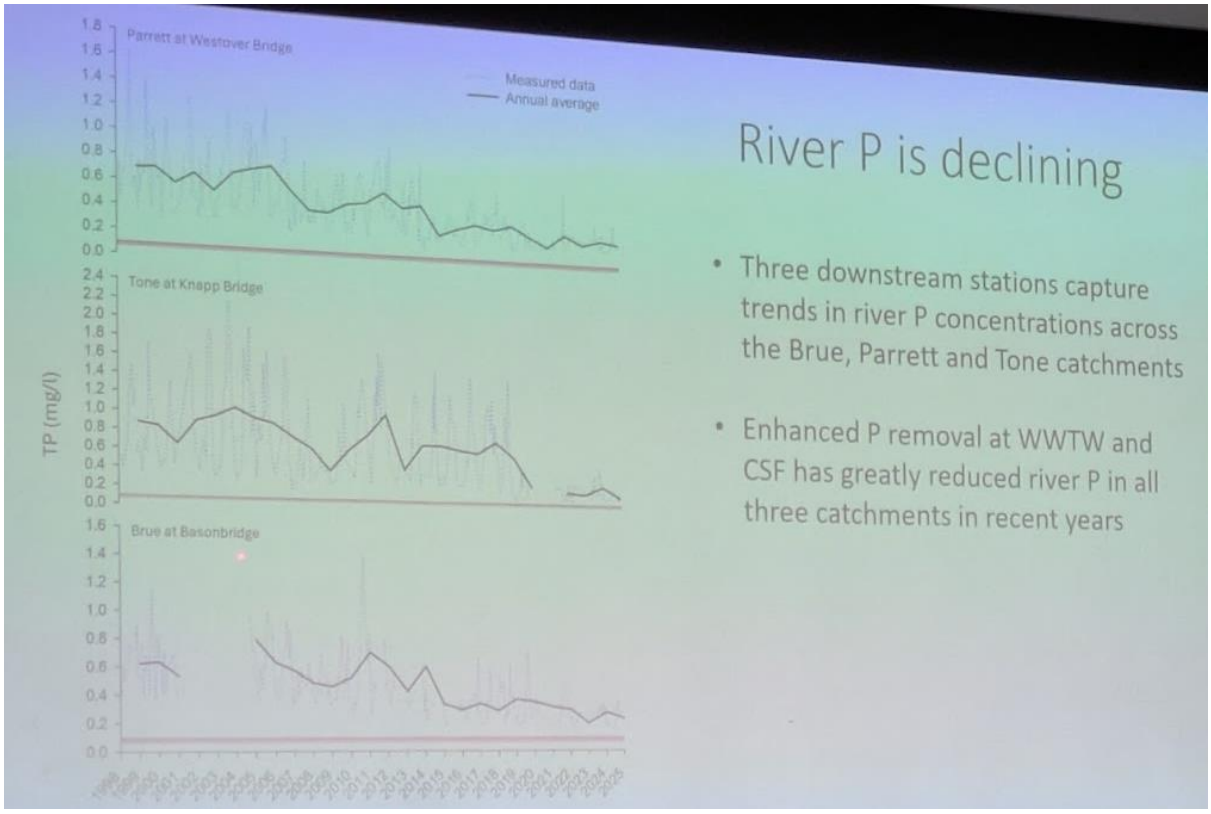
Surplus trends







P surpluses have reduced since the 1970's due to declines in cattle numbers and a big drop in P fertilizer use



River P is declining

- Three downstream stations capture trends in river P concentrations across the Brue, Parrett and Tone catchments
- Enhanced P removal at WWTW and CSF has greatly reduced river P in all three catchments in recent years