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Managing the Risk of Phosphorus Loss from Slurry Applications in Northern Ireland

DAERA E&I Project 17/04/08

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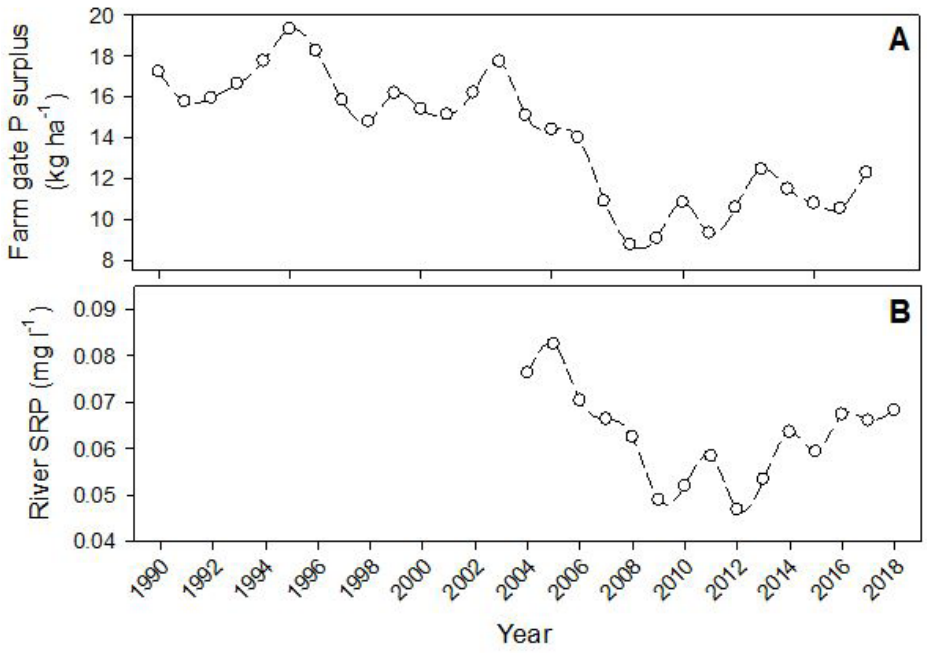
19th Novemebr 2021

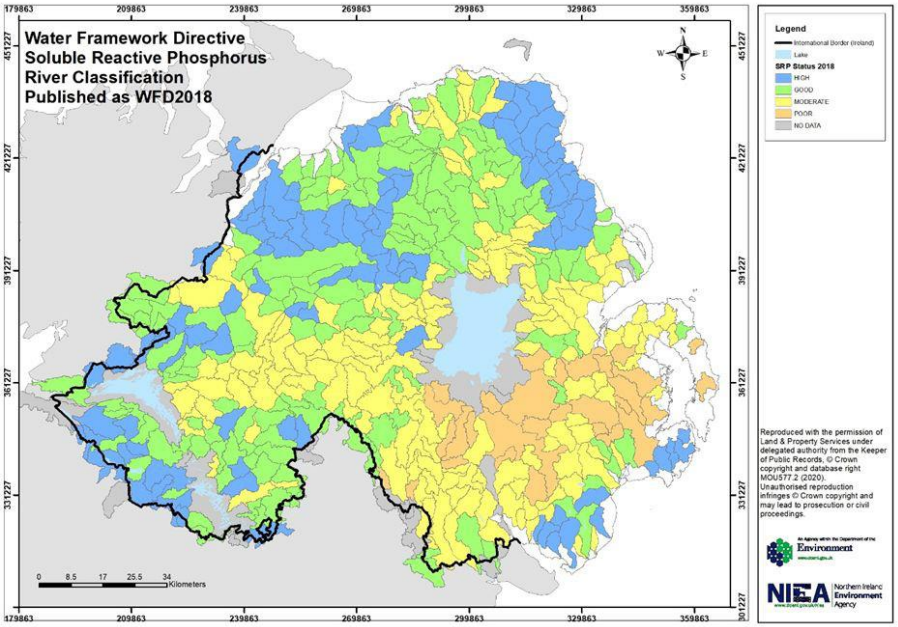
afbini.gov.uk

Water Quality in Northern Ireland



940 tonnes agricultural P lost to water

61% of waterbodies are above the target required for good status



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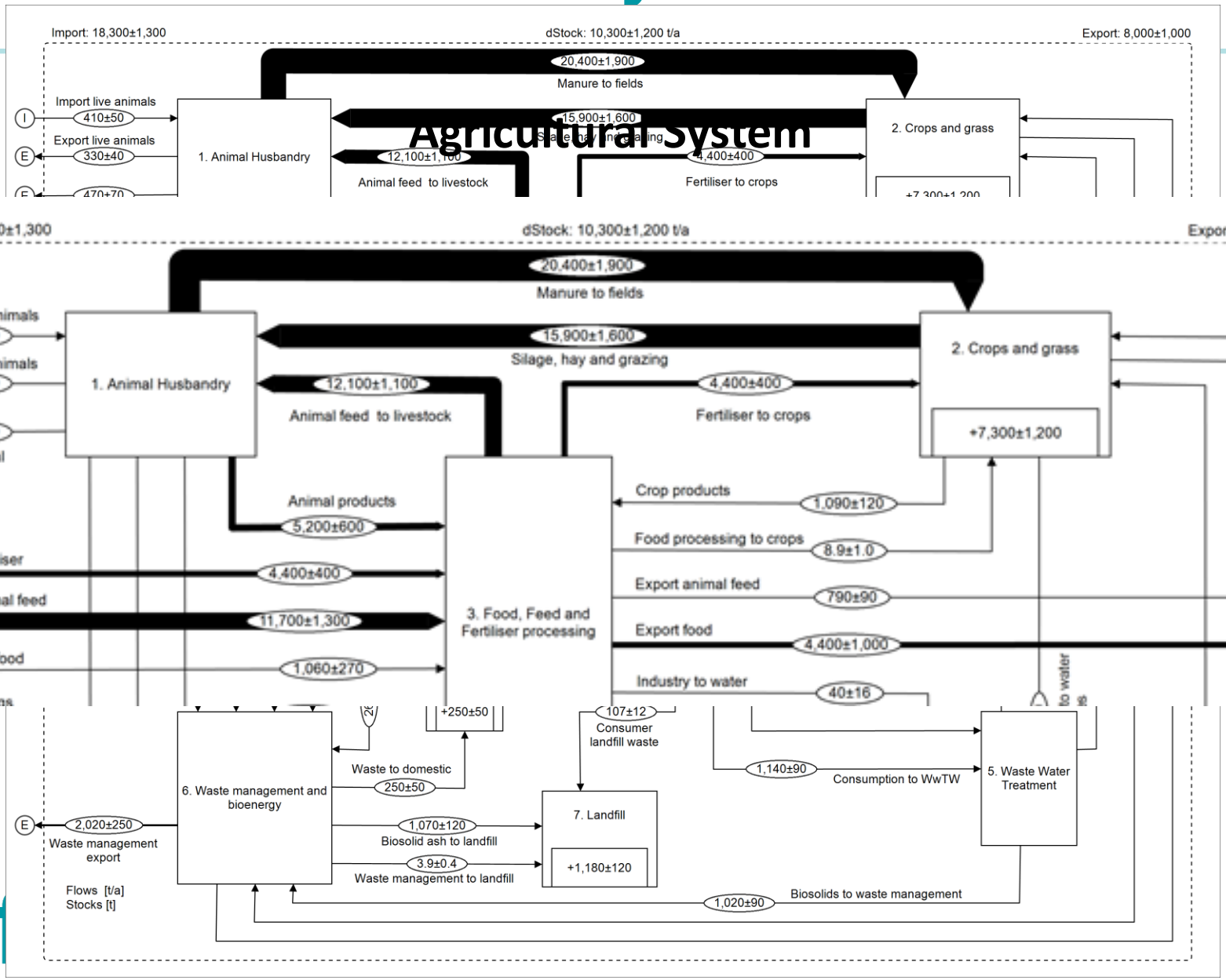
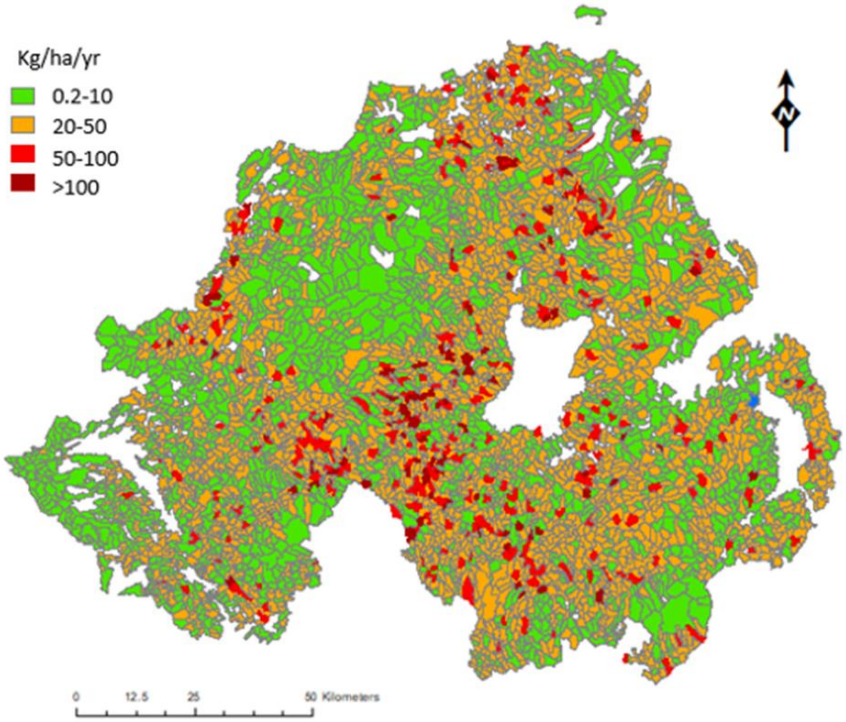
P Substance Flow Analysis.

Rothwell, et al *Resources, Conservation and Recycling*, *163*, p.105065.

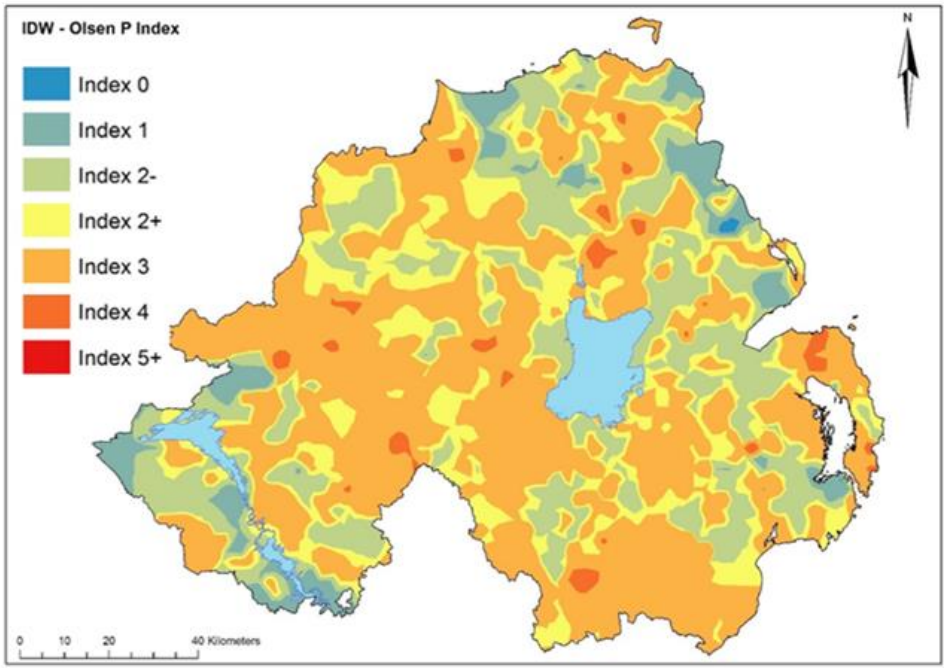


Phosphorus Surplus - Spatial Distribution

P Load -Townlands



Olsen Soil P



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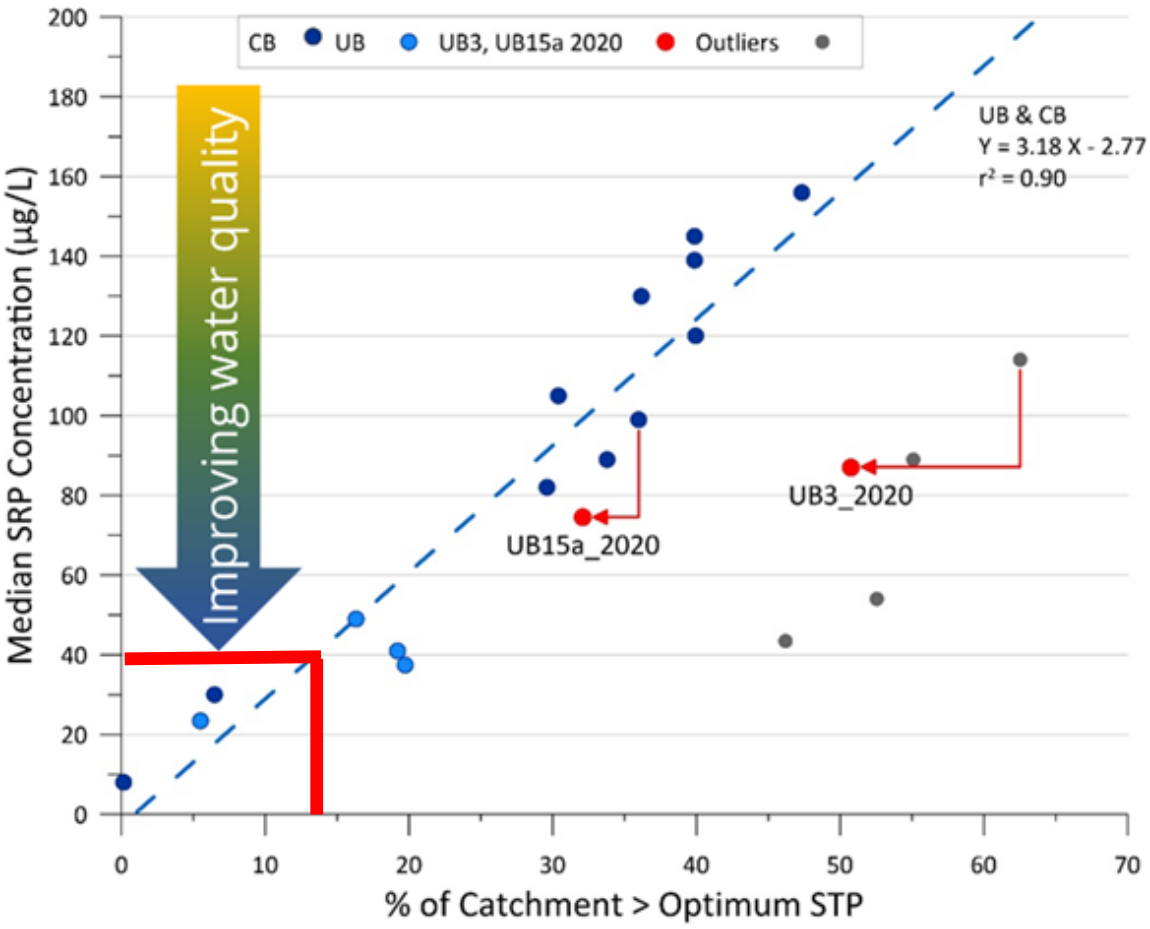
- Higgins et al 2021.. *Soil Use and Management*, *37*(4), pp.900-905.

Achieving Water Quality Targets
Upper Bann Catchment

- Currently 41% of soil in the Upper Bann Catchment are above agronomic optimum soil P
- WFD Target in the Upper Bann Catchment is 40ug/l
- To achieve this target only <15% can be above agronomic optimum



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- Cassidy et al 2019.. *Science of the total environment*, *687*, pp.277-286

Nutrient Action Programme

STATUTORY RULES OF NORTHERN IRELAND

2019 No. 81

ENVIRONMENTAL PROTECTION

The Nutrient Action Programme Regulations (Northern Ireland) 2019

Made - - - - 8th April 2019

Coming into operation - 11th April 2019

CONTENTS

Restrictions on Slurry Application

Closed Period 15th October to 31st January

No application on

- waterlogged or frozen soils
- if heavy rain (4 mm hr^{-1}) within 48hrs
- Steep slopes (average incline ≥ 20%)

Set back distances from watercourses

Application rates ≤ 50 m^3 ha^{-1}

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Other Considerations

Storage Capacity

Next opportunity to spread

Maximise nutrient efficiency

Animal welfare

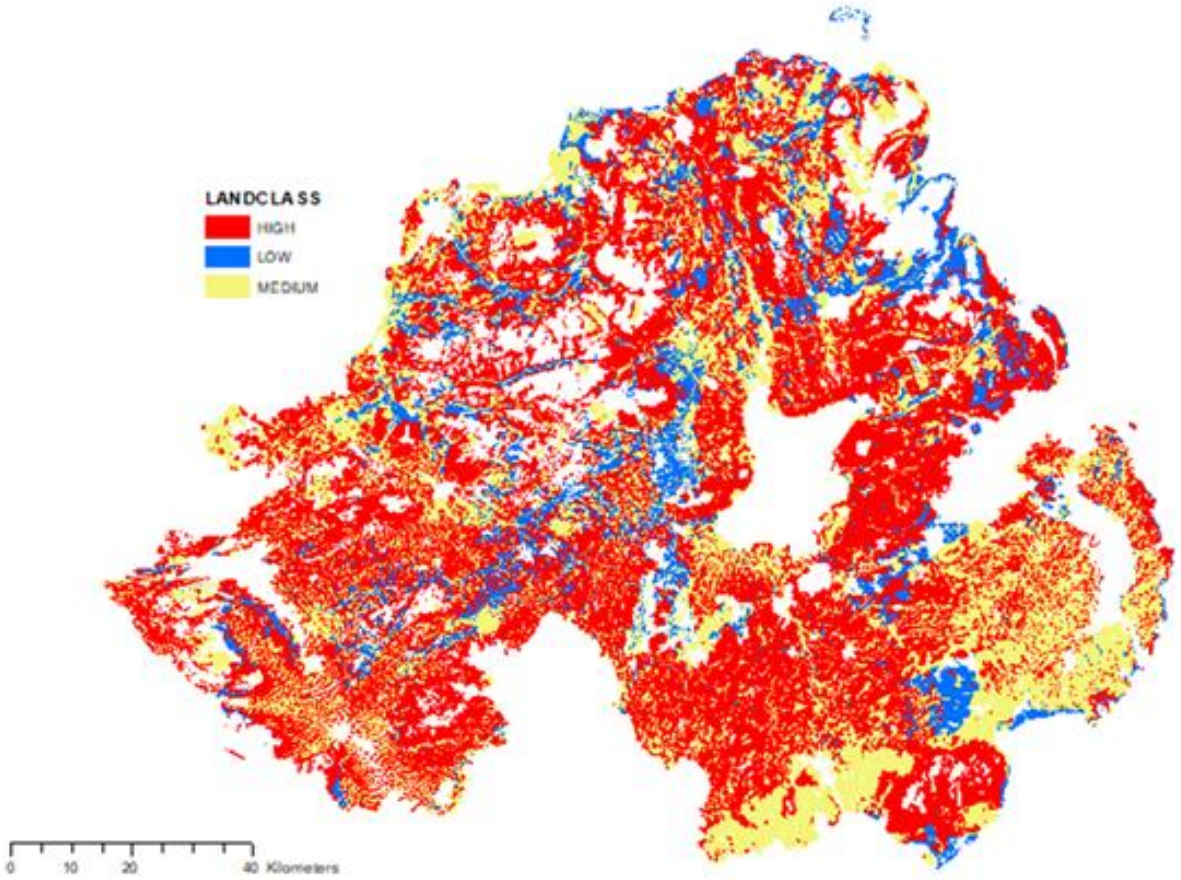
Soil compaction

Contractor availability

Timing of other farm activities

Runoff Risk - Spatial Variability

High Runoff Potential
58%
Medium Runoff Potential
31%
Low Runoff Potential
11%



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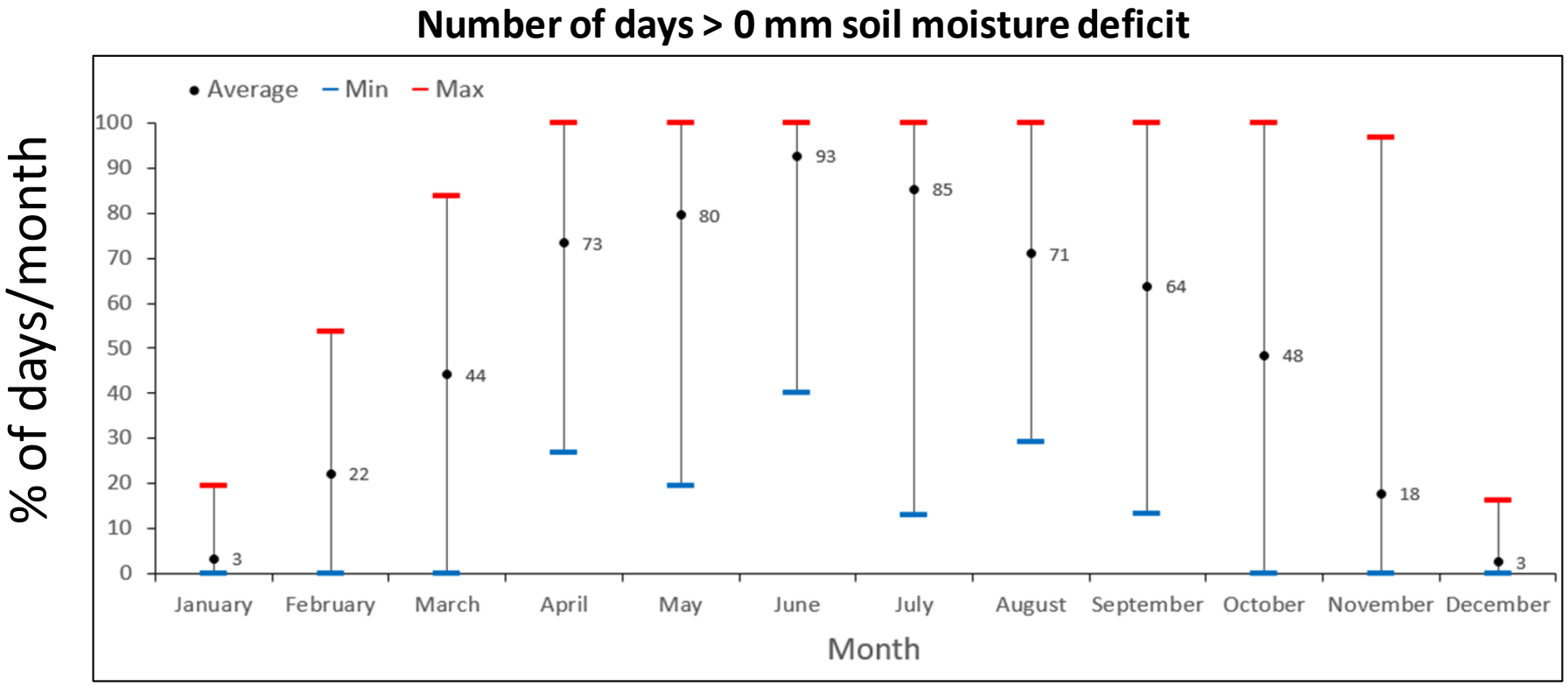
Based on the UK Hydrology of Soil Type Classification

Runoff Risk –Temporal Variability



Soil Moisture Deficit (SMD)

0 mm SMD = Field Capacity

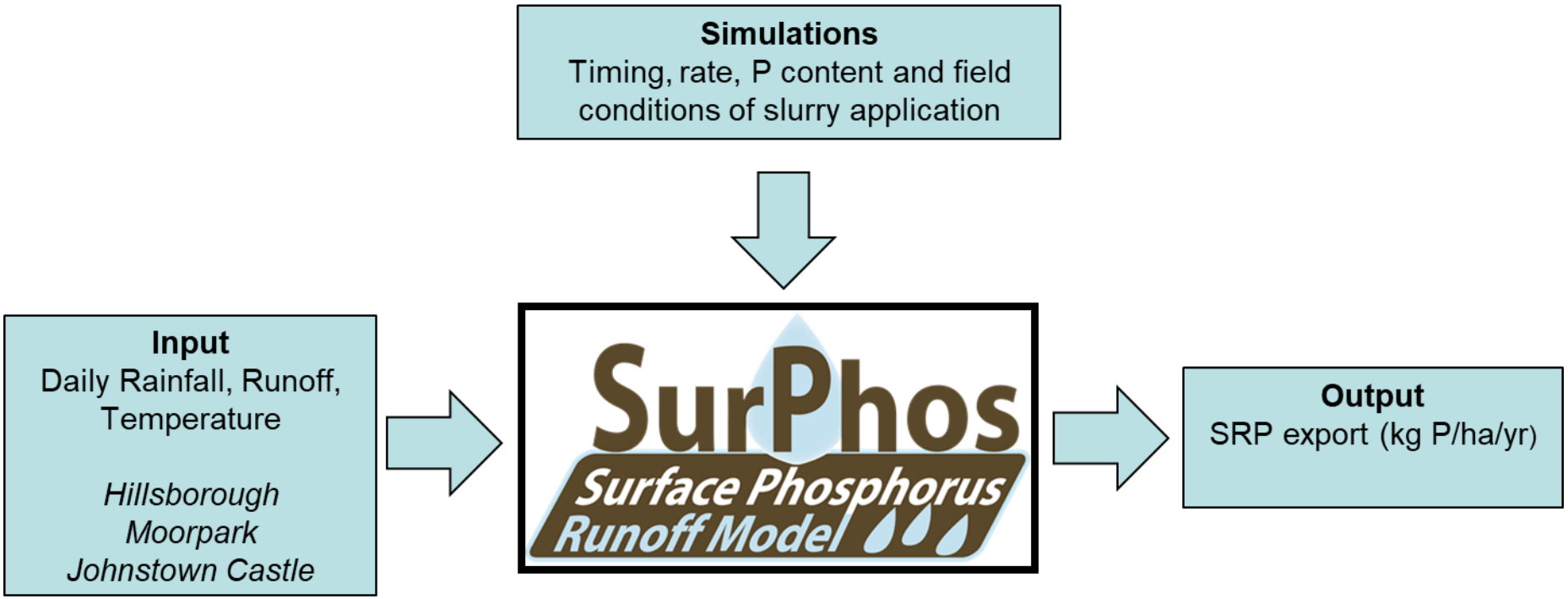
-10mm SMD = Saturated Soil

> 0mm SMD = Soil Getting Drier

For Slurry Spreading

0-5mm SMD

How well do the current NAP regulations mitigate the risk of P loss due to slurry applications in Northern Ireland?



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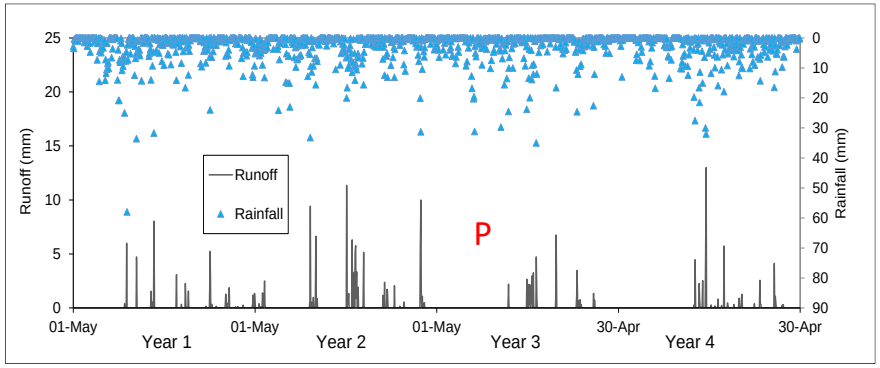
Adams et al 202 (in Review)*
Vadas, et al 2017. *Journal of Environmental Quality*, *46*(6), pp.1395-1402.

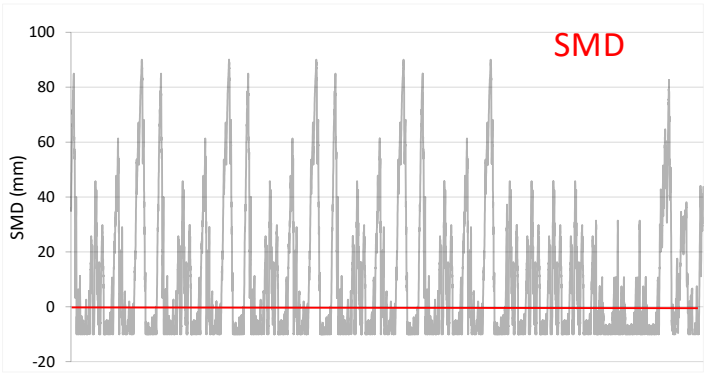
USDA ARS

Modelling Overview

Rainfall Data



Soil Moisture Data



Do SMD and P permit a Slurry Application?

N → No Application

Repeats 365 times from 1st May to 30th April

Y → Application Rate According to Scenario → Surphos Model Simulates Application → Mean SRP Loss

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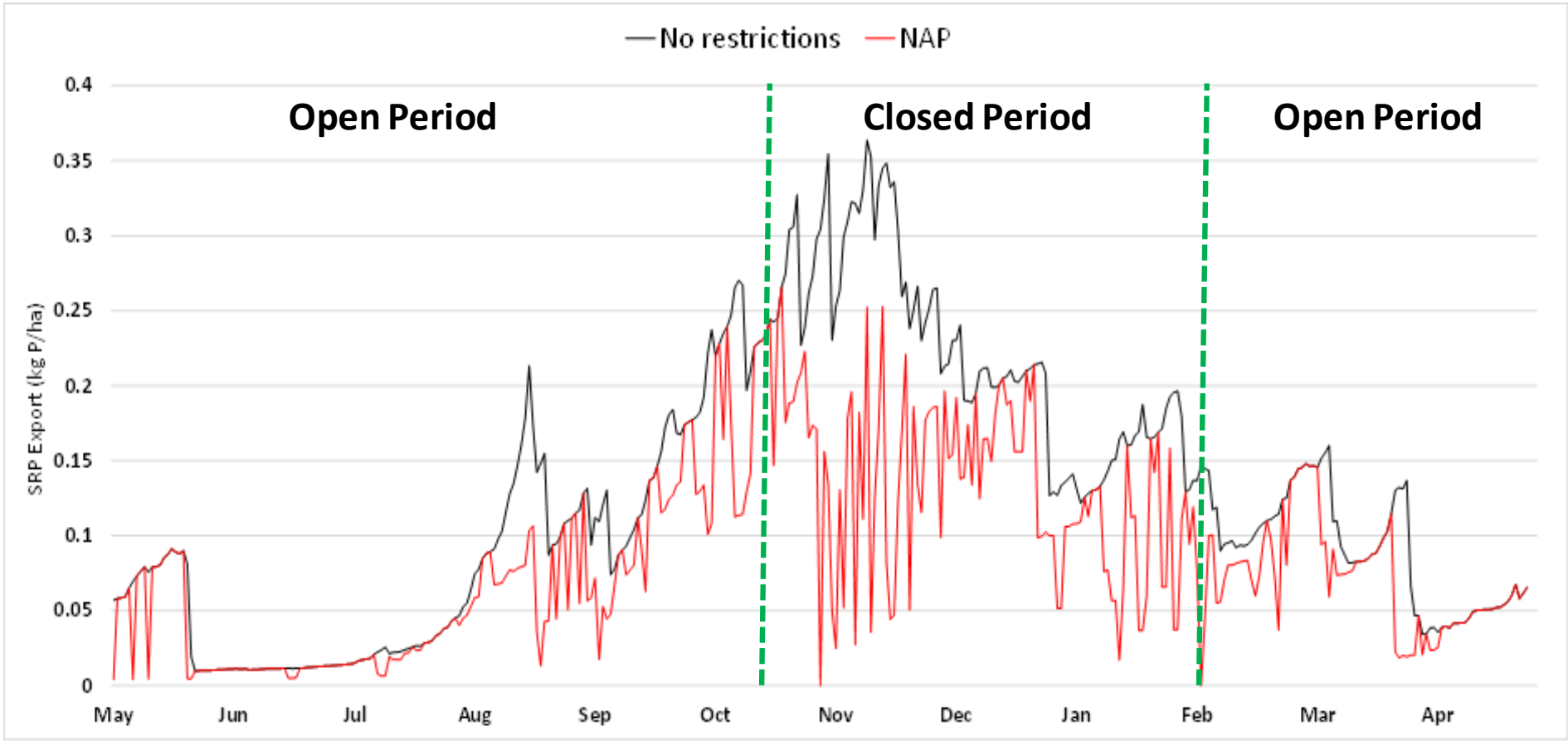
USDA ARS



Key Findings

- NAP regulations result in 24% reduction in P loss during the open period
- If slurry spreading was allowed during the closed period P losses would be 52% higher than in the open period
- Even with the NAP Regulation significant losses of P are occurring

Additional Mitigation Measures

- **Right Time, Right Place**
  - Access to high resolution soil and weather data
- **Phosphorus content of slurry**
  - Reducing the P content of slurry by 10% (P10) & 30% (P30)
- **Application rates**
  - Application rates of 50 m^3 ha^{-1} (A50) 30 m^3 ha^{-1} (A30) 10 m^3 ha^{-1} (A10)
- **Longer closed period**
  - Extension of the closed period from the 1st October to 28th February

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Right Time, Right Place

Compared to Poorly Drained Soils

- 46% less P loss from moderately drained soils
- 87% less P loss from well drained soils

Limit applications to ≥ 0 mm SMD in the Open Period - 44% reduction in SRP export

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Okumah, et al 2021 *Land Use Policy*, *105*, p.105397

Lower Phosphorus Content of Slurry

Lower P in Diets

Lower P in Slurry

Reduction in P Content	Reduction in P loss
10%	11%
30%	29%

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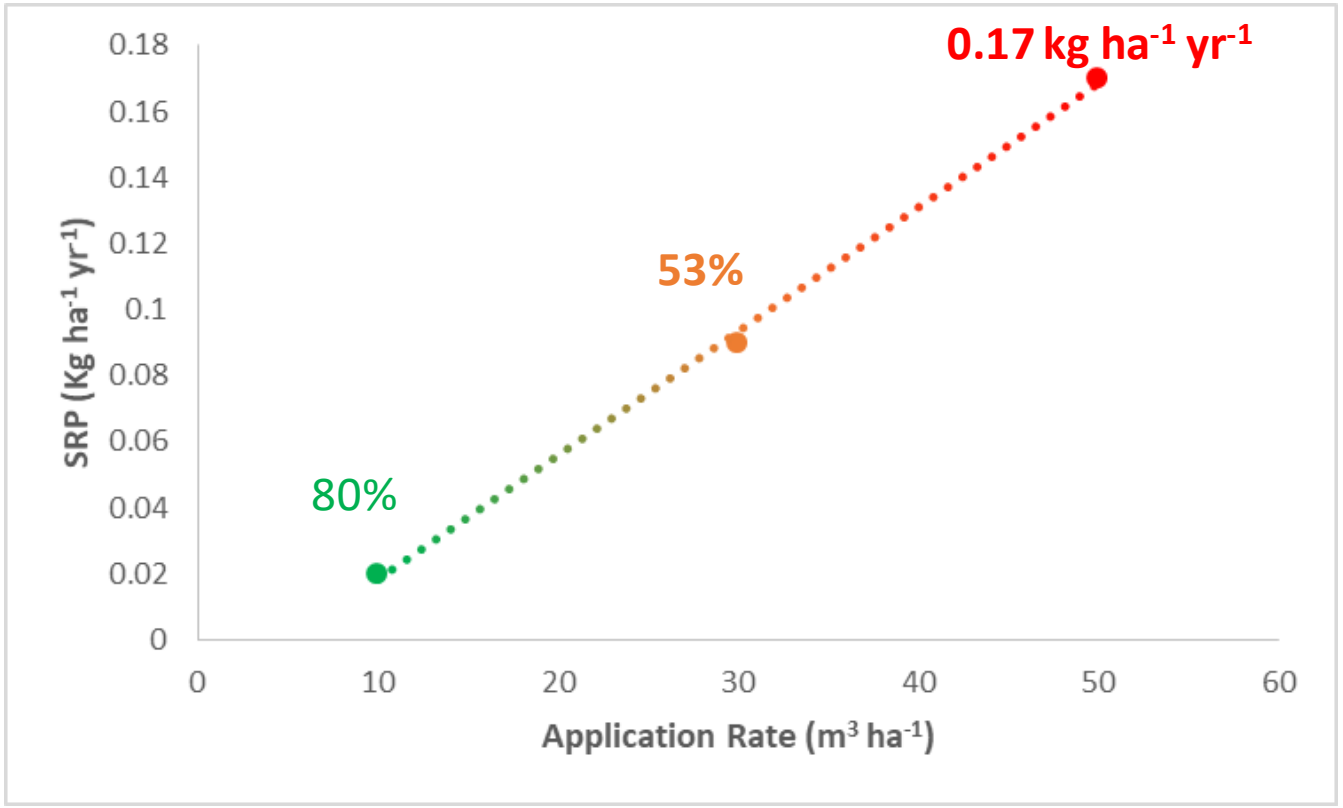
Reduced Application Rates



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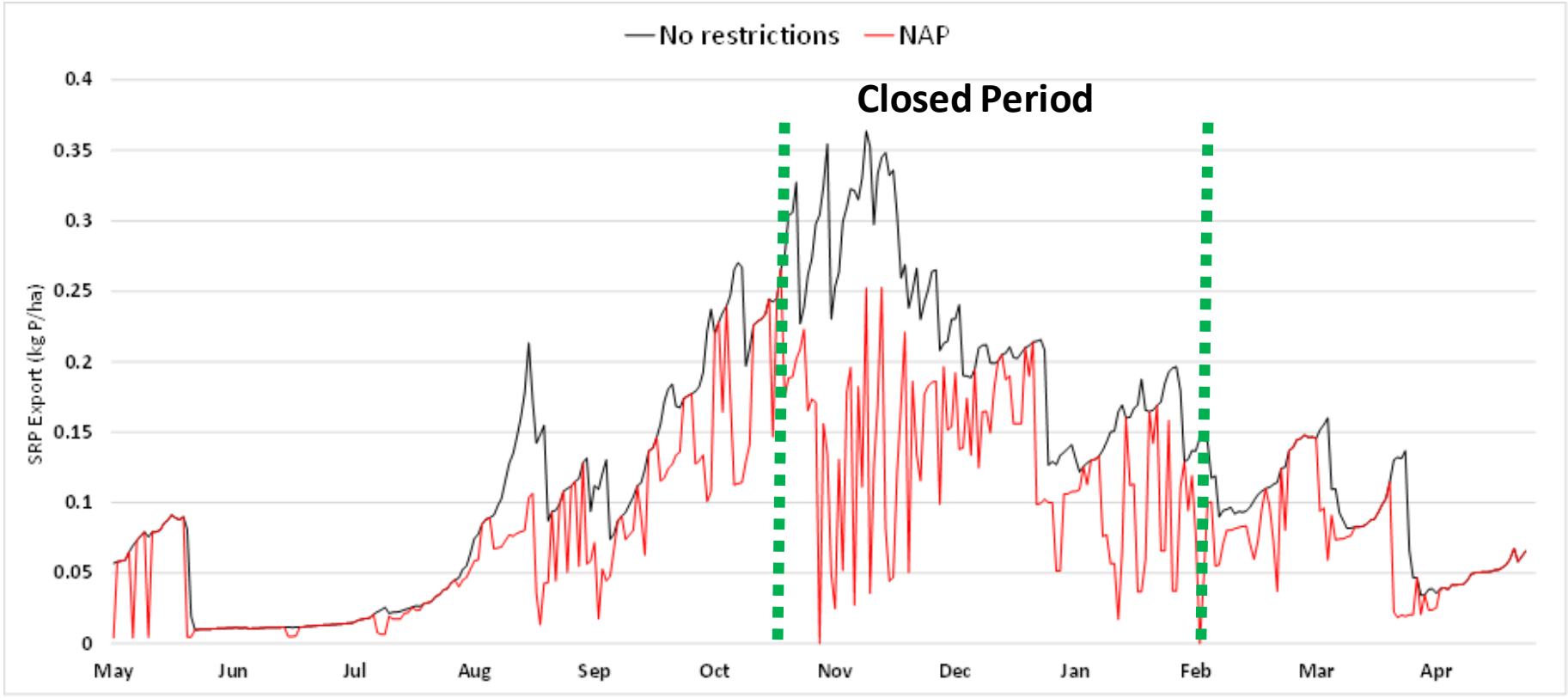
Longer Closed Period



Dates	SRP Open Period	% Change
15th Oct- 31st Jan	0.065 kg ha^{-1} yr^{-1}	-
1st Oct – 29th Feb	0.056 kg ha^{-1} yr^{-1}	-14%

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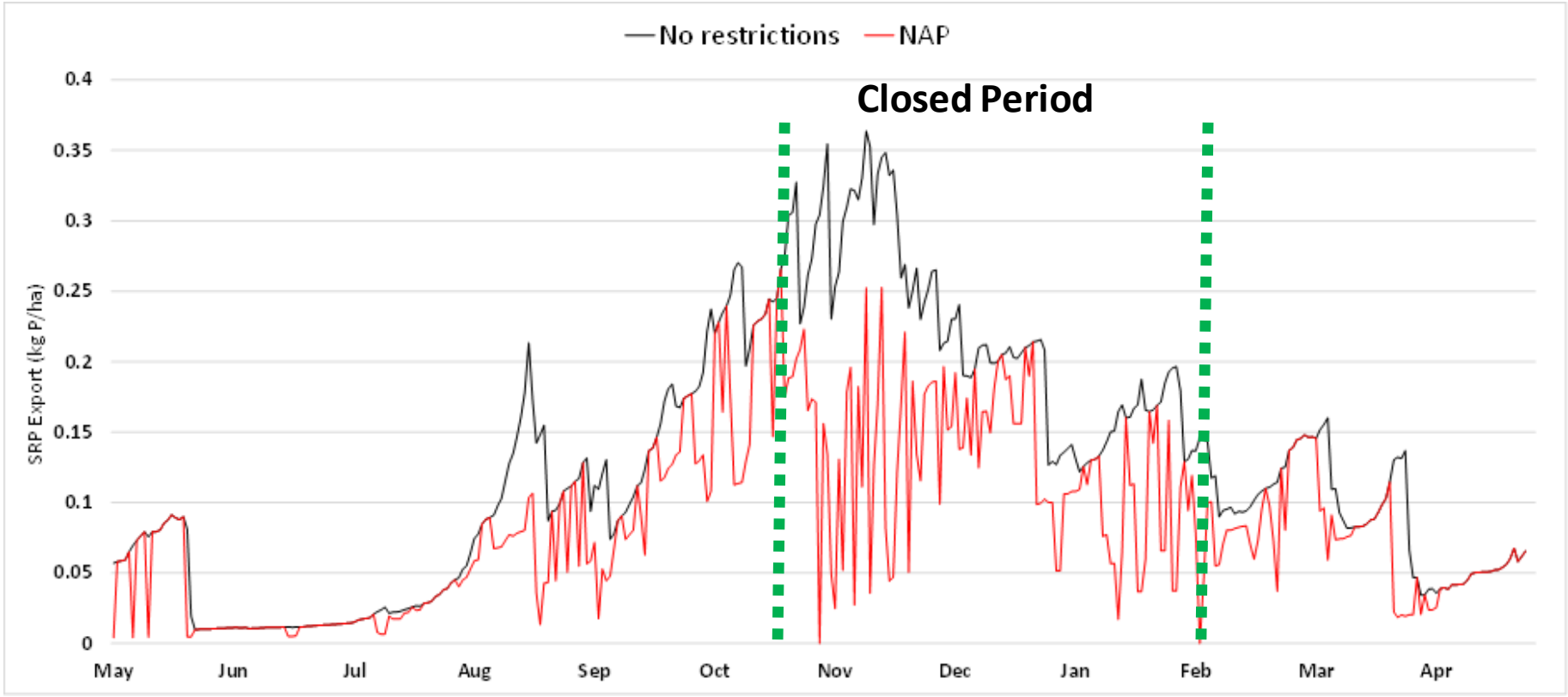
Shorter Closed Period



Dates	SRP Open Period	% Change
15th Oct- 31st Jan	0.065 kg ha^{-1} yr^{-1}	-
1st Oct – 29th Feb	0.056 kg ha^{-1} yr^{-1}	-14
15th Oct – 31st Dec	**0.068 kg ha^{-1} yr^{-1}**	**+4.5**

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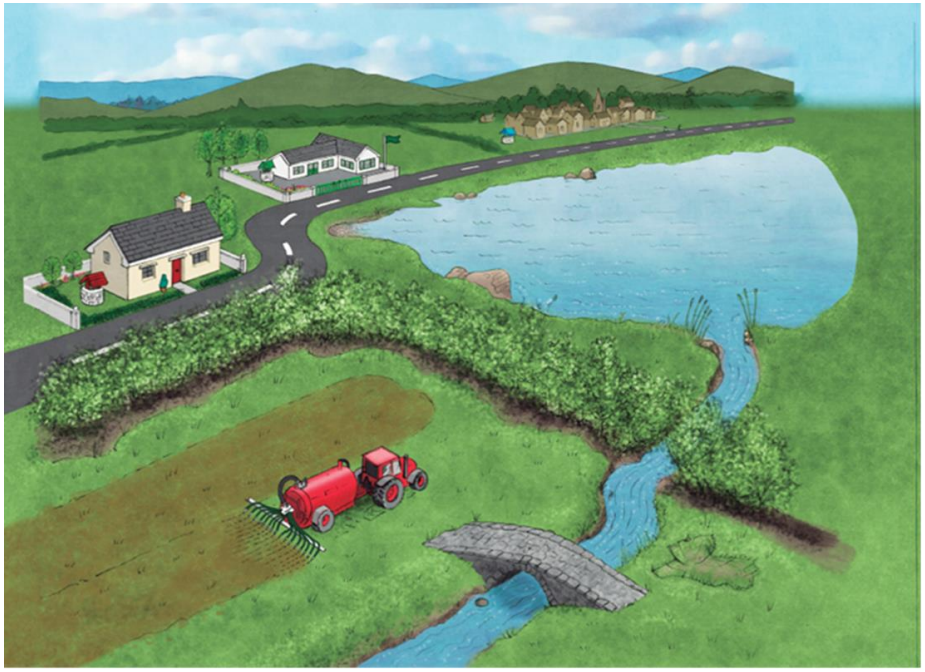
Reducing the National P Surplus

SFA Scenario Analysis

- Fertiliser P import and use reduced by 75%
- Animal feed P concentration reduced to 0.35%
- Export 20% of the manure P



- Surplus (kg/ha) 1.6 (-81%)
- **Predicted river SRP (ug/l) 35 (-40%)**
- P import (t/yr) 12,269 (-33%)
- Food system efficiency % 58 (+20%)

Doody et al 2020
https://www.afbini.gov.uk/publications/rephokus-report-oct-2020

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Take Home Messages

- Slurry spreading inherently risky practice
- NAP Regulation are making a difference
  - Dependant of Right Time, Right Place
  - Need high resolution rainfall and soil moisture data
- Only ~5% of the P lost to water, will causes water quality decline
- More P in slurry than is required for agronomic purposes

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Thank You

Any Questions?

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(Figure used with permission from Interreg CatchmentCARE Project https://www.catchmentcare.eu/)