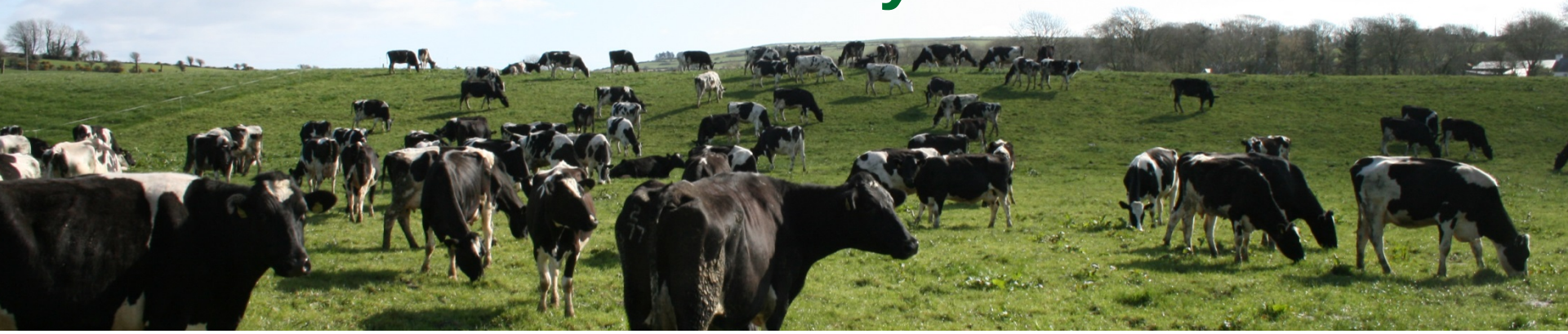
Improved Nutrient Management on Intensive Dairy Farms



Soil Fertility Conference

Clonmel Park Hotel

16th October 2015

Noeleen McDonald[1], Paul Murphy[2], Cathal Buckley [3] and Ger Shortle[1]

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[3]Agricultural Catchments Programme, Teagasc, Athenry, Galway

The Irish Agriculture and Food Development Authority

The Agricultural Catchments Programme (ACP)

2008 to present

Drivers - Environmental and Economic

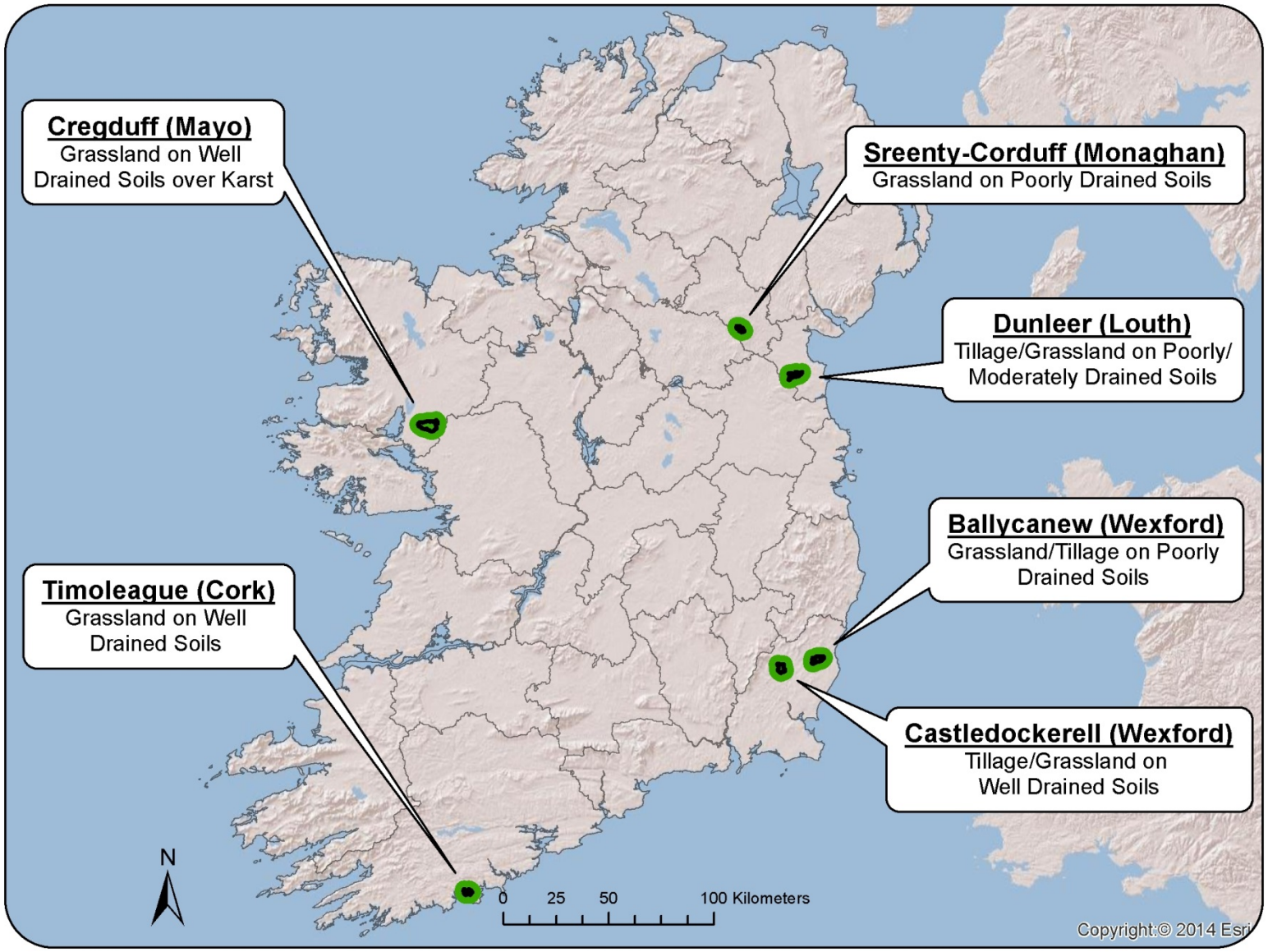
- **Nitrates Directive – Member States required "*to assess…action programmes*"**
- **Water Framework Directive - attain and sustain at least good status waters**
- **Food harvest 2020 & Food Wise 2025 – SMART, GREEN, GROWTH,**

Objectives

- **Biophysical - evaluation of the GAP measures and nitrates derogation**
- **Socio-economic - farmers' understanding/implementation, economic impact**
- **Dissemination of outcomes**

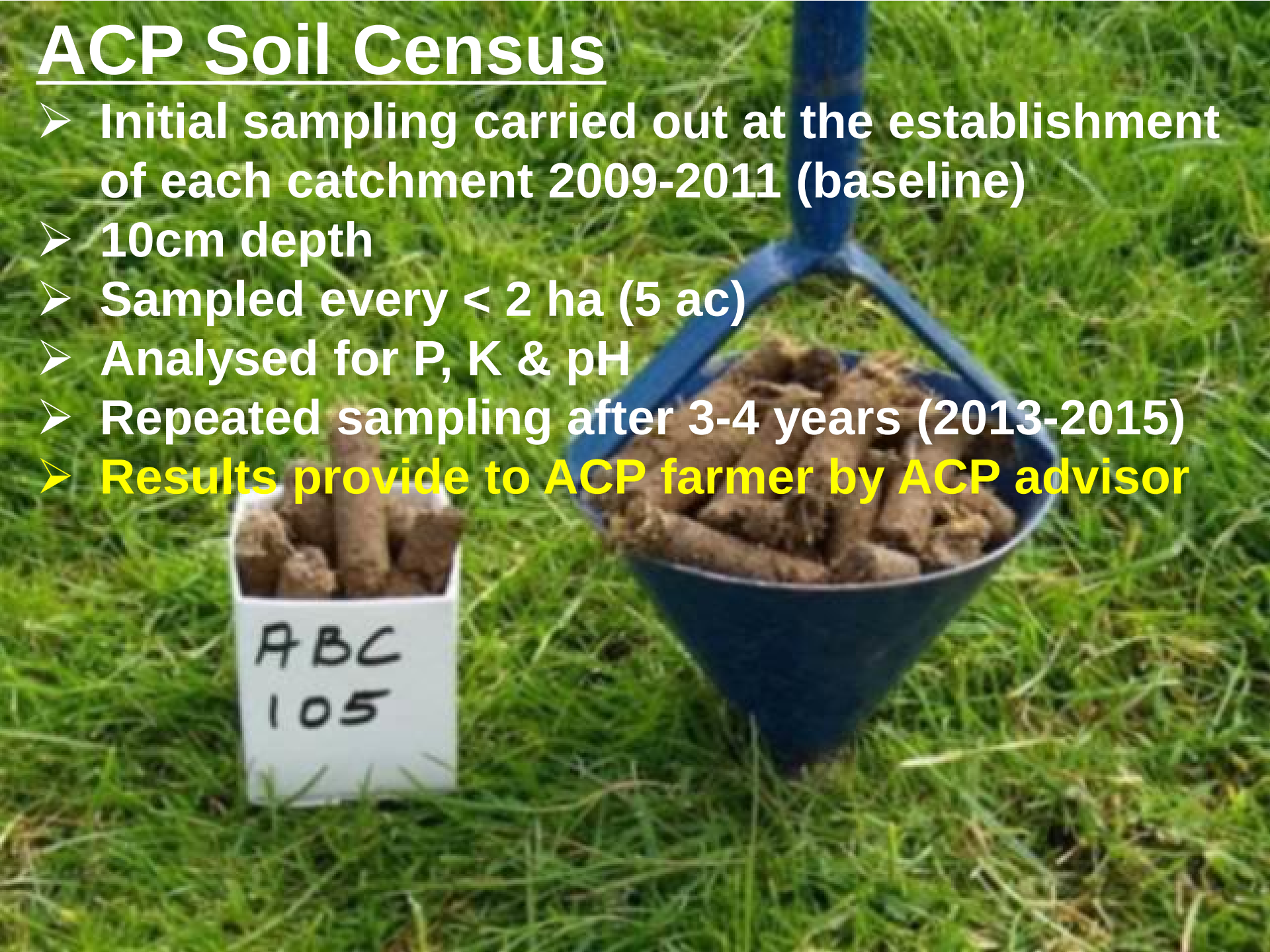
Approach

- **Integration – research/advisory**
- **Partnership – c.300 farmers in catchment + nationally**
- **A scientific body of evidence – over years and across catchments**
- **Finding the WIN:WINS e.g. Nutrient Management/Nutrient Use Efficiency**

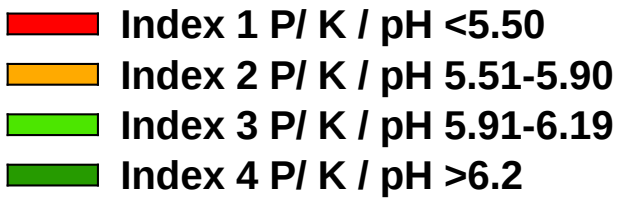

Cregduff (Mayo)
Grassland on Well Drained Soils over Karst
Sreenty-Corduff (Monaghan)
Grassland on Poorly Drained Soils
Dunleer (Louth)
Tillage/Grassland on Poorly/ Moderately Drained Soils
Ballycanew (Wexford)
Grassland/Tillage on Poorly Drained Soils
Timoleague (Cork)
Grassland on Well Drained Soils
Castledockerell (Wexford)
Tillage/Grassland on Well Drained Soils
N
0 25 50 100 Kilometers
Copyright:© 2014 Esri

ACP Soil Census

- Initial sampling carried out at the establishment of each catchment 2009-2011 (baseline)
- 10cm depth
- Sampled every < 2 ha (5 ac)
- Analysed for P, K & pH
- Repeated sampling after 3-4 years (2013-2015)
- Results provide to ACP farmer by ACP advisor

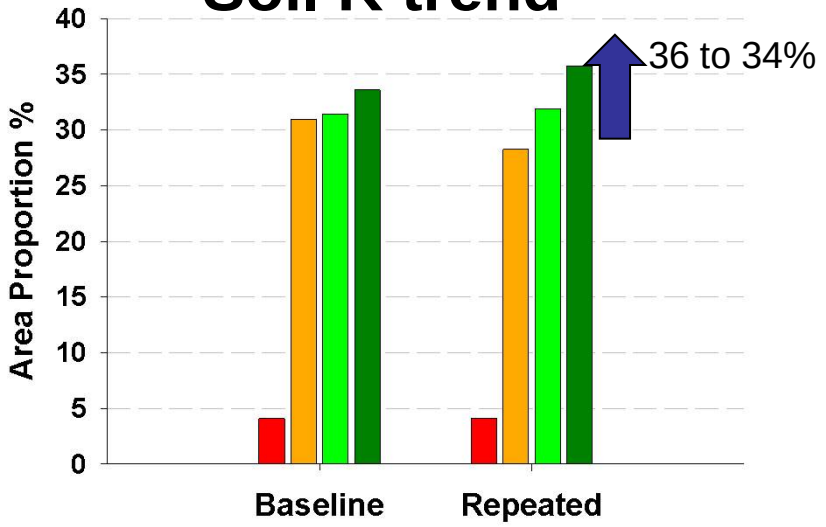


Soil Fertility Trends of ACP Grassland Soils *(2,379 samples)*

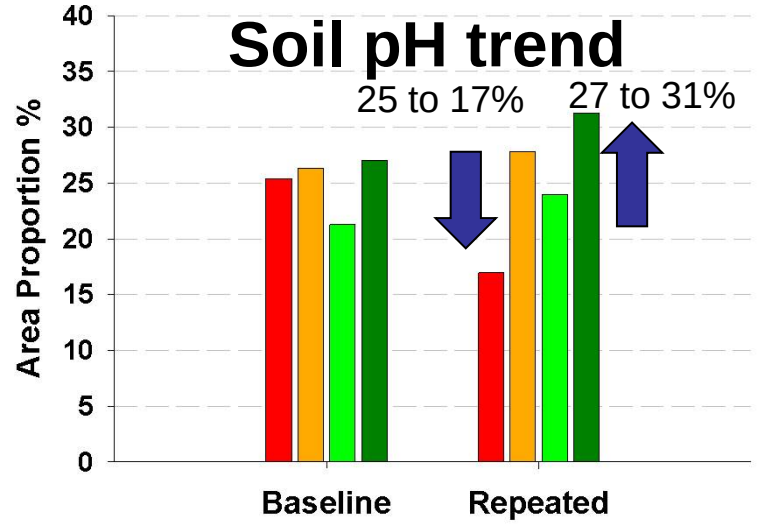


Soil P trend

Soil K trend



Soil pH trend



- 2% drop in risky P Index 4 soils
- But alarmingly increase of 8% area with soils in Index 1, very deficient in P.
- 3% increase area proportion of K Index 4 soils
- Area proportion of very acid soils (<5.5) dropped by 8% & soils with pH optimum >6.2 increased by 4%.

Soil Fertility Trends of ACP Grassland Soils *(2,379 samples)*

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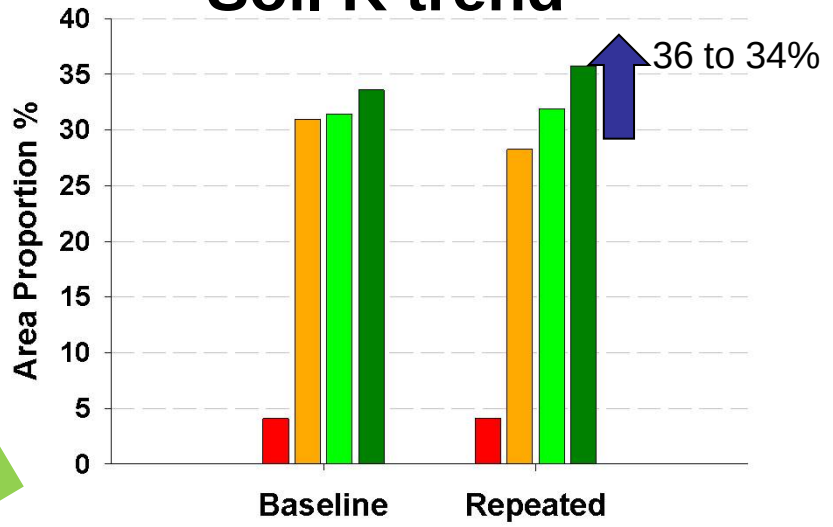
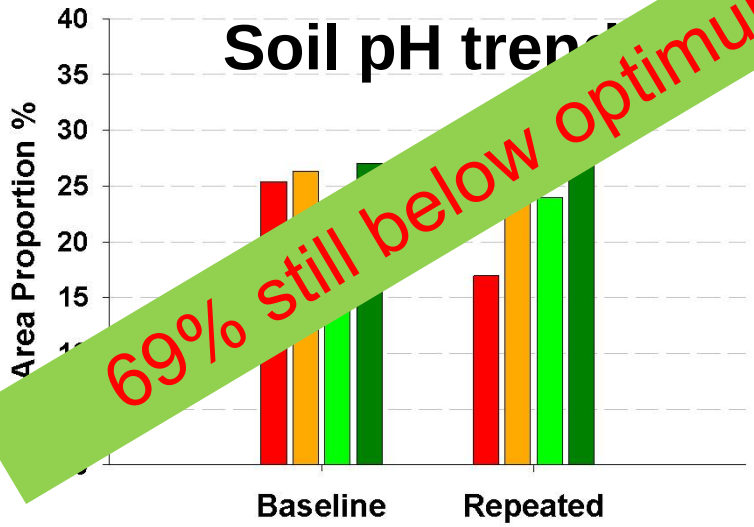
Soil P trend

Soil K trend



Soil pH trend



69% still below optimum pH

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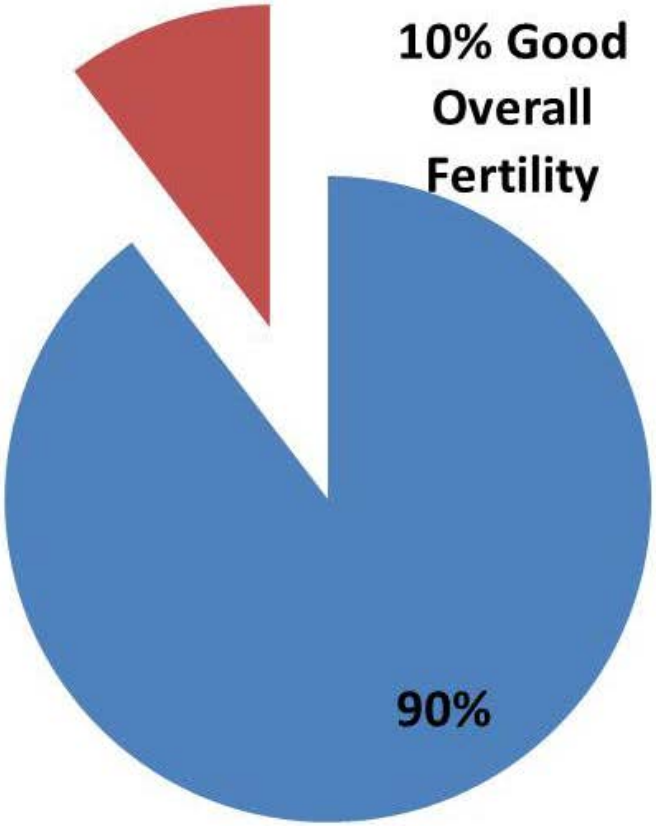
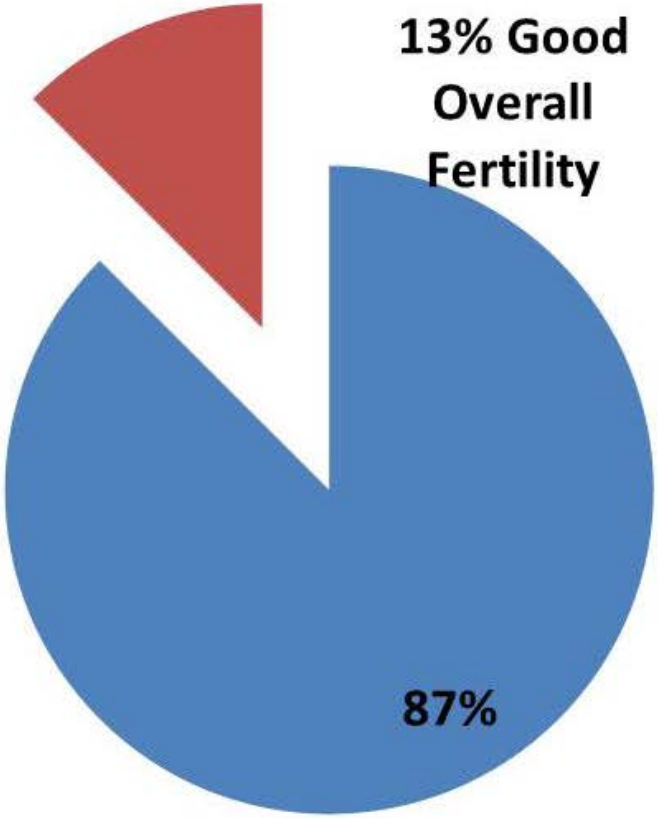
Trend in Good Overall Soil Fertility in ACP Grassland Soils *(n = 2,379)*

Baseline sampling



Repeated sampling



Soil Fertility Trends of Timoleague

Intensive Dairy Catchment (452 samples)

Index 1 P/ K / pH <5.50
Index 2 P/ K / pH 5.51-5.90
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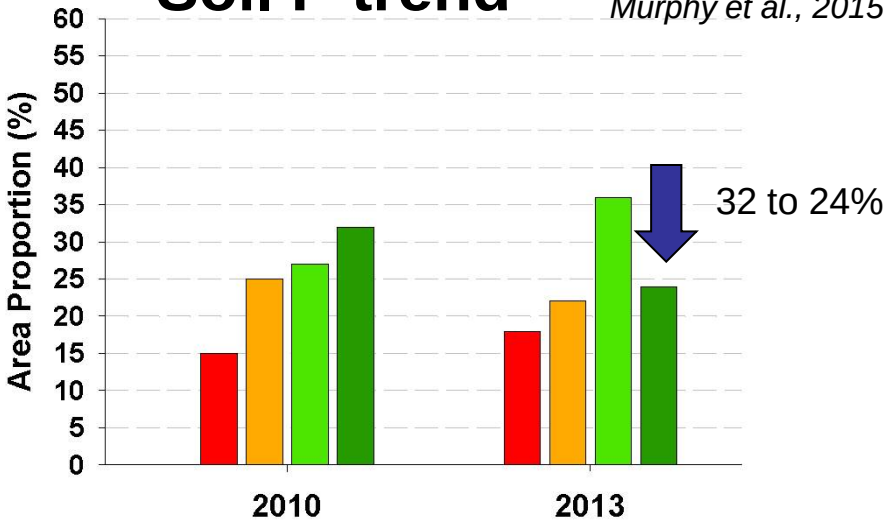
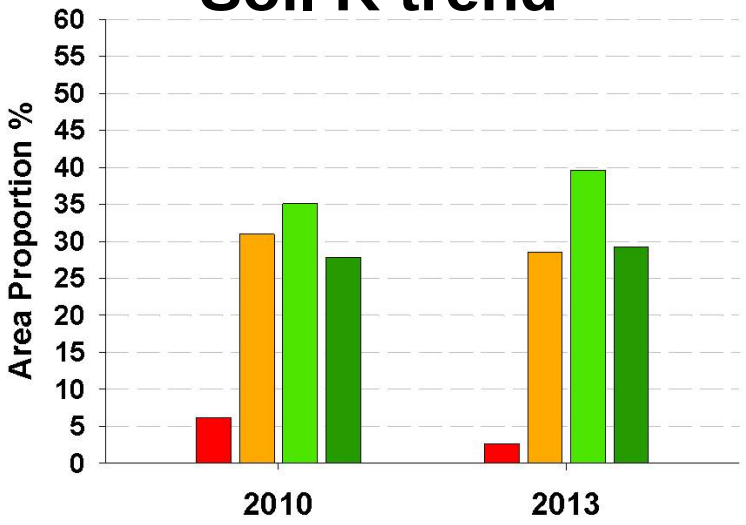
Index 4 P/ K / pH >6.2

Soil P trend

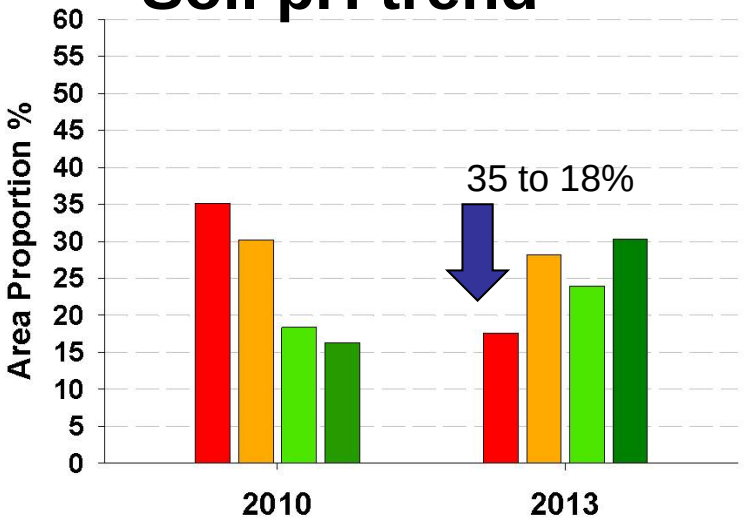
Murphy et al., 2015



Soil K trend



Soil pH trend



- 8% drop in risky P Index 4 soils.
- Area proportion of P Index 2 soils reduced by 3%, optimum P Index 3 increased by 9%, however, Index 1 soils increased by 2%.
- 6% combined increase for area proportion of K Index 3 & 4 soils.
- Area with very acid soils (<5.5) dropped by 17%.

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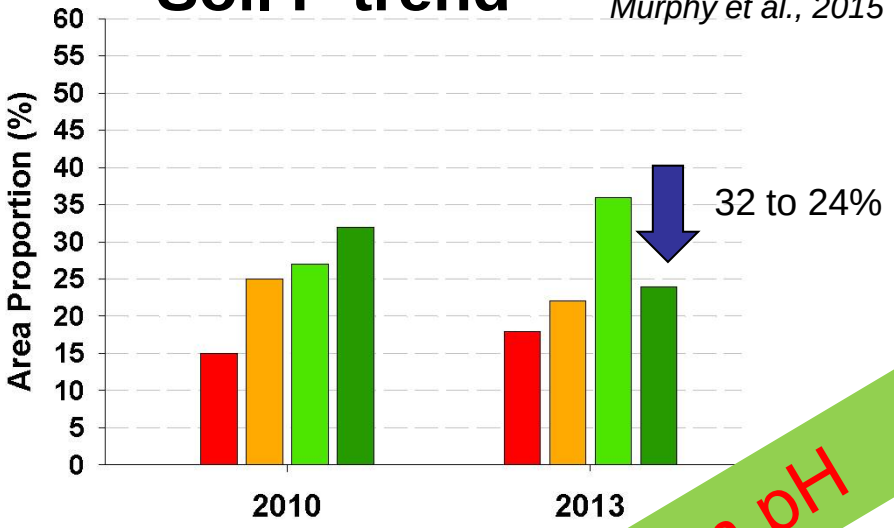
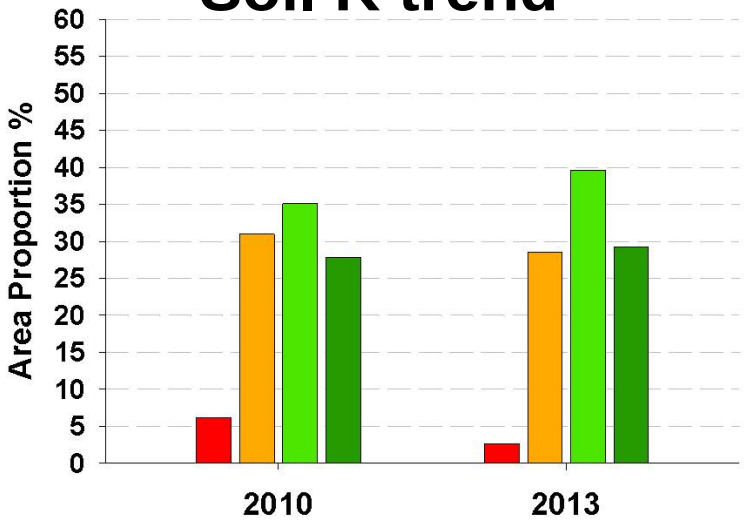
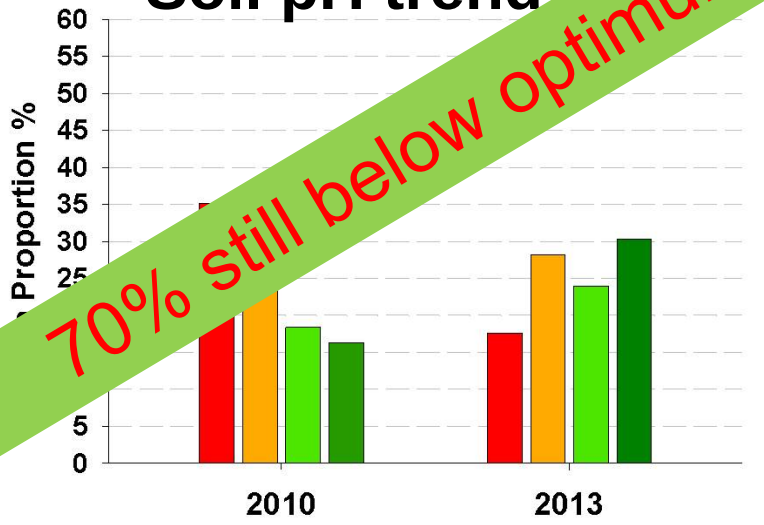


Soil K trend



Soil pH trend



70% still below optimum pH

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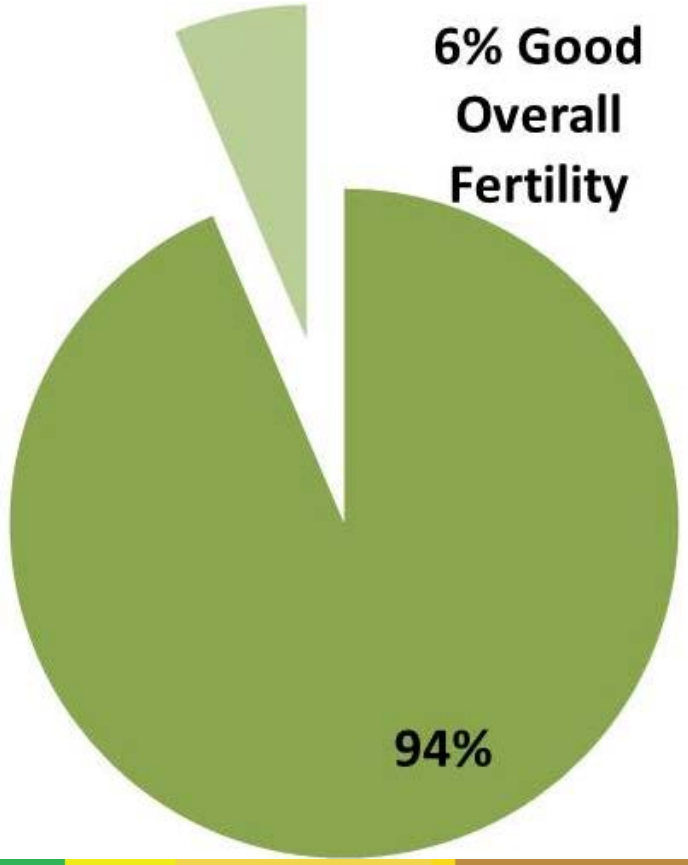
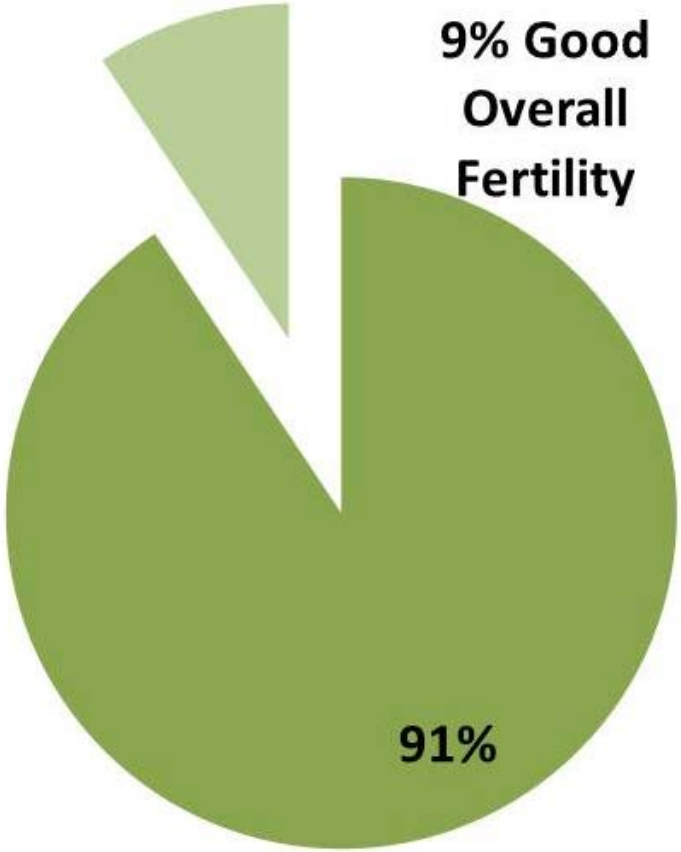
Trend in Good Overall Soil Fertility

Timoleague *(n =452)*

Baseline sampling (2010)



Repeated sampling (2013)



Case Study: Dairy Farm Improved Soil Fertility Change

(40 samples)

Index 1 P/ K / pH <5.50
Index 2 P/ K / pH 5.51-5.90
Index 3 P/ K / pH 5.91-6.19
Index 4 P/ K / pH >6.2

- Whole Farm Stocking rate = 1.9 LU ha^{-1}
- Grazing Stocking rate = 2.5 LU ha^{-1}
- Farm-gate P balance:

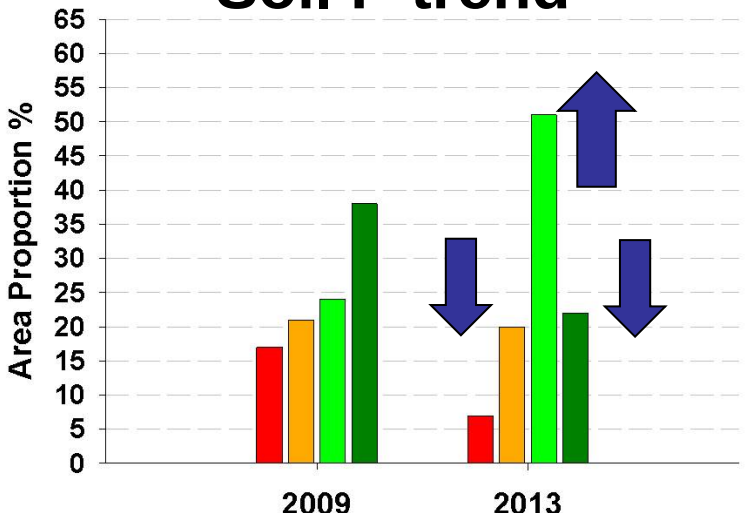
(P inputs - P outputs) = 3.9 kg ha^{-1}

- P use efficiency:

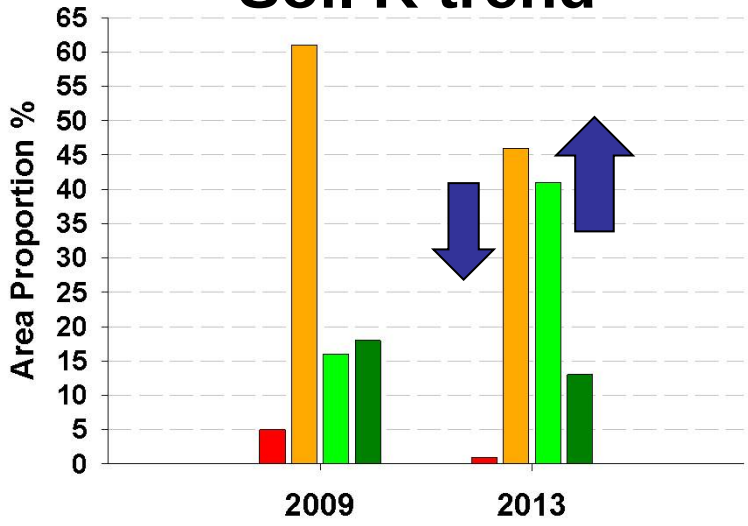
P outputs / P inputs X 100 = 74%

- But, based on P build up (Index 1 & 2) Optimal P balance = -1.45 kg ha^{-1}

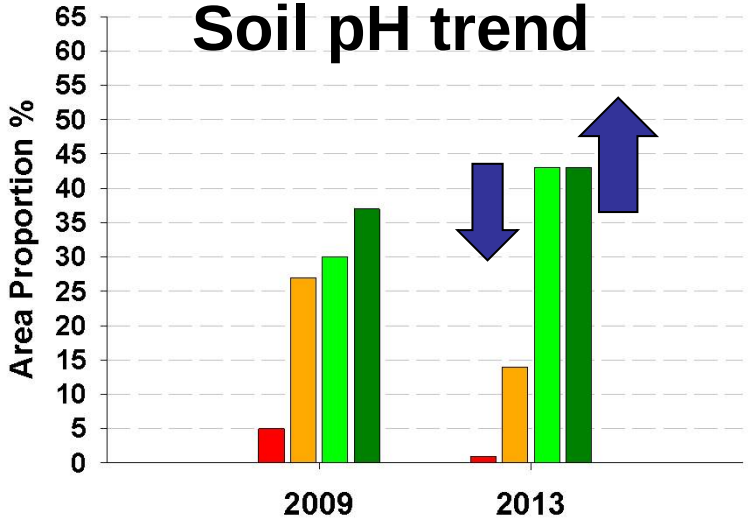
Soil P trend



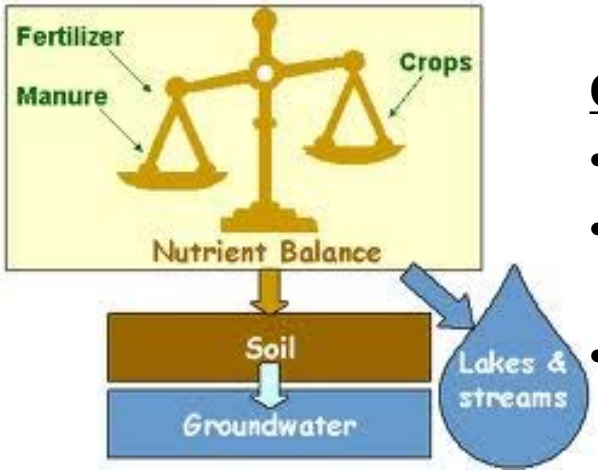
Soil K trend



Soil pH trend



Case Study: On Farm
Improved Soil Fertility Change *(40 samples)*

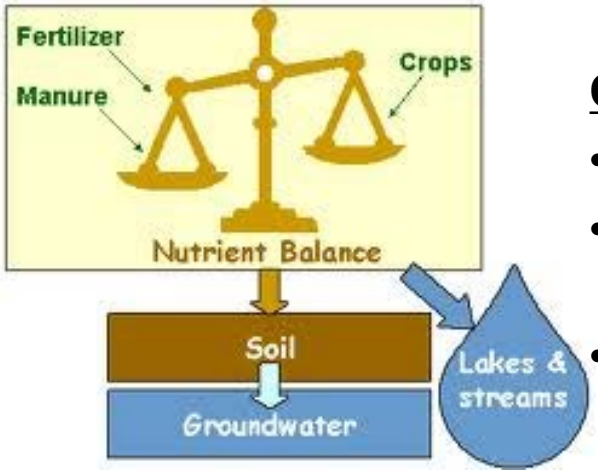


Good on farm nutrient management practices:

- **Reduced risky P Index 4 soils by 16%**
- **Reduced the area proportion previously deficient in P, K & pH**
- **Convergence to optimum Index 3 for P & K and pH >6.2 = good overall soil fertility = benefits agronomy + environment (WIN:WINS)**

	% Farm in P index			% Farm in K index			% Farm in pH threshold		
P & K Index /pH thresholds	2009	2013	% Diff	2009	2013	% Diff	2009	2013	% Diff
1 / <5.5	17	7	-10	5	1	-3	6	1	-5
2 / 5.51-5.90	21	20	1	61	45	-15	27	14	-13
3 / 5.91-6.19	24	51	27	16	41	25	30	43	13
4 / >6.2	38	22	-16	18	13	-5	37	42	5

Case Study: On Farm Improved Soil Fertility Change



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Production & Profitability

Comparable with top 10% of national dairy farmers of 2012 that were averaging:

- **Whole-Farm Stocking rate 2.47 LU ha^{-1}**
- **Milk production outputs of 14,356 l ha^{-1}**
- **Gross Margins of €3,261 ha^{-1}**

Murphy et al., 2015

In Summary

- Since initial sampling, grassland soil samples within the ACP have improved from 10 to 13% for good overall soil fertility.
- Timoleague catchment had a positive change in soil fertility:
  - Overall soil fertility improved from 6 to 9%.
  - Reduction of risky P Index 4 soils by 8%.
- High percentage area of soils below optimum pH 6.2-6.3 is hindering good overall soil fertility.
- Evidence of soil fertility can be improved through good nutrient management practices on farms and benefit production and the environment.
- However, optimum soil fertility for catchment soils are alarming low.
- Mining built up P reserves on Index 4 soils needs to be continued.

Recommendations

5 steps to improving soil fertility

- Regularly soil sample
  -Every 3-5 years
- Timely draw up a yearly NMP
  -i.e. previous Nov/Dec.
- Create practical nutrient recommendation farm map
  -right place, product & rate.
- Follow fertiliser programme
  -right time & rate.
- Update NMP accordingly with any changes to on-farm practices
- Track progress by mapping on-farm soil fertility trends

Department of Agriculture, Fisheries and Food
An Roinn Talmhaíochta, Iascaigh agus Bia

Acknowledgements/thanks:

AGRICULTURAL CATCHMENTS PROGRAMME

Farmers, ACP Team, Teagasc colleagues

www.teagasc.ie/agcatchments

Teagasc
Agriculture and Food Development Authority

The Irish Agriculture and Food Development Authority