

New Paradigms for Crop and Soil Management

Tapping and preserving nutrients in soil

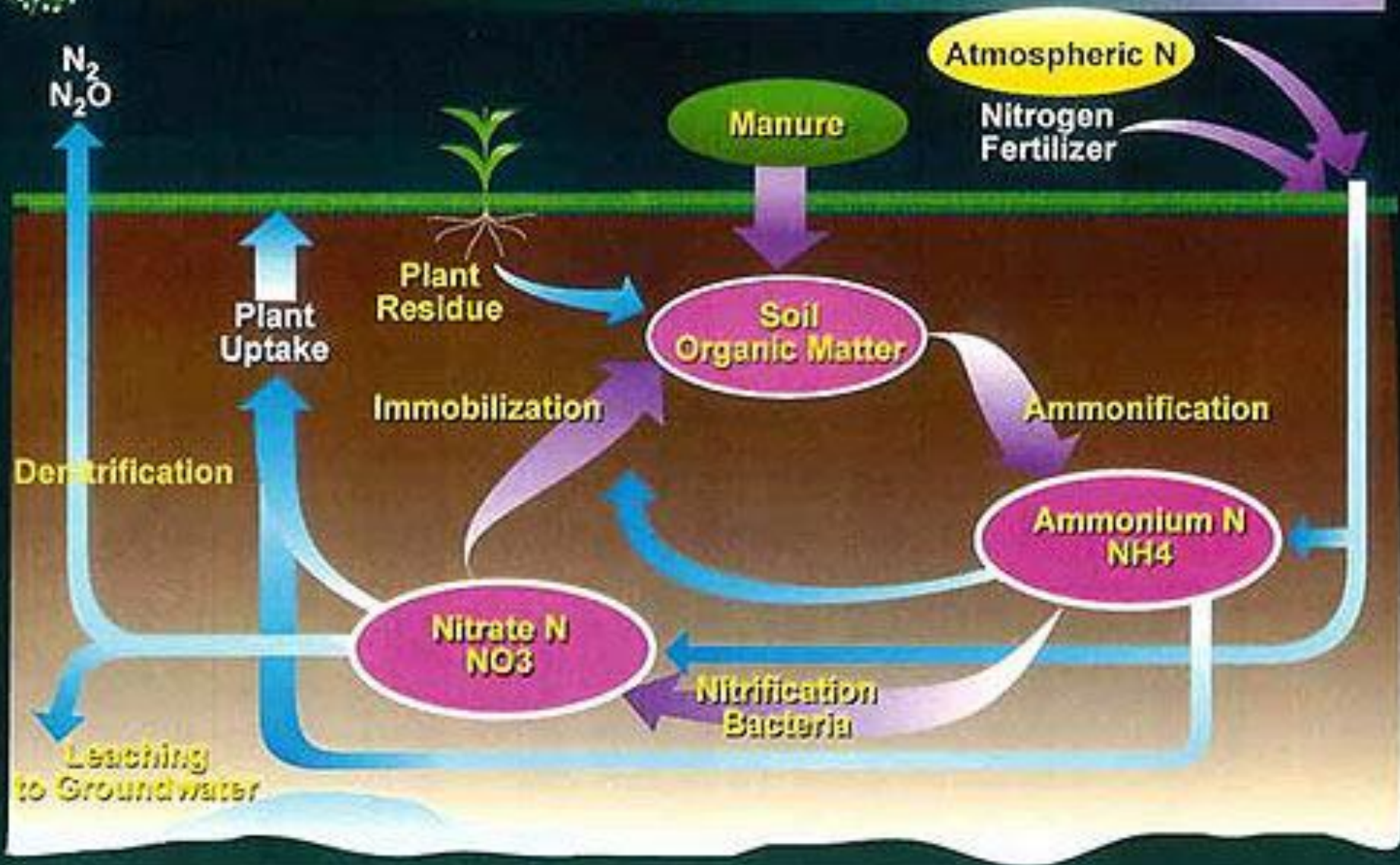
Andy Whitmore

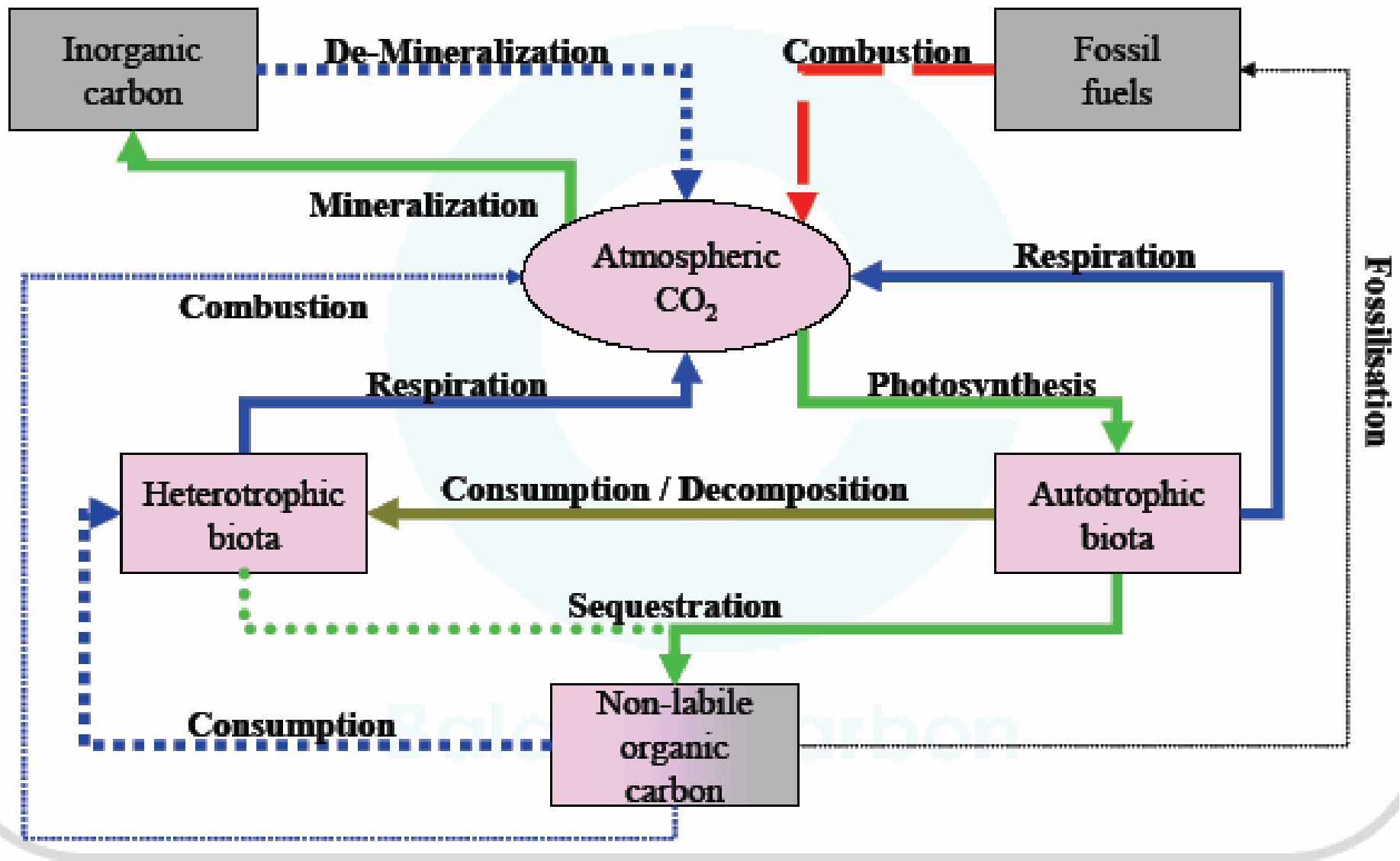
Rothamsted Research

Plan of Talk

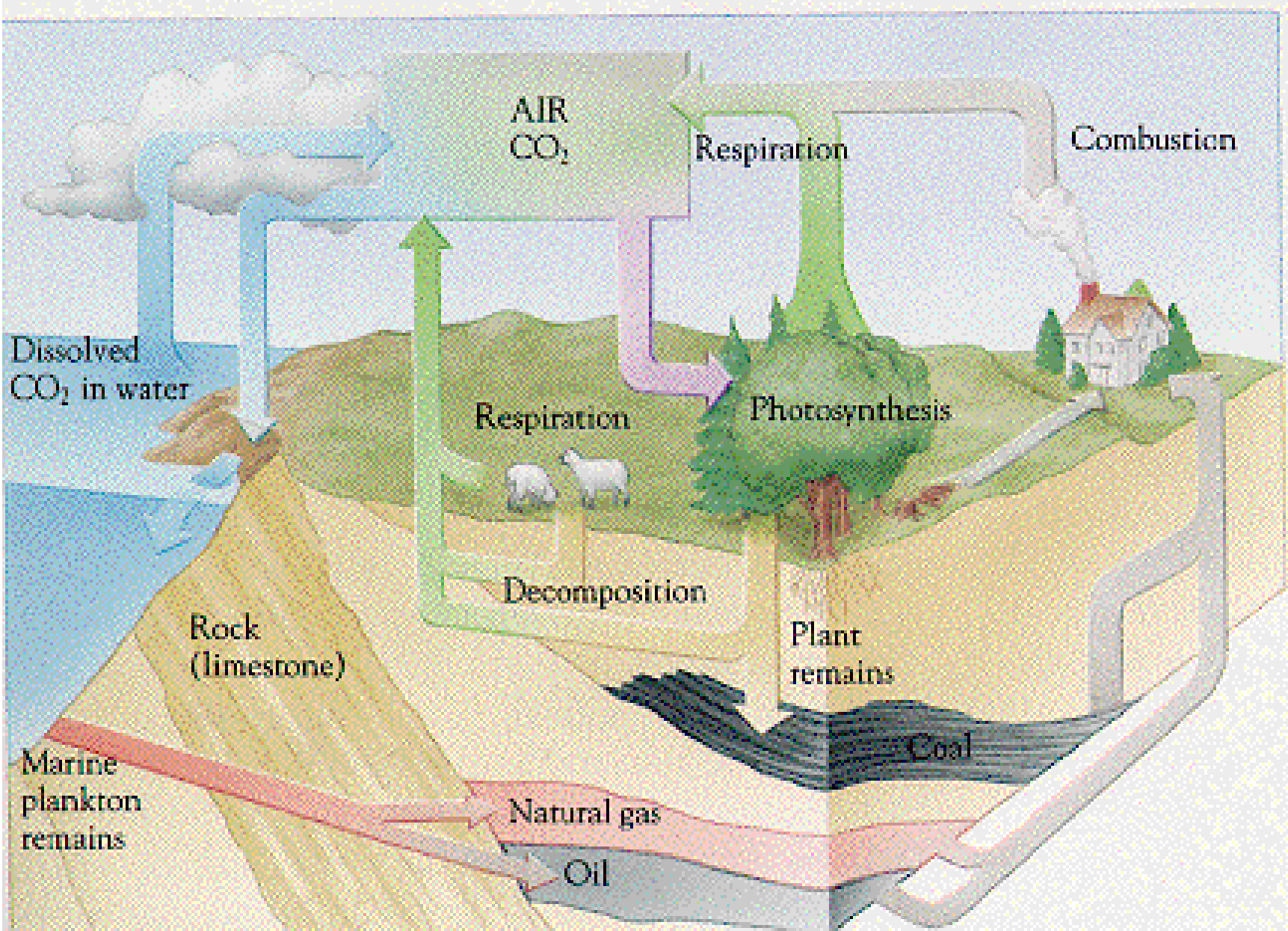
- N, P cycles differences
- Dependence on C cycle
- Fertiliser costs, cost fossil fuels Peak P and oil
- Strategies to retain, tap soil N and improve efficiency of use

Nitrogen Cycle





Carbon Cycles

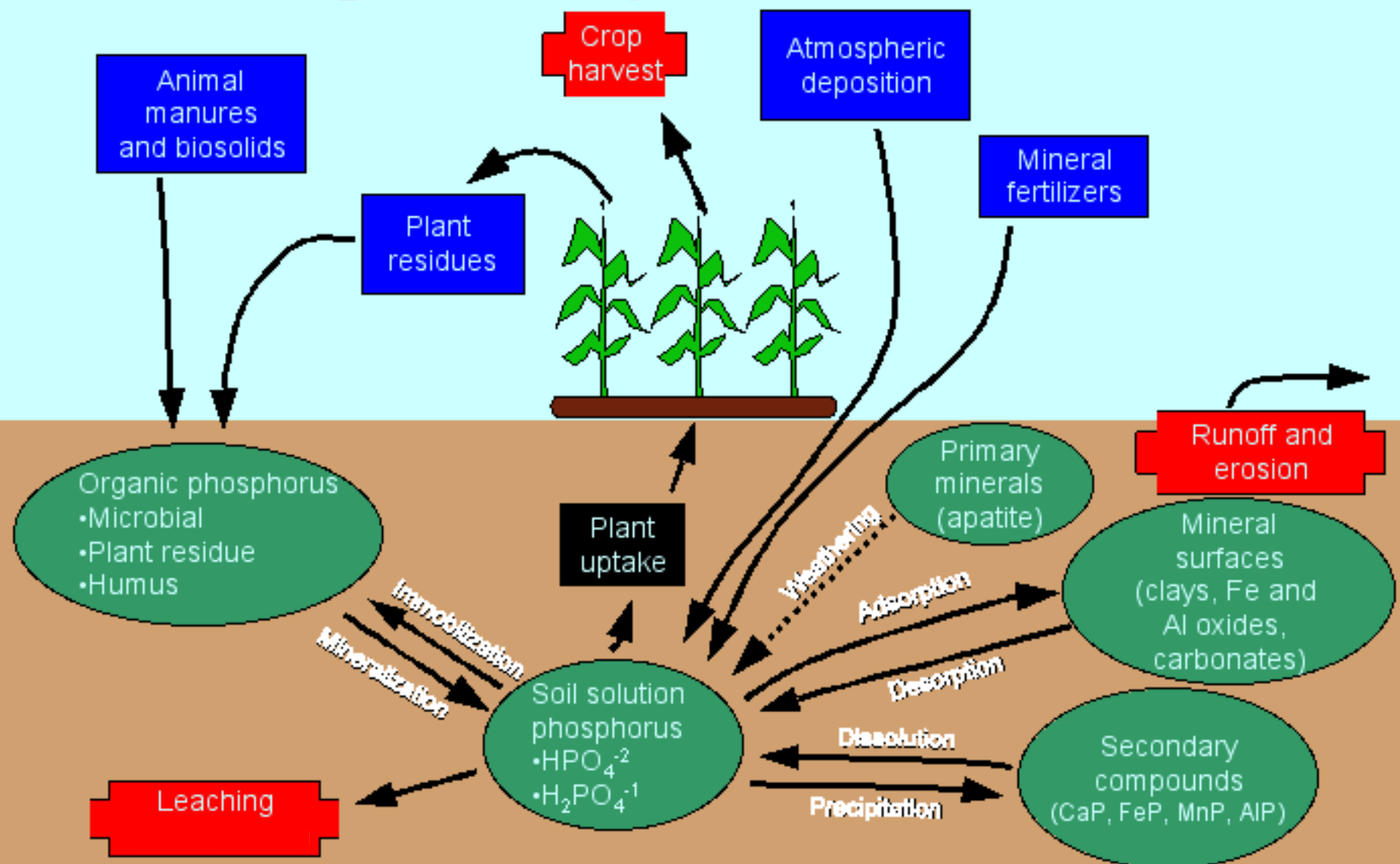


Component

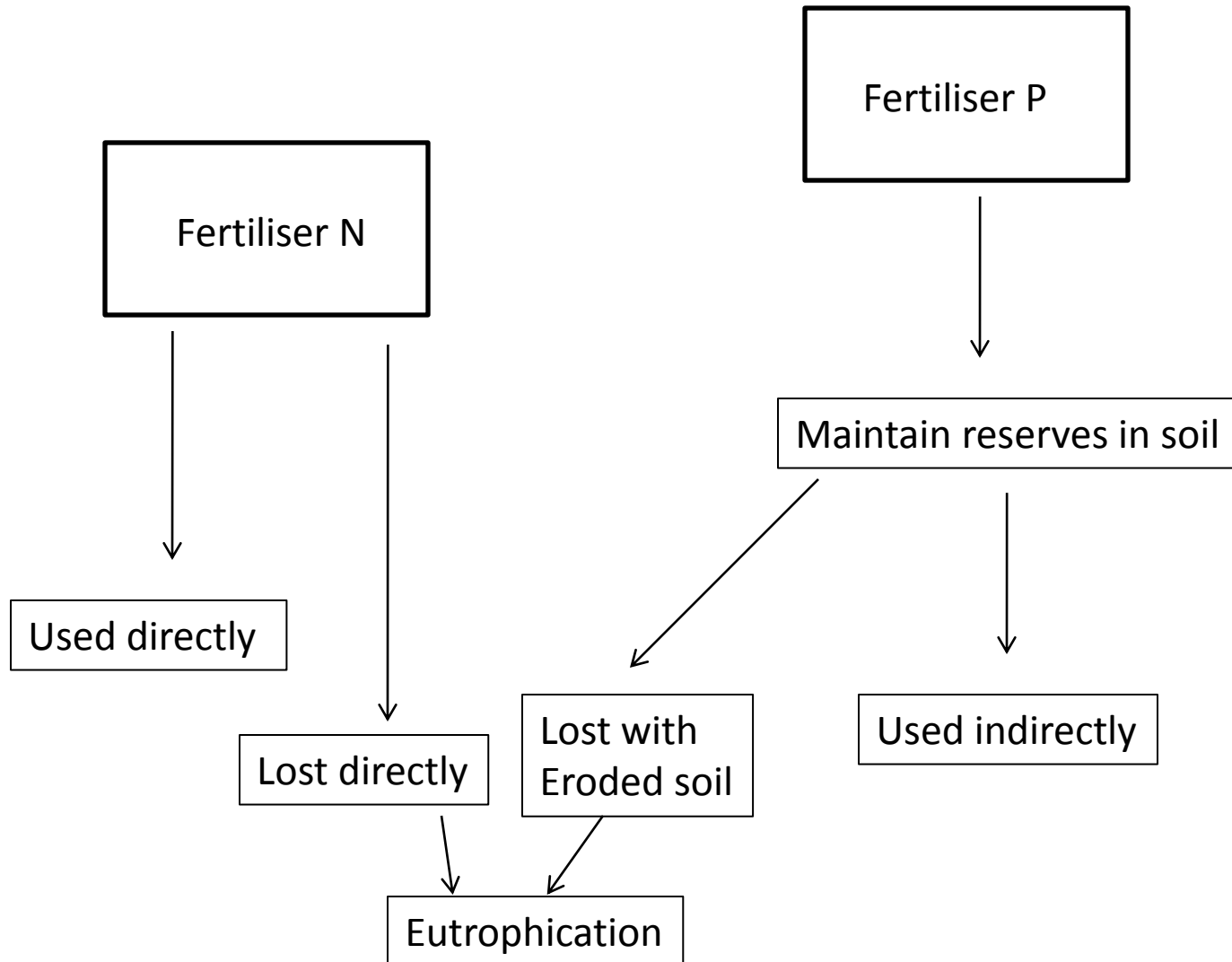
Input to soil

Loss from soil

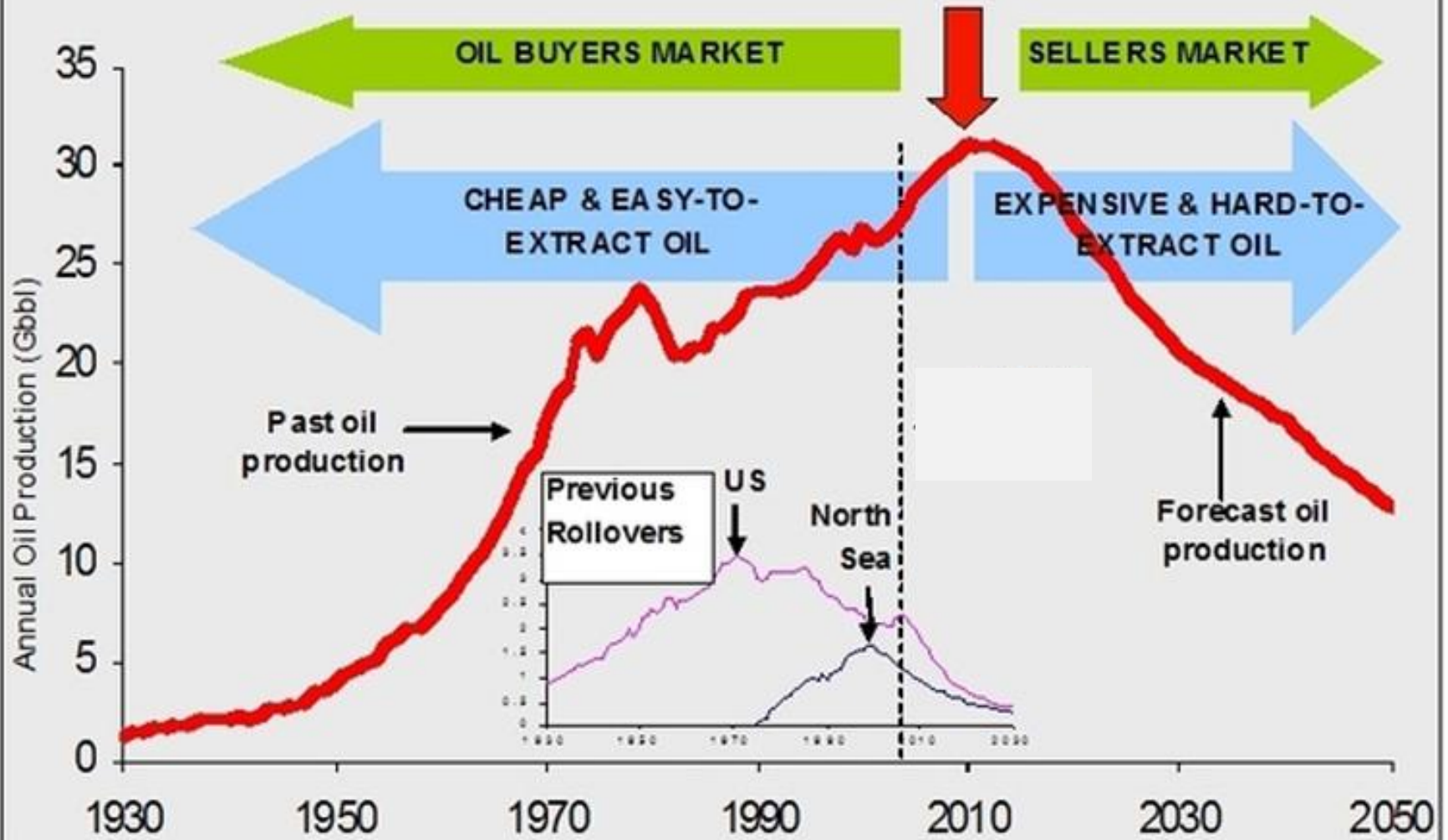
The Phosphorus Cycle



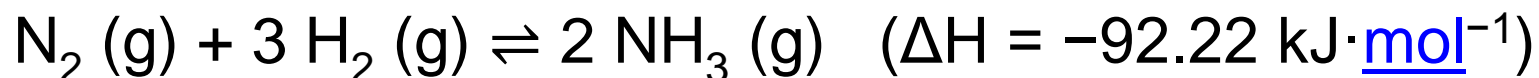
Different routes of loss of N & P



The Peak of World Oil Production



Haber Bosch for fixed nitrogen



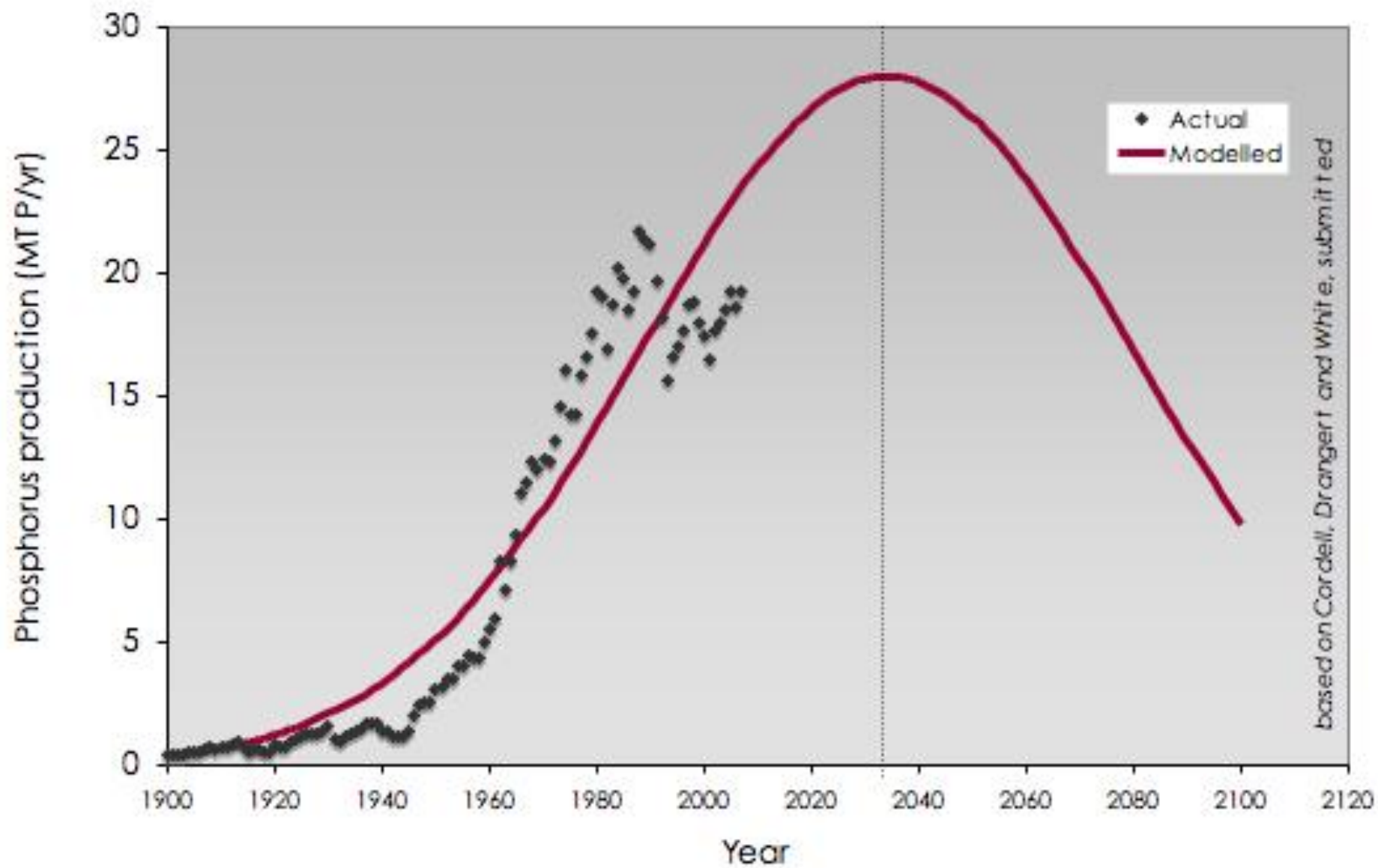
But

$\text{CH}_4 \rightarrow \text{H}_2$ and pressure, 15% yield. Unreacted components recycled

15-25 MPa, 300-550°C, Fe catalyst requires high temperatures

Uses 2% of global energy, 3-5% of annual natural gas production

Peak Phosphorus curve



based on Cordell, Drangert and White, submitted

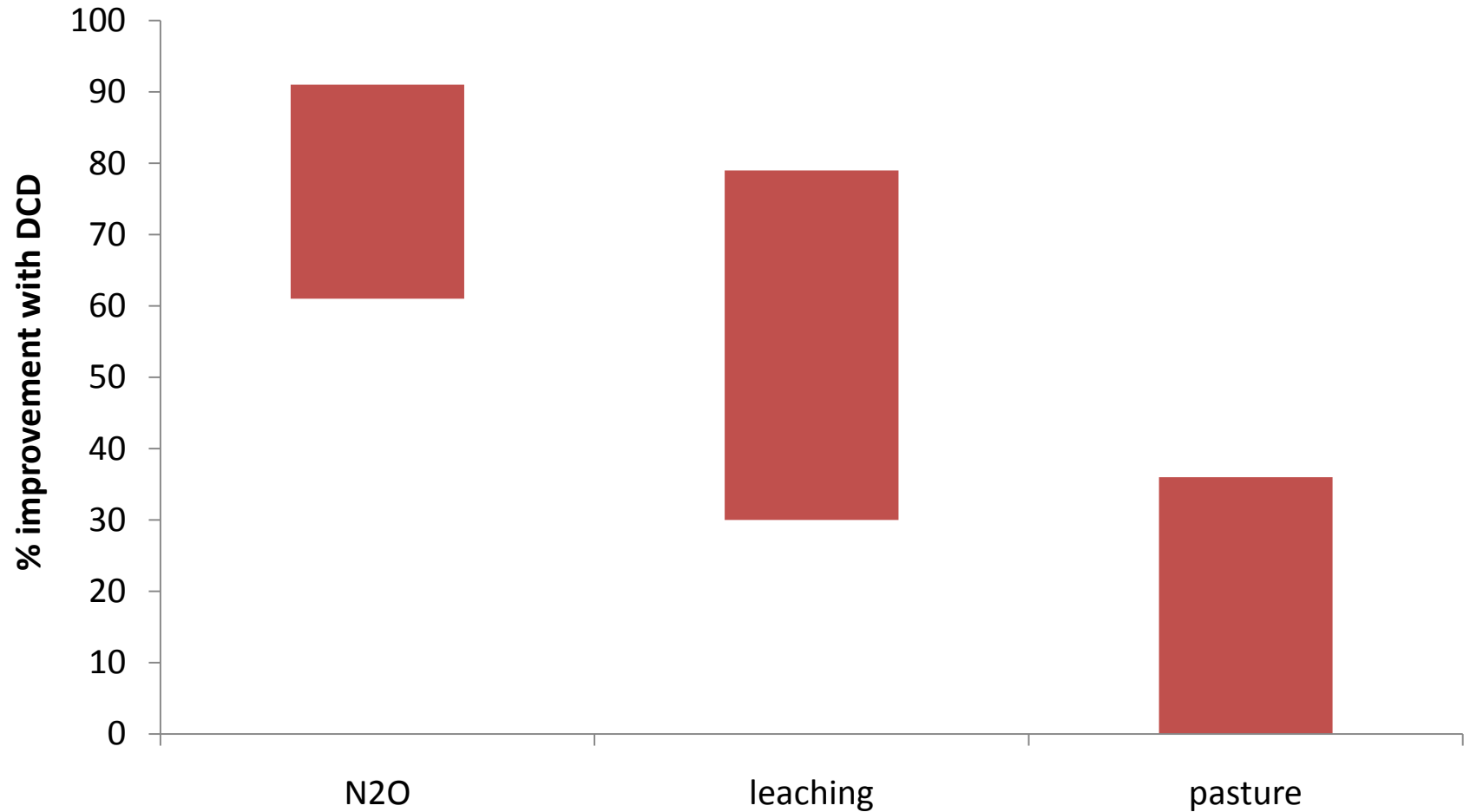
Economics

- Note that oil and Phosphorus supplies depend on the cost of their extraction.
- P reserves in Morocco for example have increased dramatically in recent years!
- This is because it is now deemed economically possible to extract P from lower grade reserves of which Morocco has ample supplies

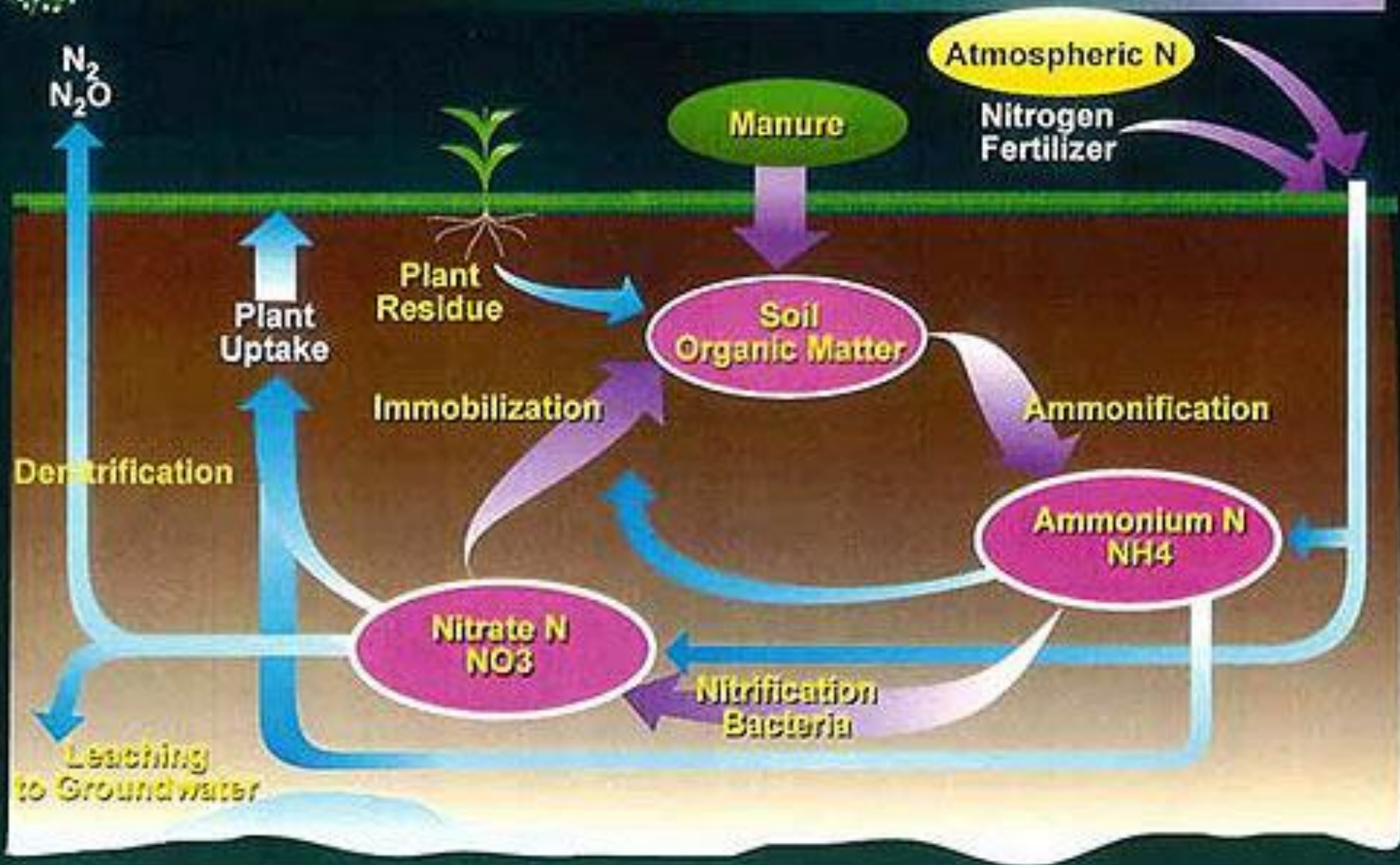
Methods to Retain N or use it more efficiently

1. Nitrification Inhibitors
2. Decision Support
3. Root environment
4. Precision Application
5. Subsoil N supply

Beneficial effect of a Nitrification Inhibitor



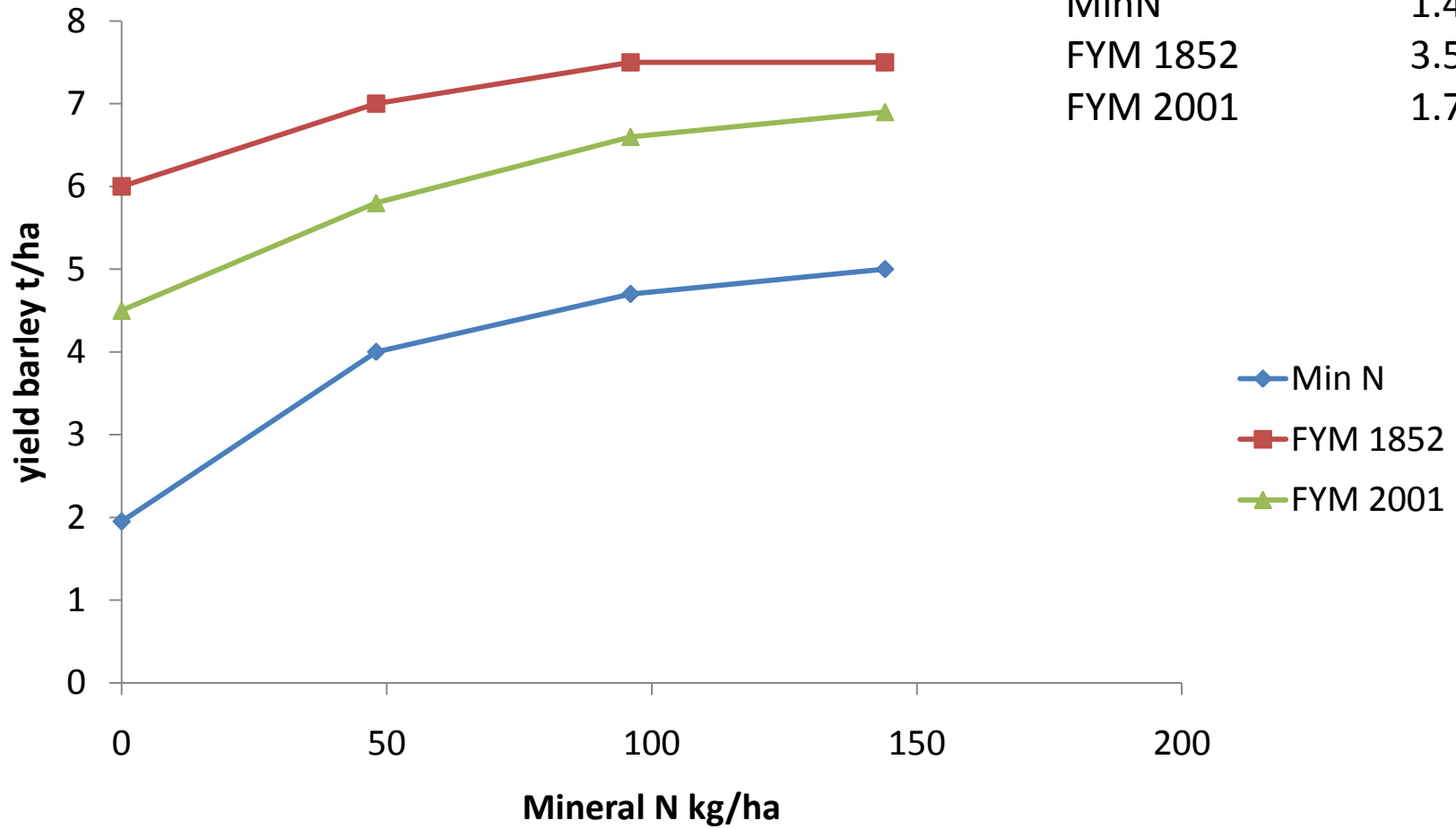
Nitrogen Cycle



Root Environment

Soil Organic Carbons:

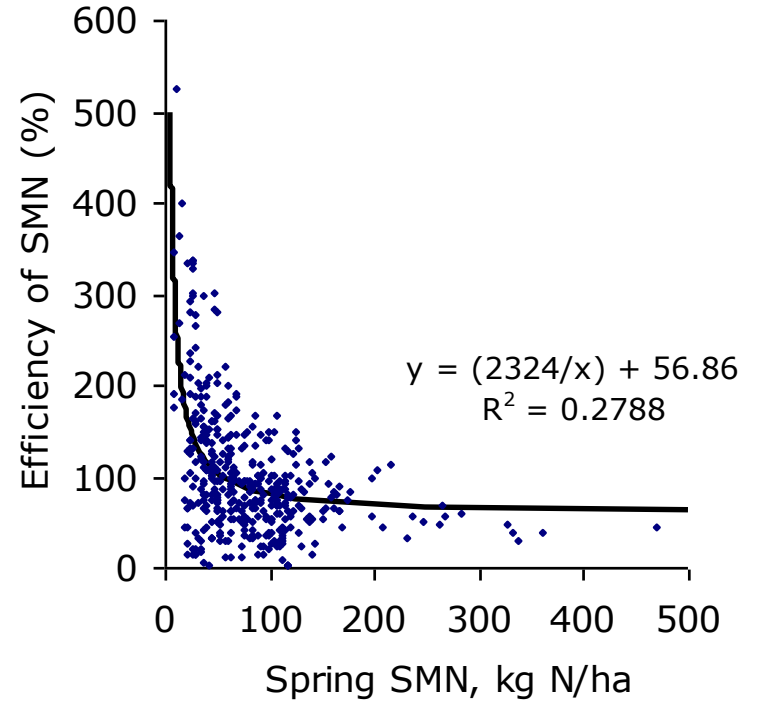
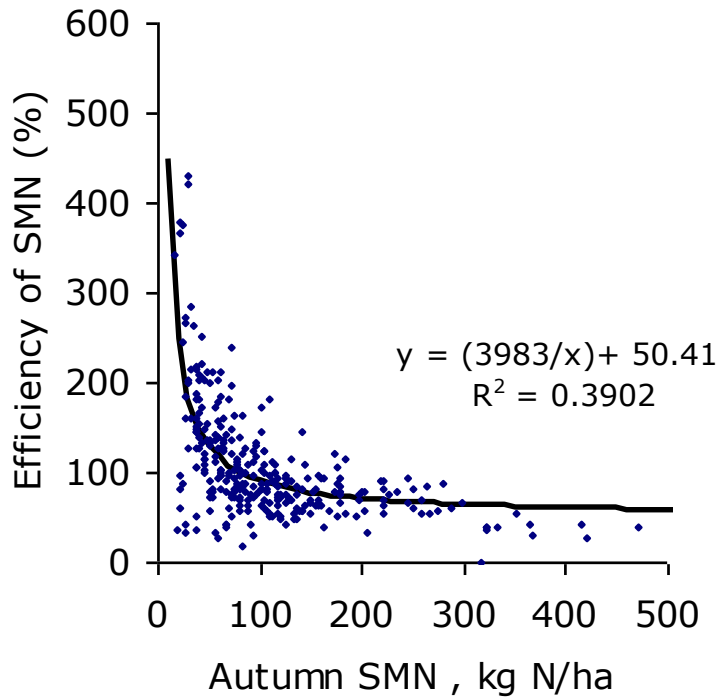
| | |
|----------|------|
| MinN | 1.4% |
| FYM 1852 | 3.5% |
| FYM 2001 | 1.7% |



Guidance



Efficiency of capture of soil N improved guidance



Precision Application of Fertiliser

Give the crop what it needs where it needs it

This could save 30 kg N ha⁻¹ or about 40 euro ha⁻¹ at 2003 prices.

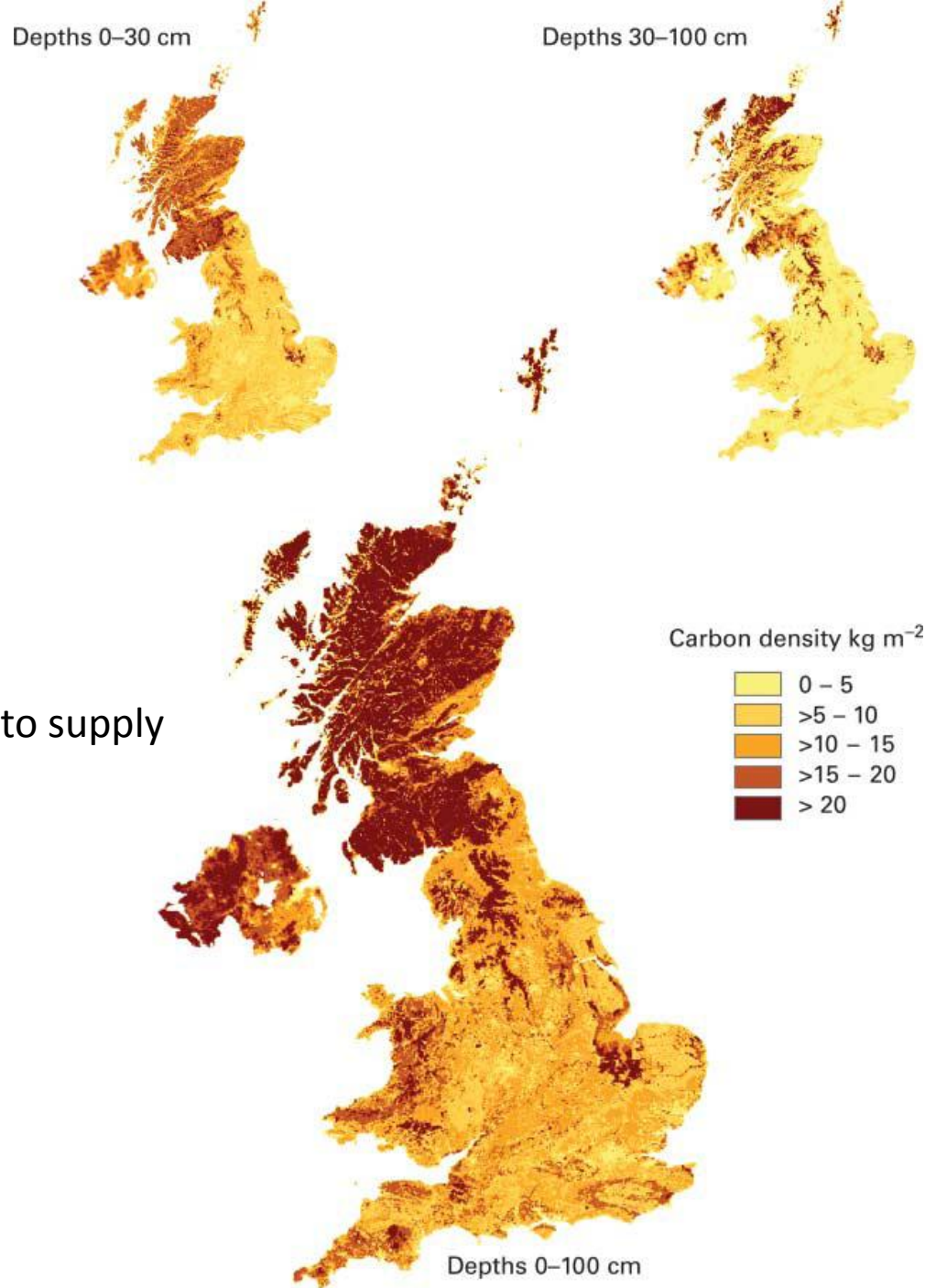
It is possible that there are reasons for the observed lack of response to N.

If these could be identified and ameliorated then profitability might increase.

In general, results imply that PA will reduce over-application. That it reduces losses of N has not yet shown to be the case.

Supply of Nitrogen from the Subsoil

Half of UK soils may be able to supply 25-30 kg N ha⁻¹



Conclusions

- P and N cycles differ
- Key to P shortages is recycling
- N cycle more closely related to C cycle with direct losses
- Several strategies exist to regulate N supply or reduce losses
- No one 'silver bullet' combination of strategies needed

N₂O and reduced tillage

