



4-8 DECEMBER 2016

MELBOURNE CRICKET GROUND | VICTORIA | AUSTRALIA



1. Is soil test useful for N management?
2. Should we mine soil nitrogen?
3. Is NUE as low as perceived?

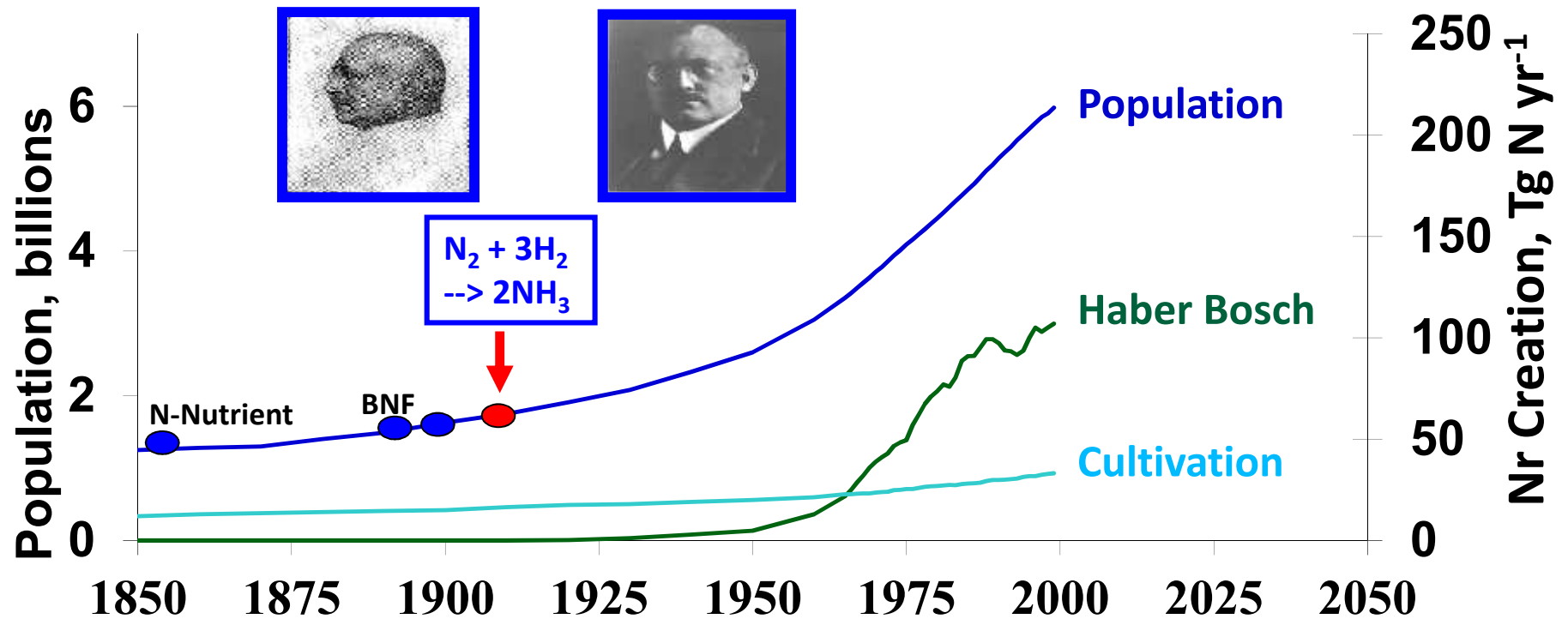
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Timeline of Global Reactive N Creation by Human Activity 1850 to 2000

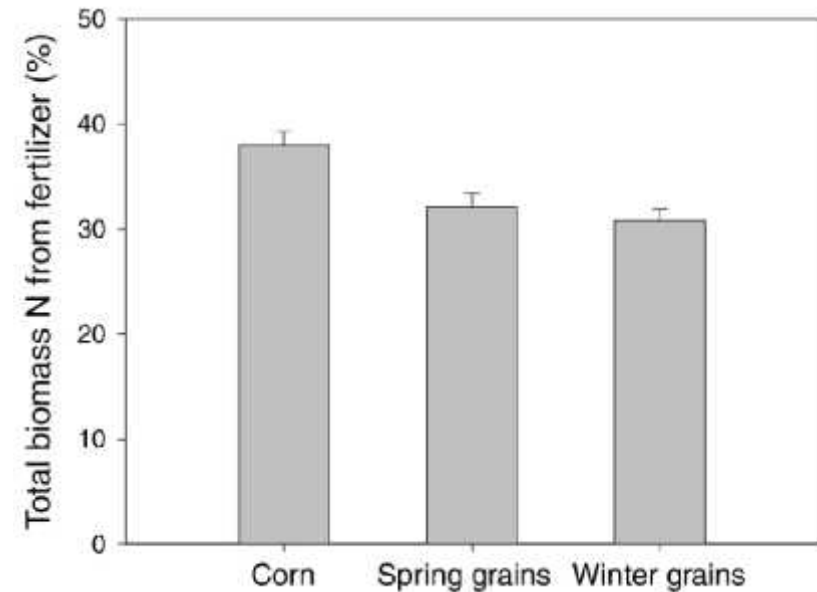
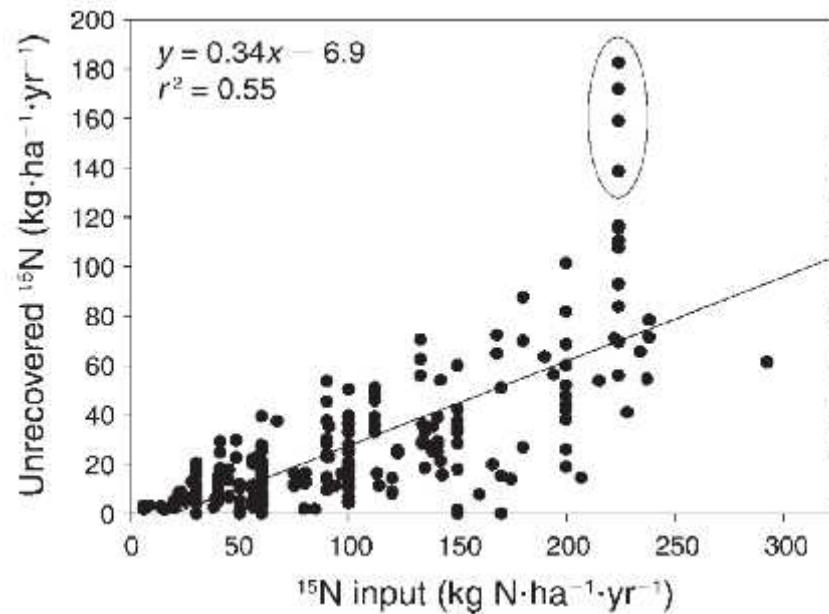


Half of the world population fed by chemical N

Galloway et al. (2003)



Soil N plays an important role in soil fertility



Based on ^{15}N studies, even in well-fertilised fields about 50 % of plant N uptake is from the soil N pool



Too much N vs. too little N

Case 1: Excessive N input



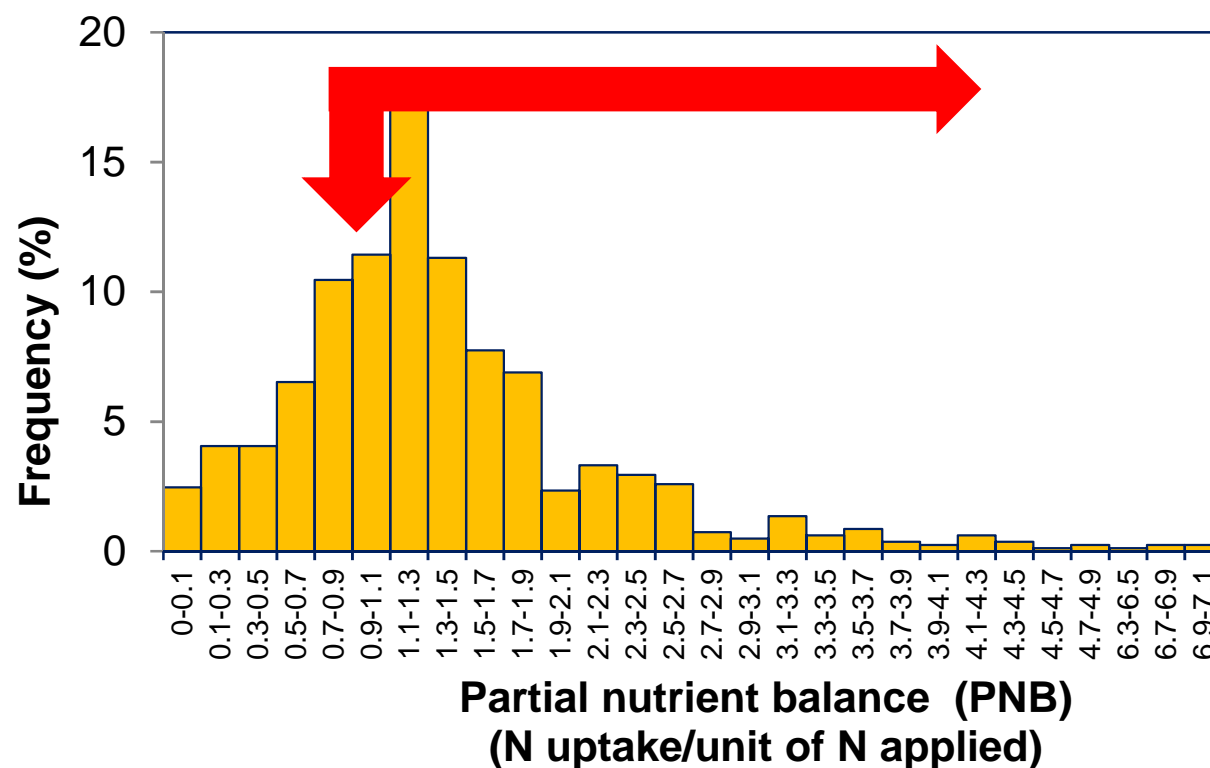
Example: intensive dairy in Australia

Case 2: Inadequate N input



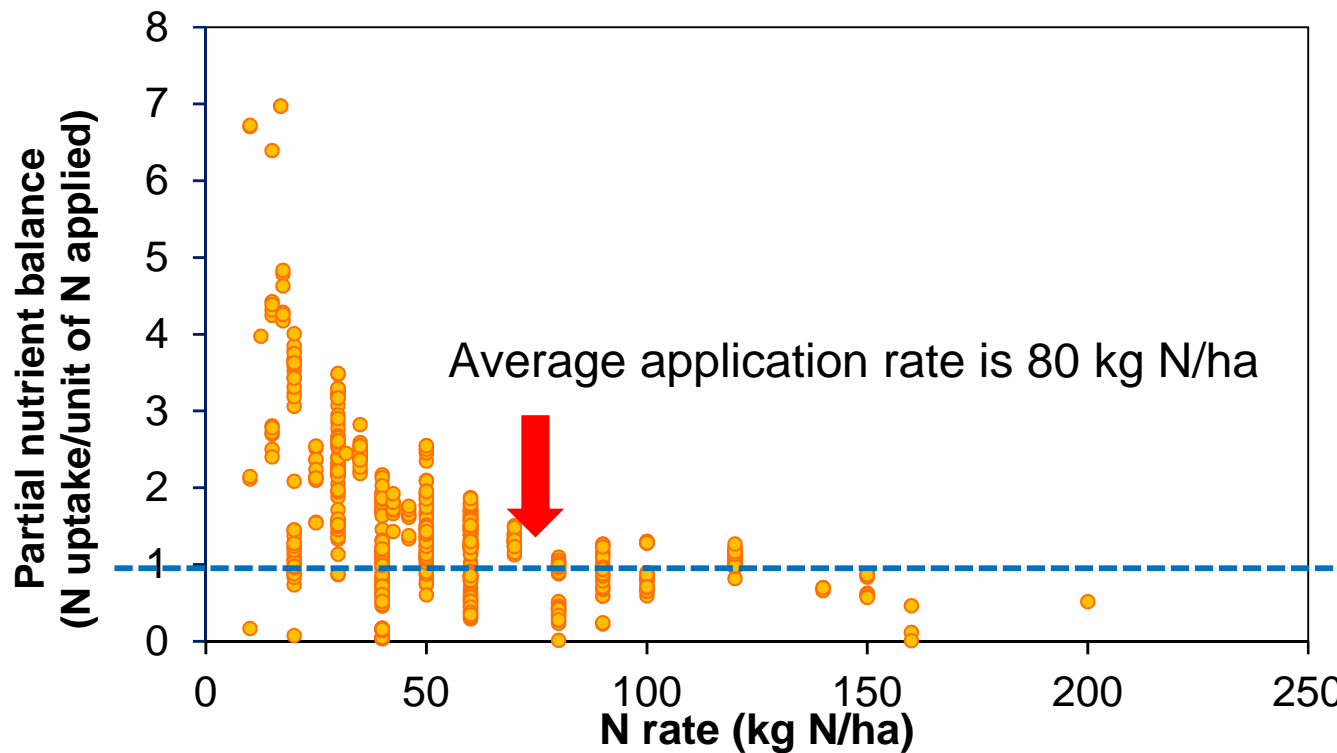
Example: wheat in Australia

- $PNB > 1$ = soil N being mined
- 67% of $PNB > 1$
- “Autumn break”: Although soil test may indicate soil N is available, it is not sustainable without N input.





Effect of N rates



'PNB > 1' occurs mostly when N rate < 100 kg N/ha

Wheat**Australia****0.3****China****43.9****US****25.7**



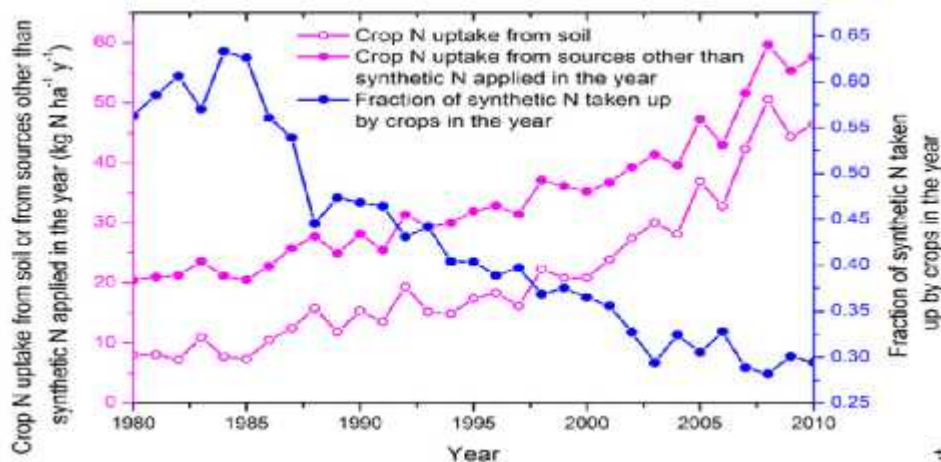
Australian pasture system, excessive N input

N source	1990	2000	2012
N inputs (average per farm) kg N ha⁻¹			
Cattle	1	1	1
Forage	10	24	31
Concentrates	24	54	81
Fertiliser	18	39	71
Legume N inputs	31	27	26
Atmosphere	6	6	5
<u>N input total</u>	<u>91</u>	<u>151</u>	<u>214</u>
N outputs (average per farm) kg N ha⁻¹			
Cattle	9	9	8
Milk	28	40	49
<u>N output total</u>	<u>36</u>	<u>48</u>	<u>57</u>
<i>N input – output (kg N ha⁻¹)</i>	<i>54</i>	<i>103</i>	<i>158</i>
<i>N use efficiency (%)</i>	<i>40</i>	<i>32</i>	<i>26</i>
<i>Dutch dairy farms: N input – output (kg N ha⁻¹)</i>			<i>210</i>

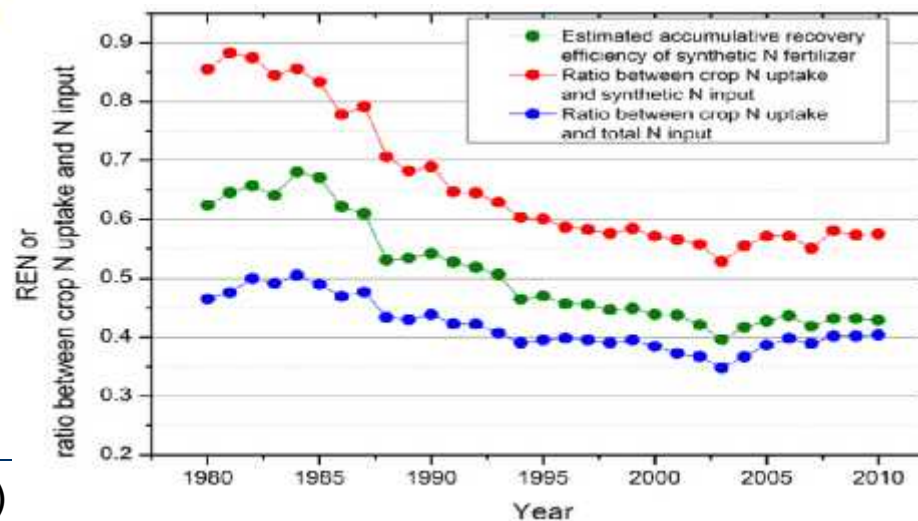
Stott and Gourley (2016); Schulte-Uebbing (2016)



Is NUE as low as perceived?



Yan et al. (2014)



Yan et al. (2014)

Paradox of mining soil N

Case 1: Excessive N input

Fertiliser N application is based on perceived need (low NUE)

N input > N removal

Does soil N build up?
Is NUE as low as perceived?

Should soil N be mined forever?

Case 2: Inadequate N input

Fertiliser N application is based on mineralisable N

N input < N removal

Is the depletion of N sustainable?

Should soil N be mined?



High yield maize production in the North China Plain

	ISSM	High yield
Maize grain yield (tonnes/ha)	13	15.2
N input (kg N/ha)	237	747
N removed in harvest (kg N/ha)	250	292
Input – harvest (kg N/ha)	-12	457

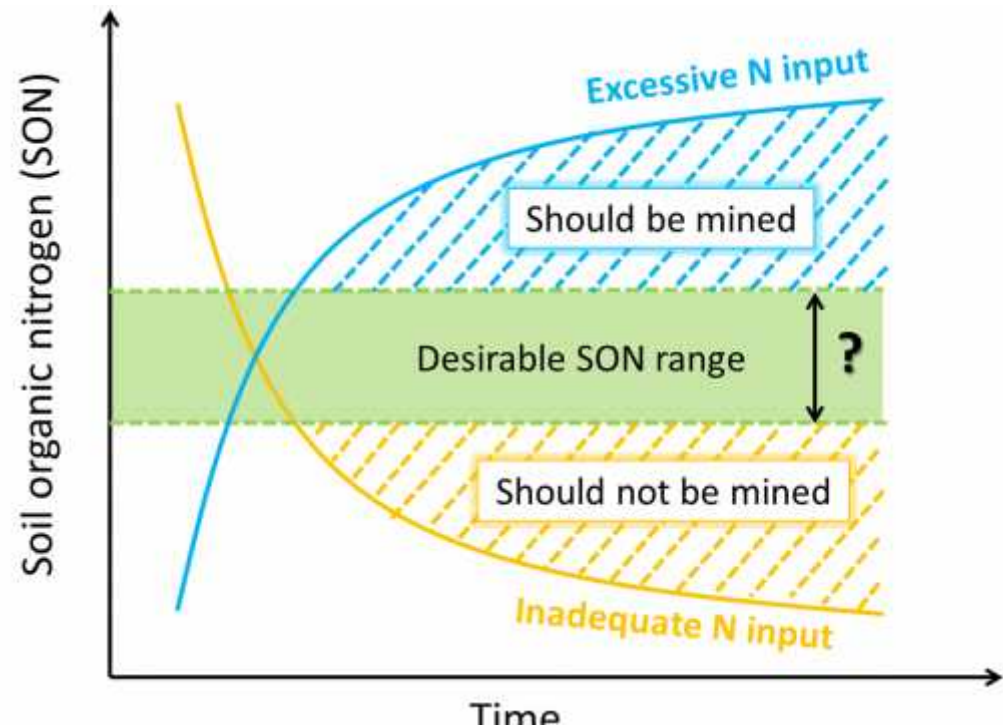
ISSM: integrated soil-crop system management

Chen et al. (2010)



Framework

- Excessive N additions need to be halted, and the surplus N should be mined, at least for some time.
- For low N input systems, N should not be mined.





- So far, no evidenced-based index for “**Green**”/sustainable agriculture products
 - Can we develop **Environmental Footprint** → **True Environmental cost**
 - To encourage and reward the more sustainable practices?
 - To give more efficient producers marketing, pricing advantages
 - To develop true environmental cost of agriculture products production leading to payment/trading (*Environmental Offset*), **Environmental (N) Credit**
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7th International Nitrogen Initiative Conference (INI 2016)

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Thank you



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