

Nutrient exchanges under increased forest biomass harvesting

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Increased harvesting of forest biomass may limit nutrient availability:

- Nutrients in above-ground biomass are mostly in branches and needles
- Branches and needles decompose on site after harvesting, giving nutrients that support growth
- Replacing fossil fuels with biomass fuels means this nutrient source will be removed

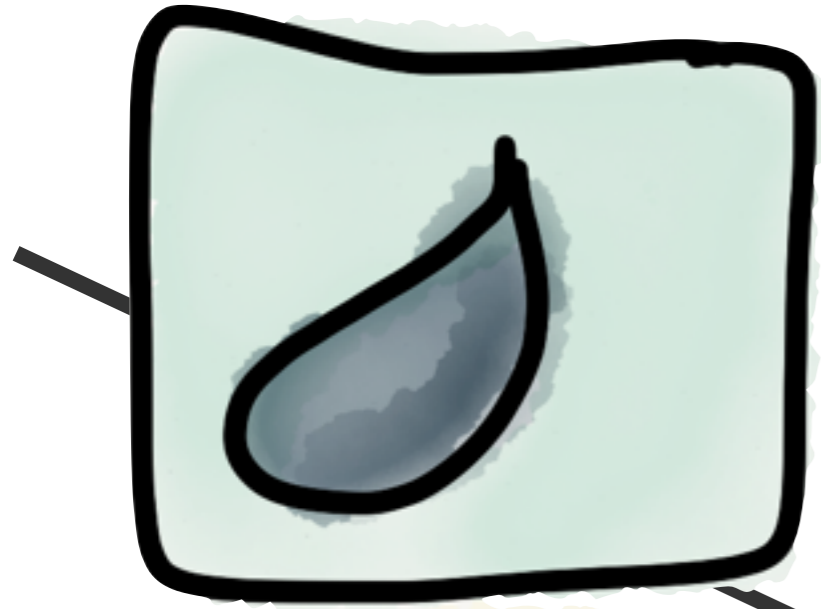


Nutrient
inputs



Nutrient
outputs

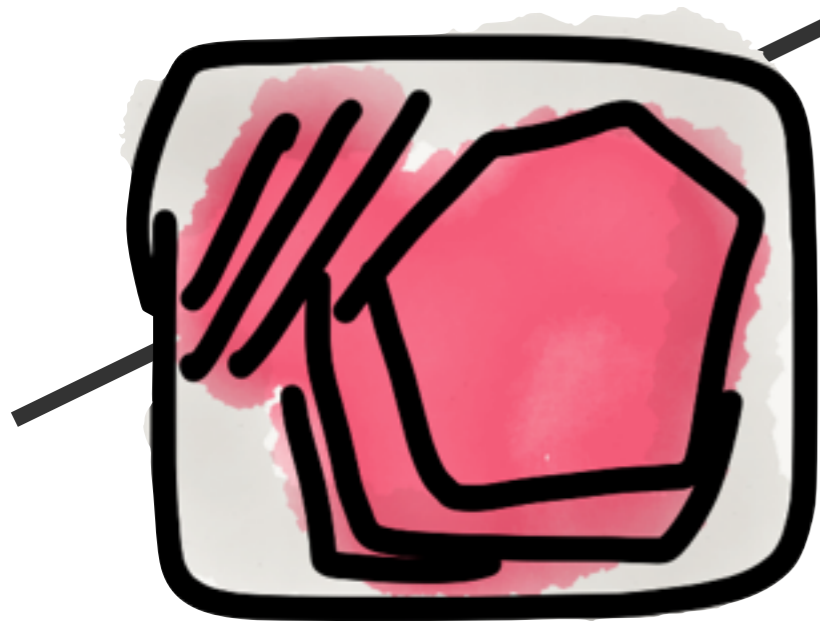
Atmospheric deposition



Nutrient inputs

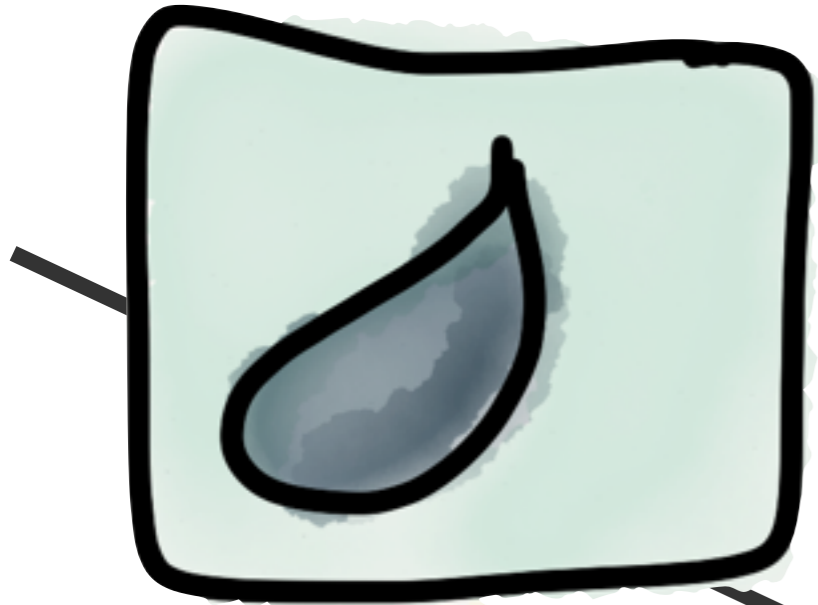


Nutrient outputs

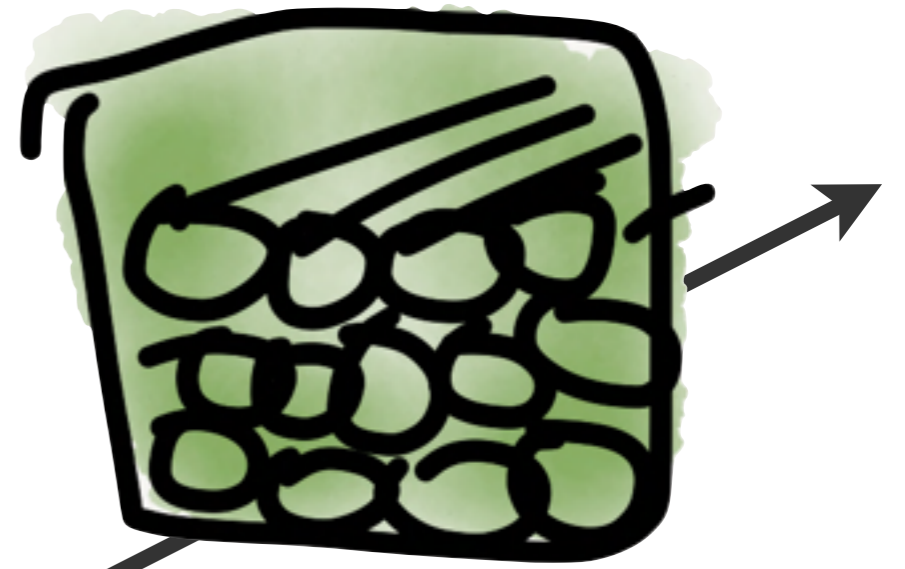


Mineral weathering

Atmospheric deposition



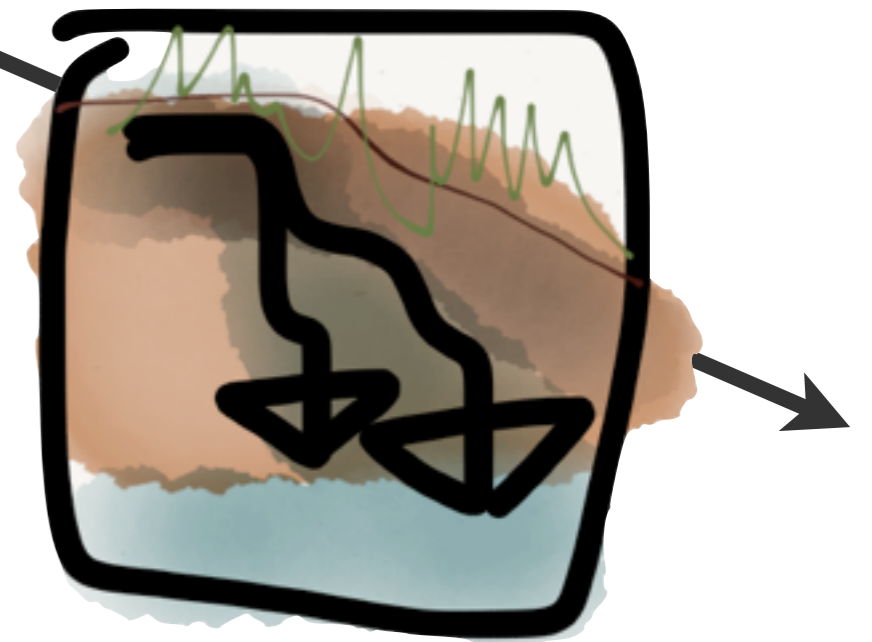
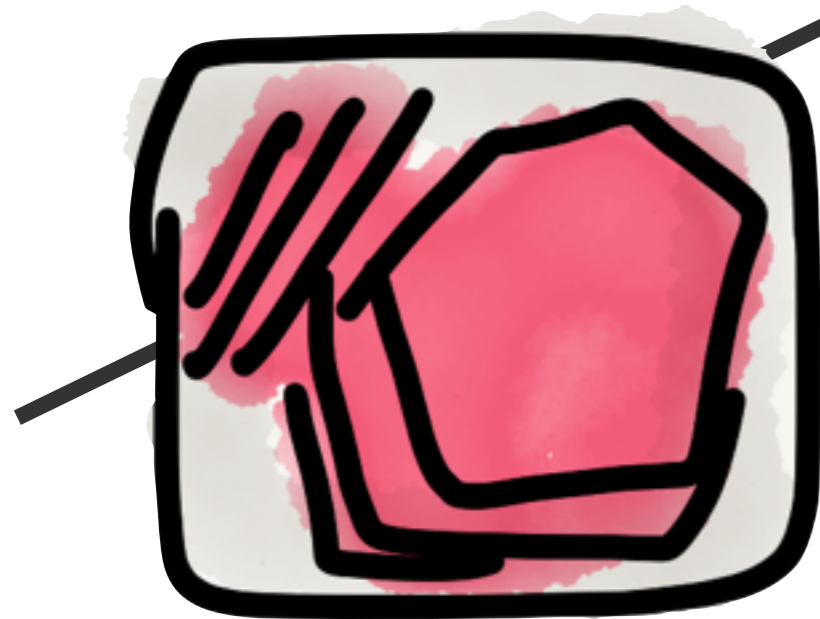
Harvest removal



Nutrient inputs



Nutrient outputs



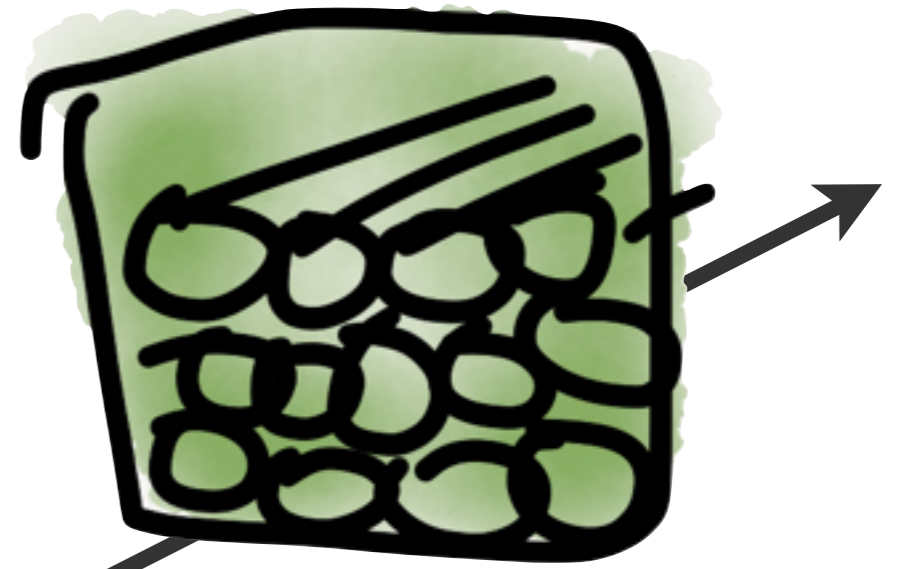
Mineral weathering

Leaching & Runoff

Atmospheric deposition



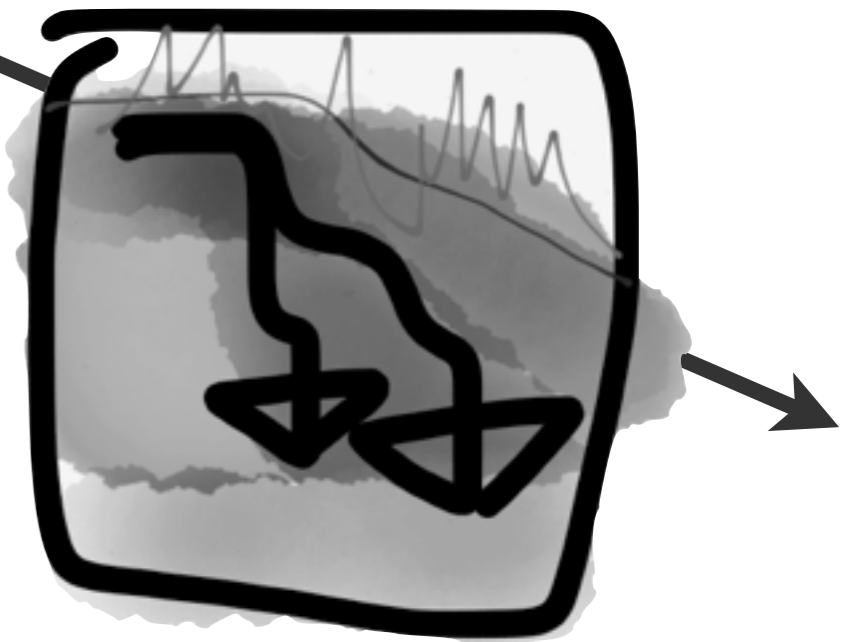
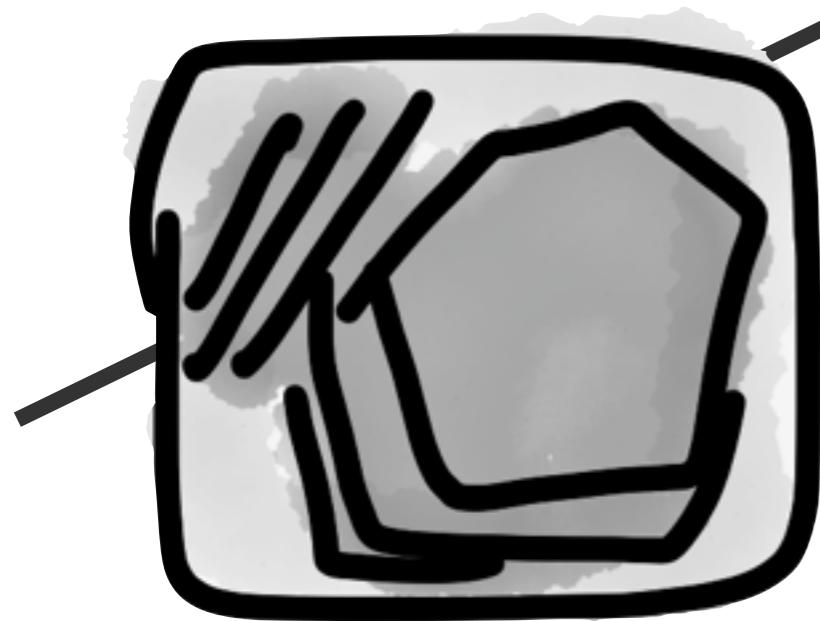
Harvest removal



Nutrient inputs



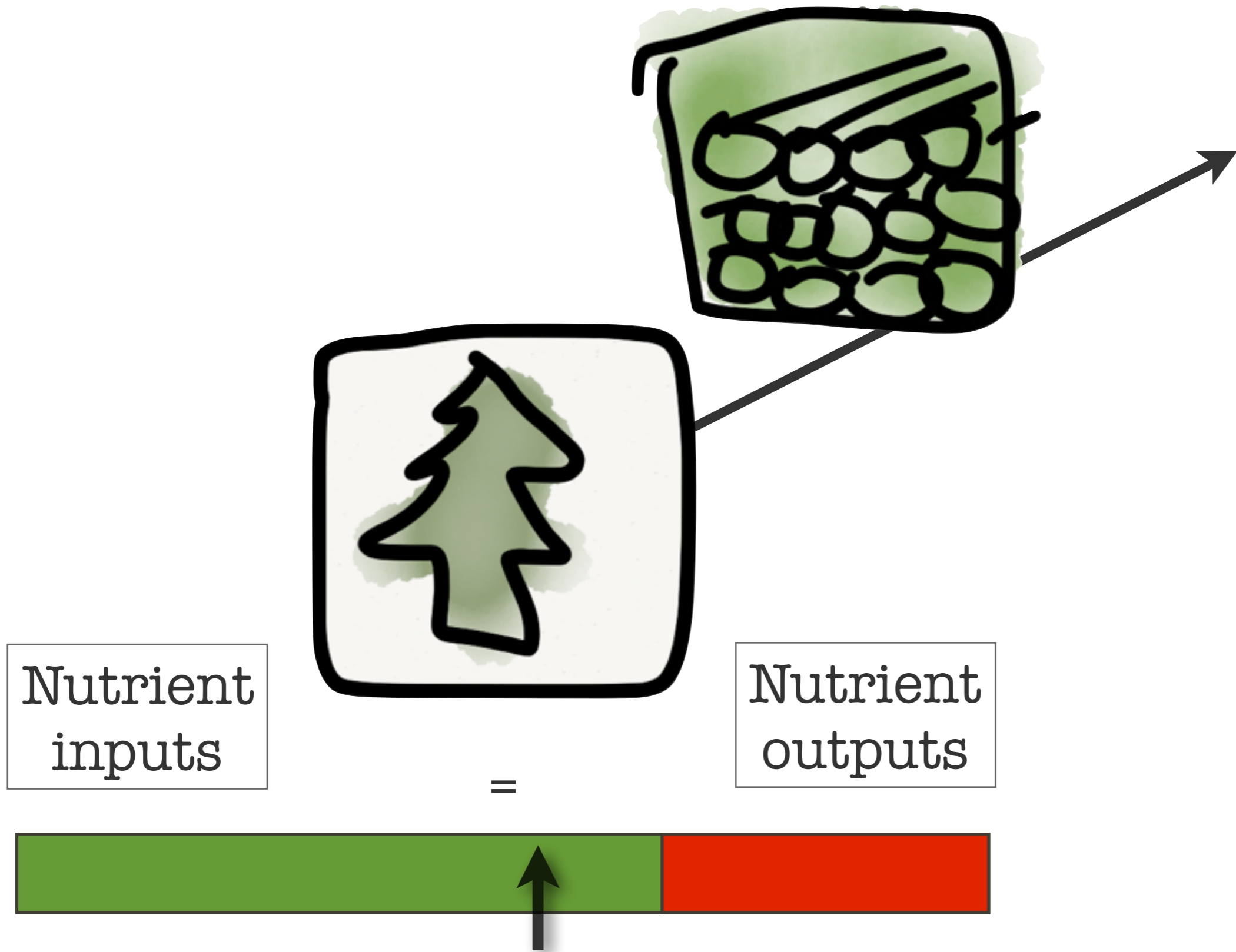
Nutrient outputs



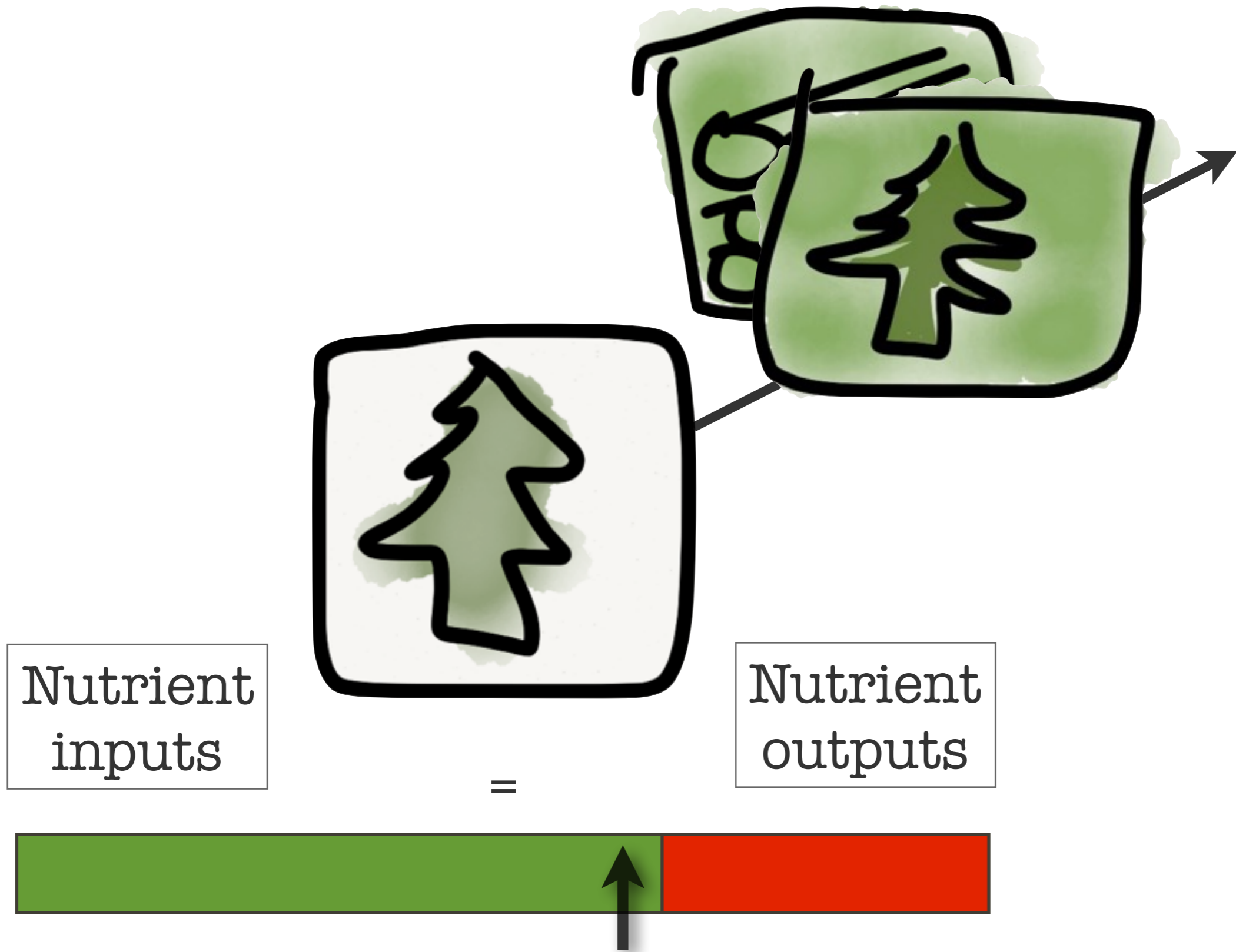
Mineral weathering

Leaching & Runoff

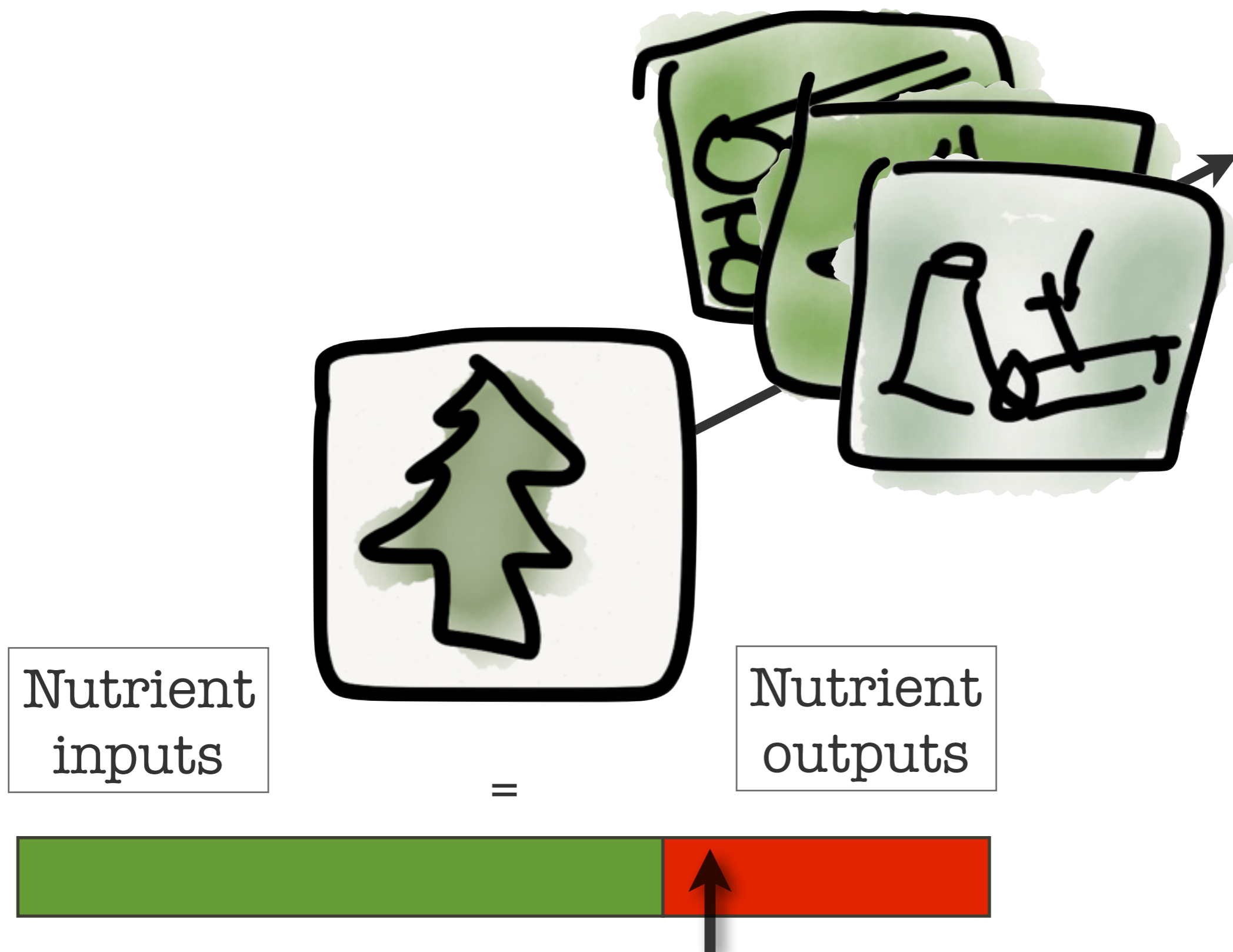
Harvest removal



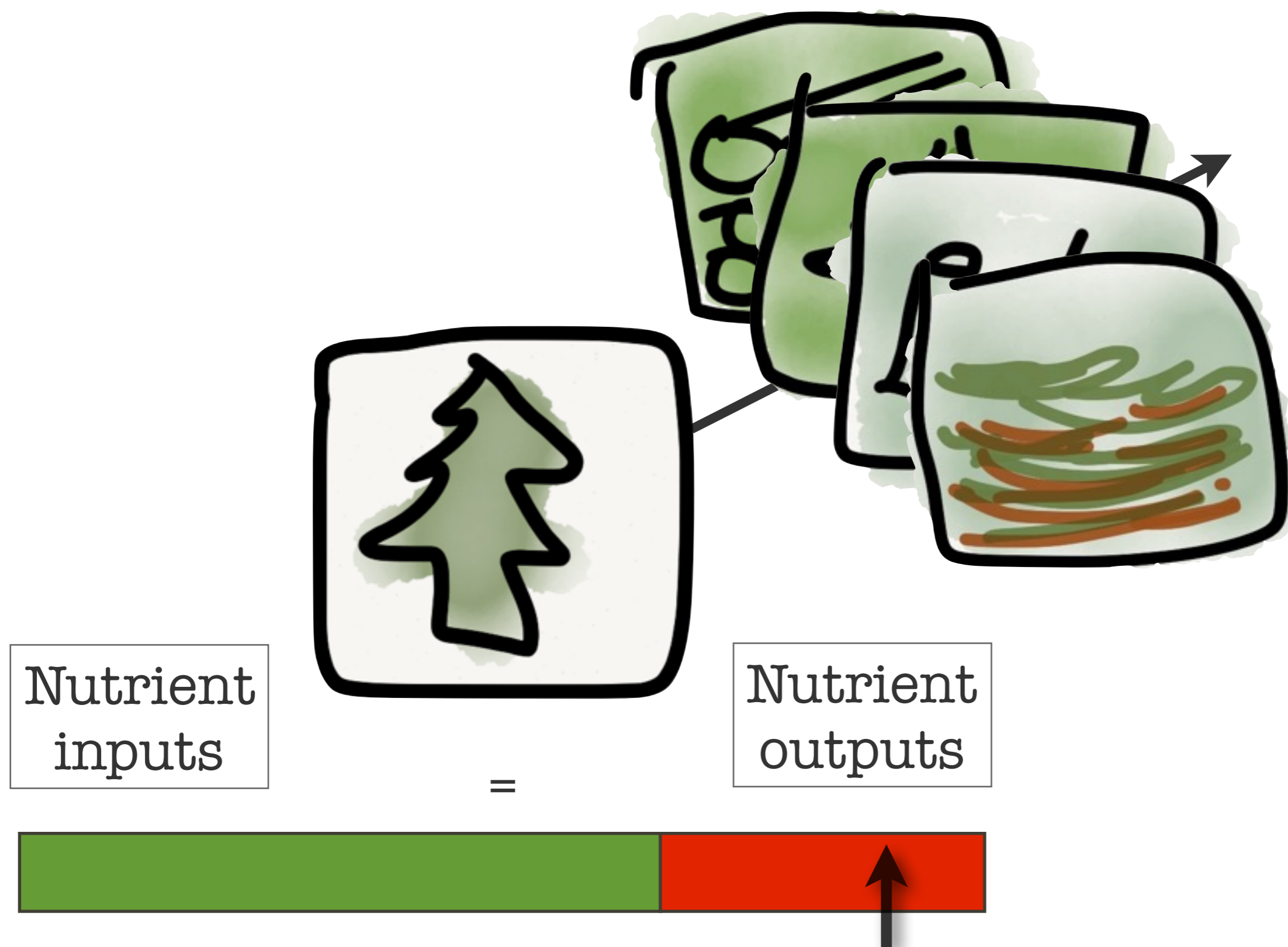
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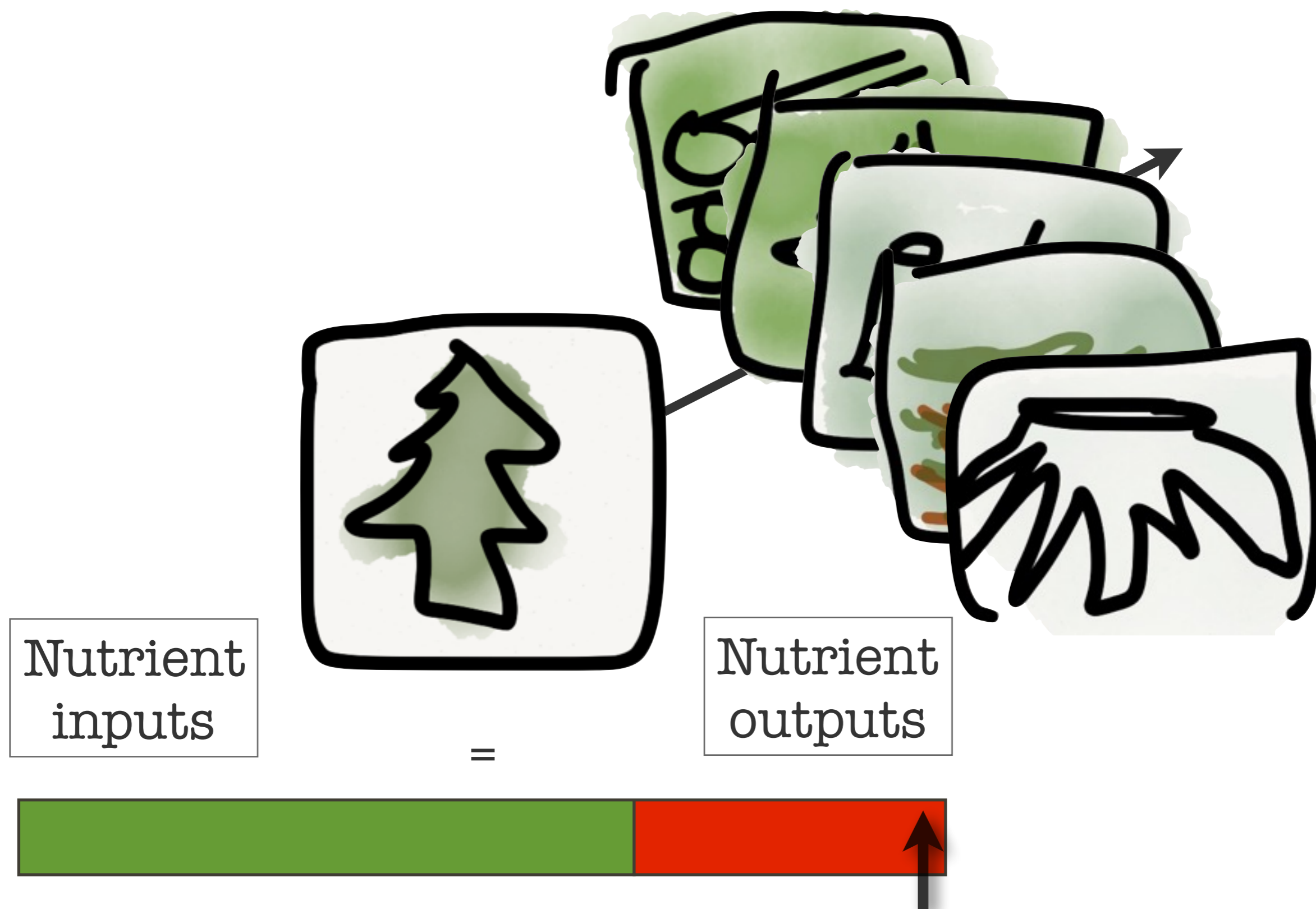
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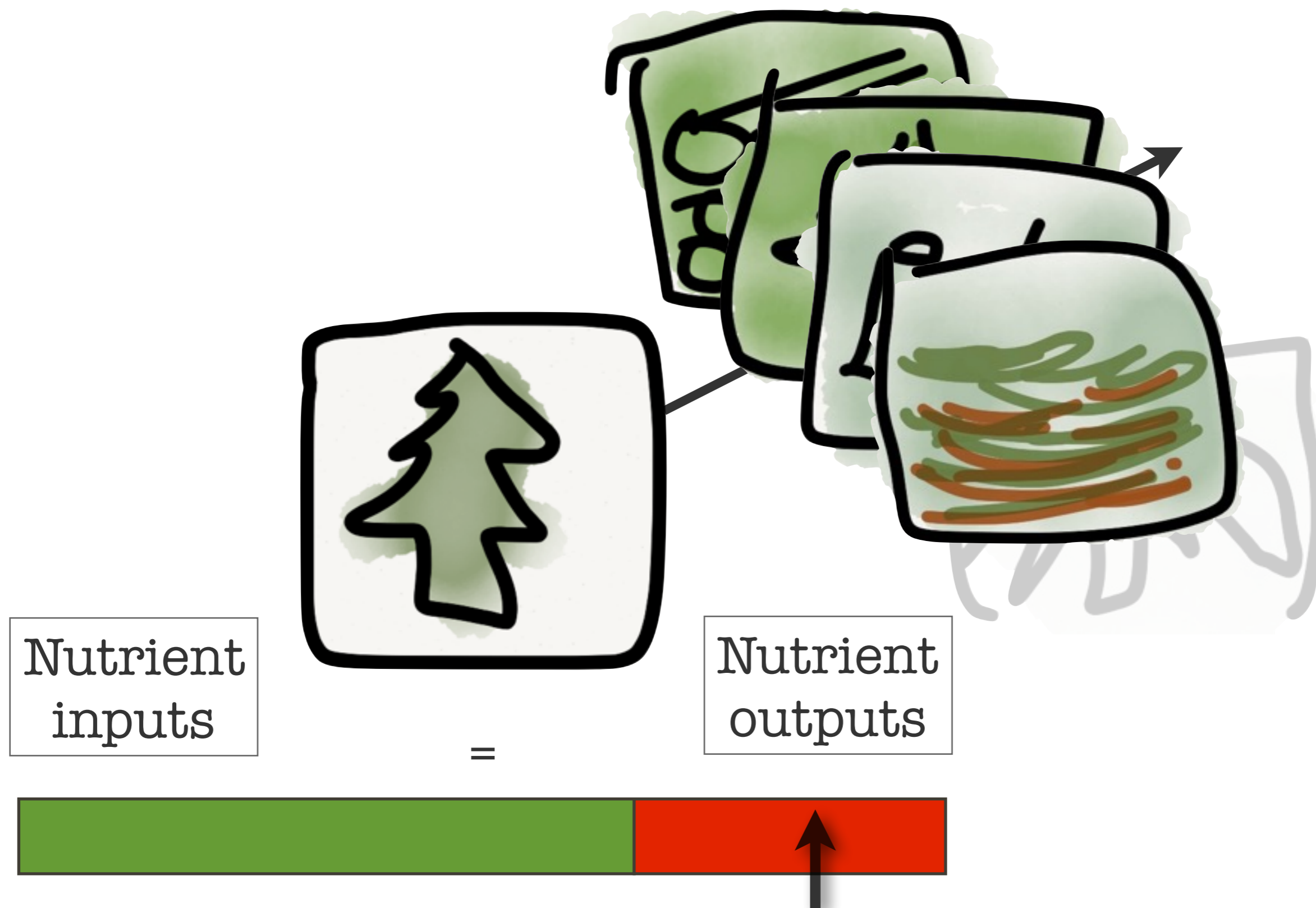
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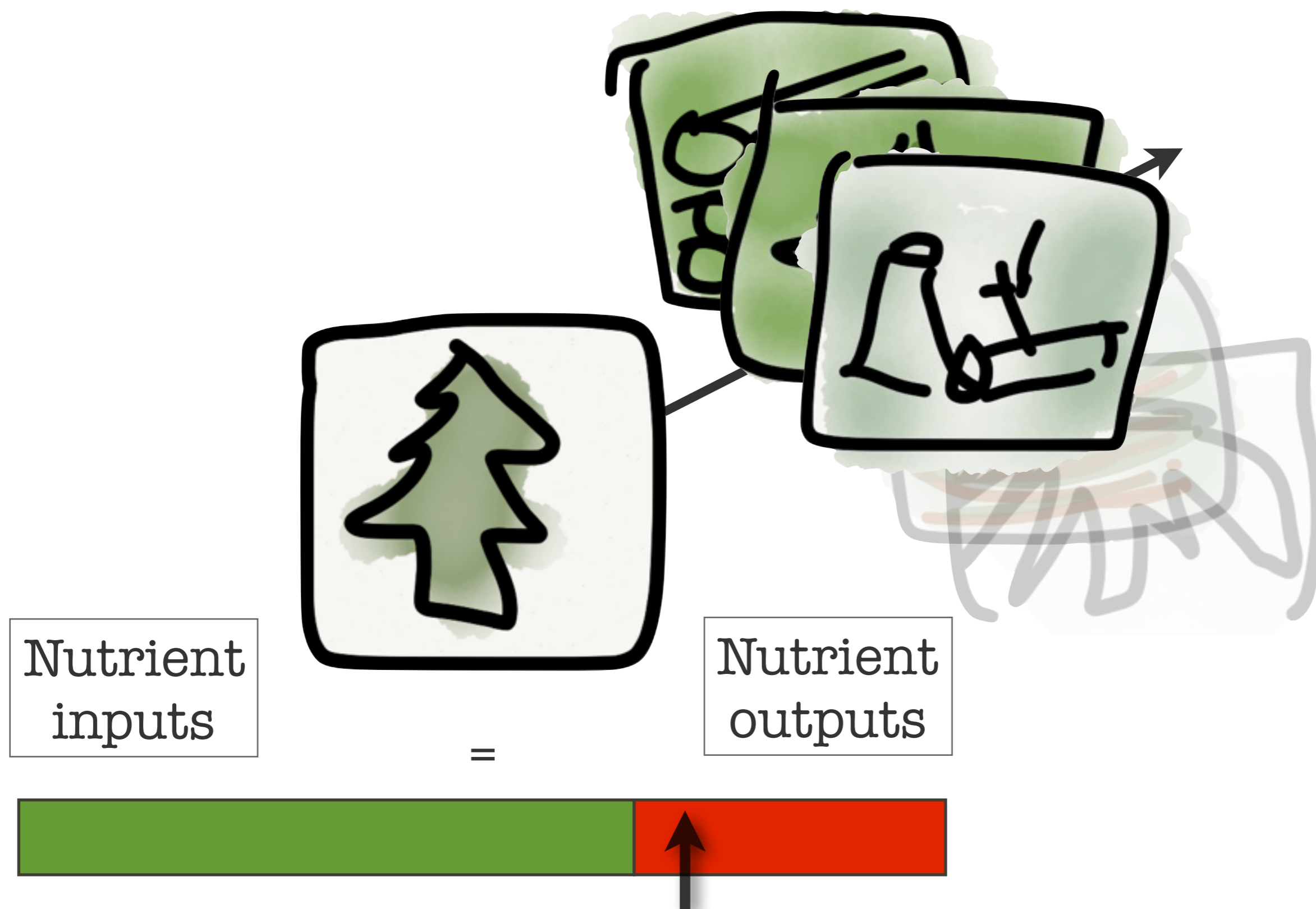
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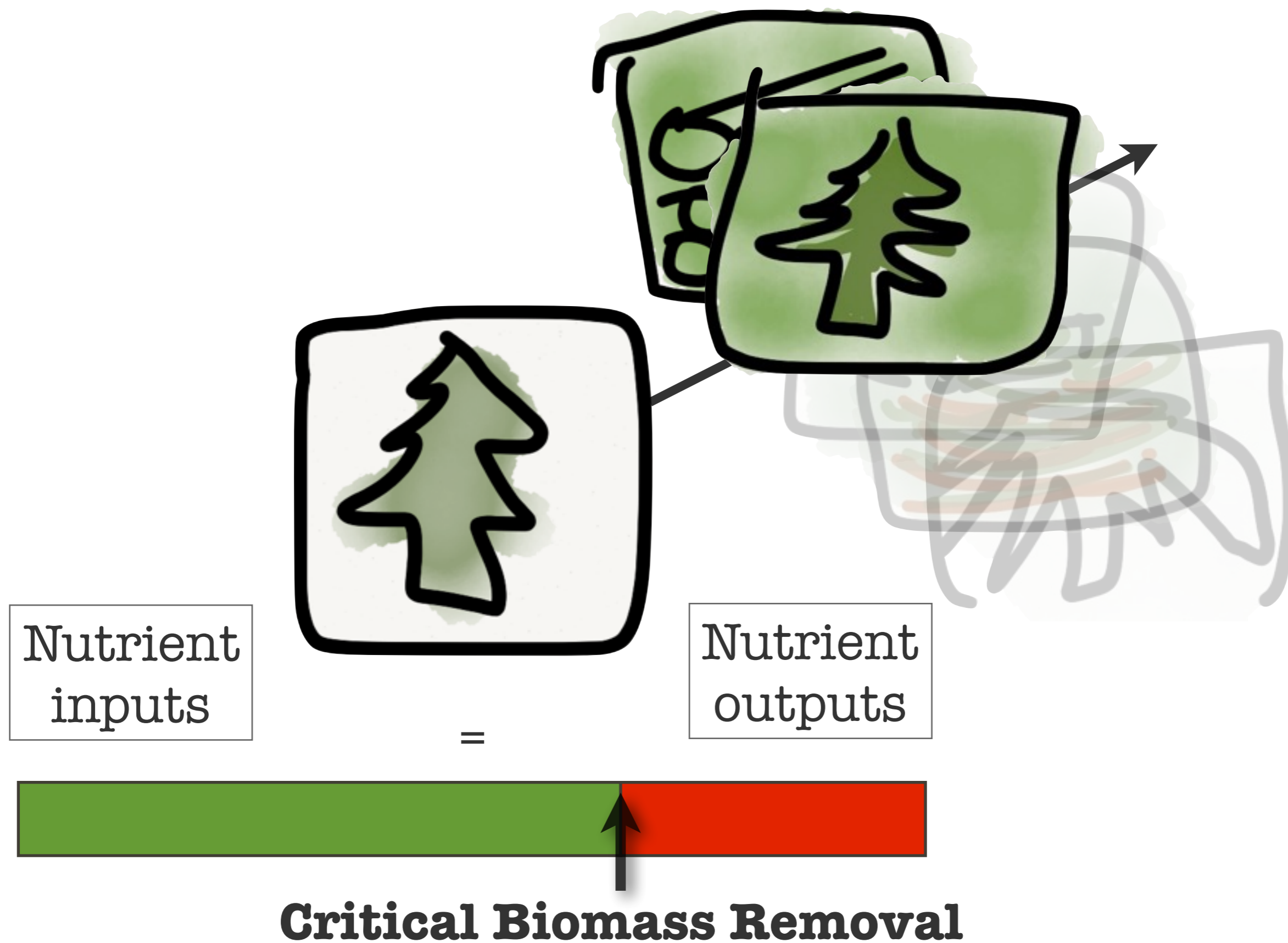
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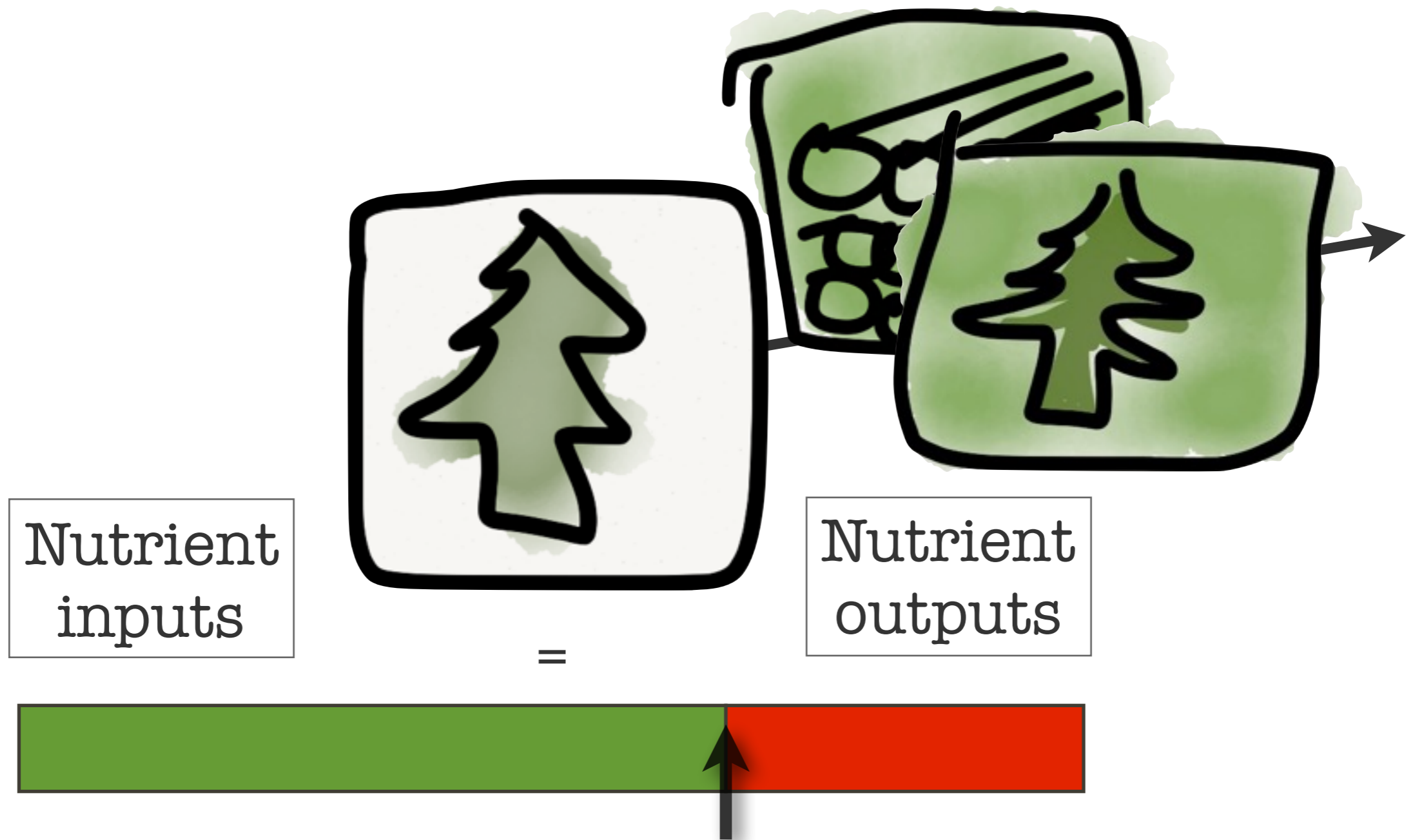
Harvest removal



Harvest removal



Harvest removal

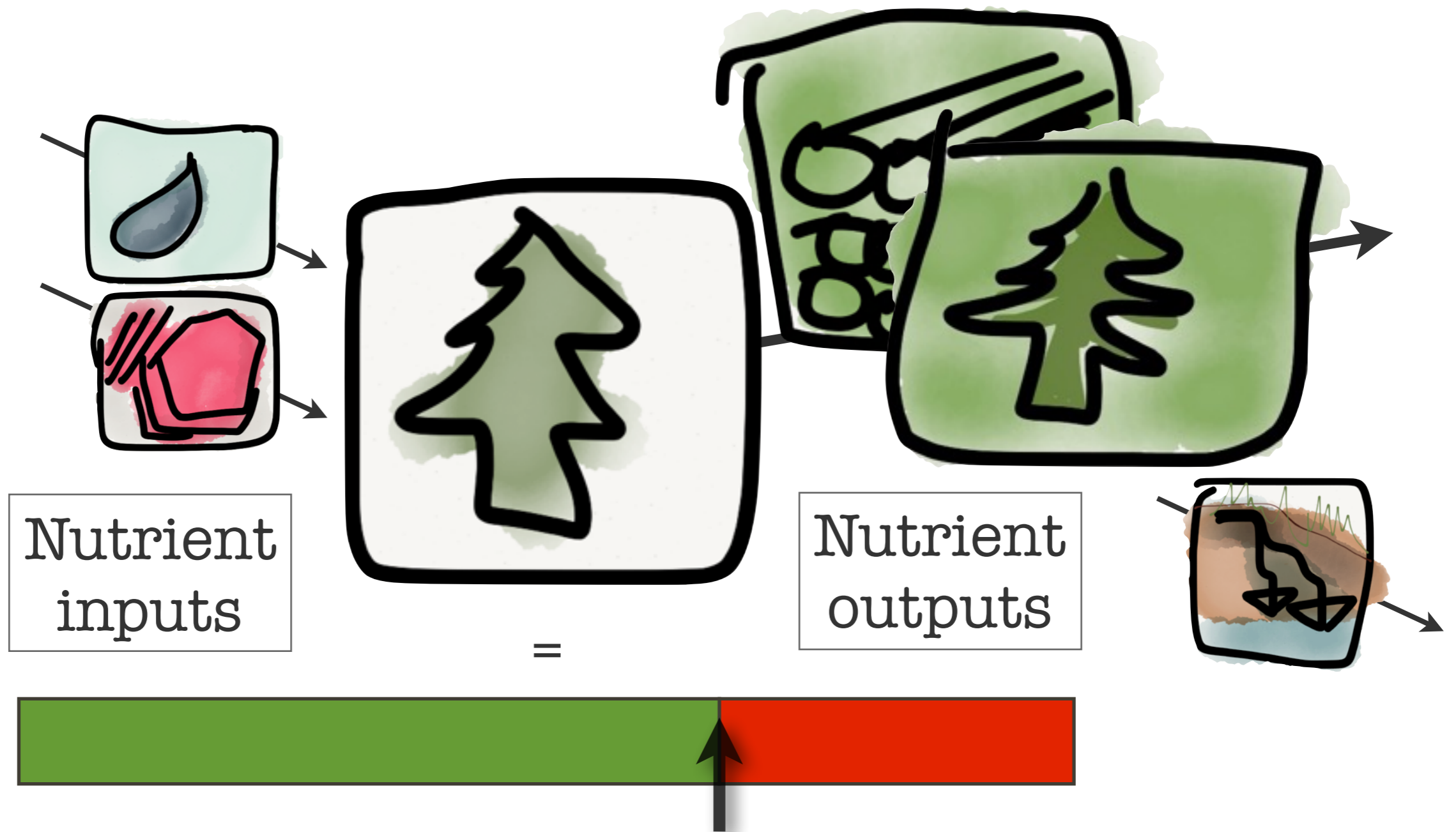


Critical Biomass Removal

The level of harvest removal below which harm will not occur, according to current knowledge.

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Harvest removal



Critical Biomass Removal

The level of harvest removal below which harm will not occur, according to current knowledge.

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Atmospheric
deposition



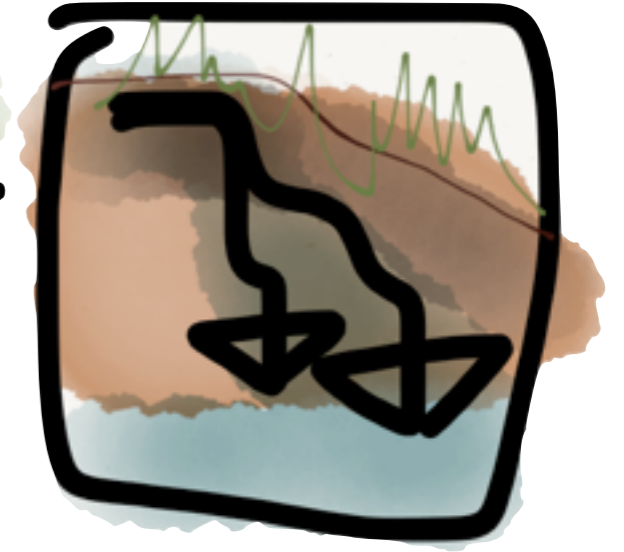
Mineral
weathering



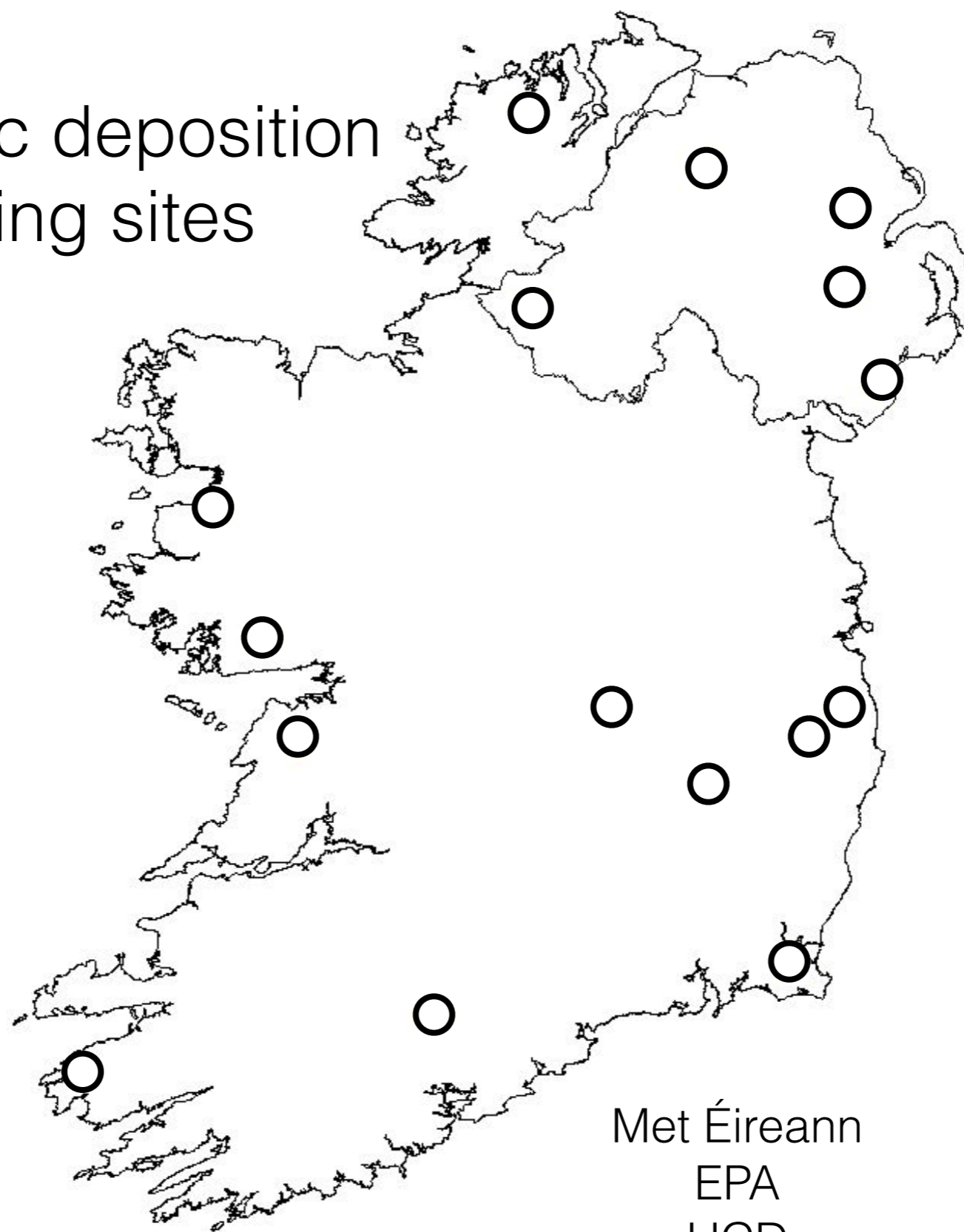
Harvest
removal



Leaching
& Runoff








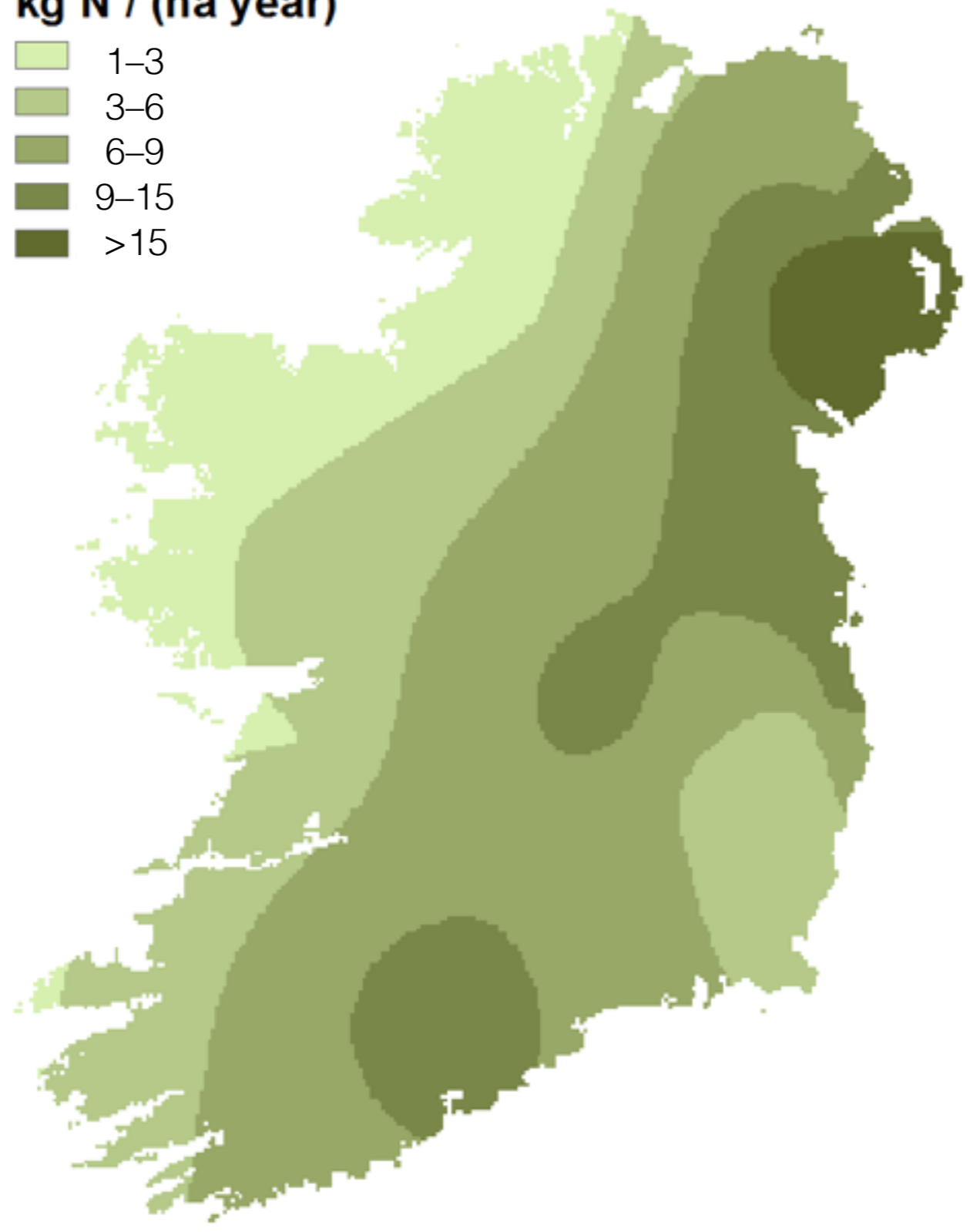
Atmospheric deposition monitoring sites



Met Éireann
EPA
UCD

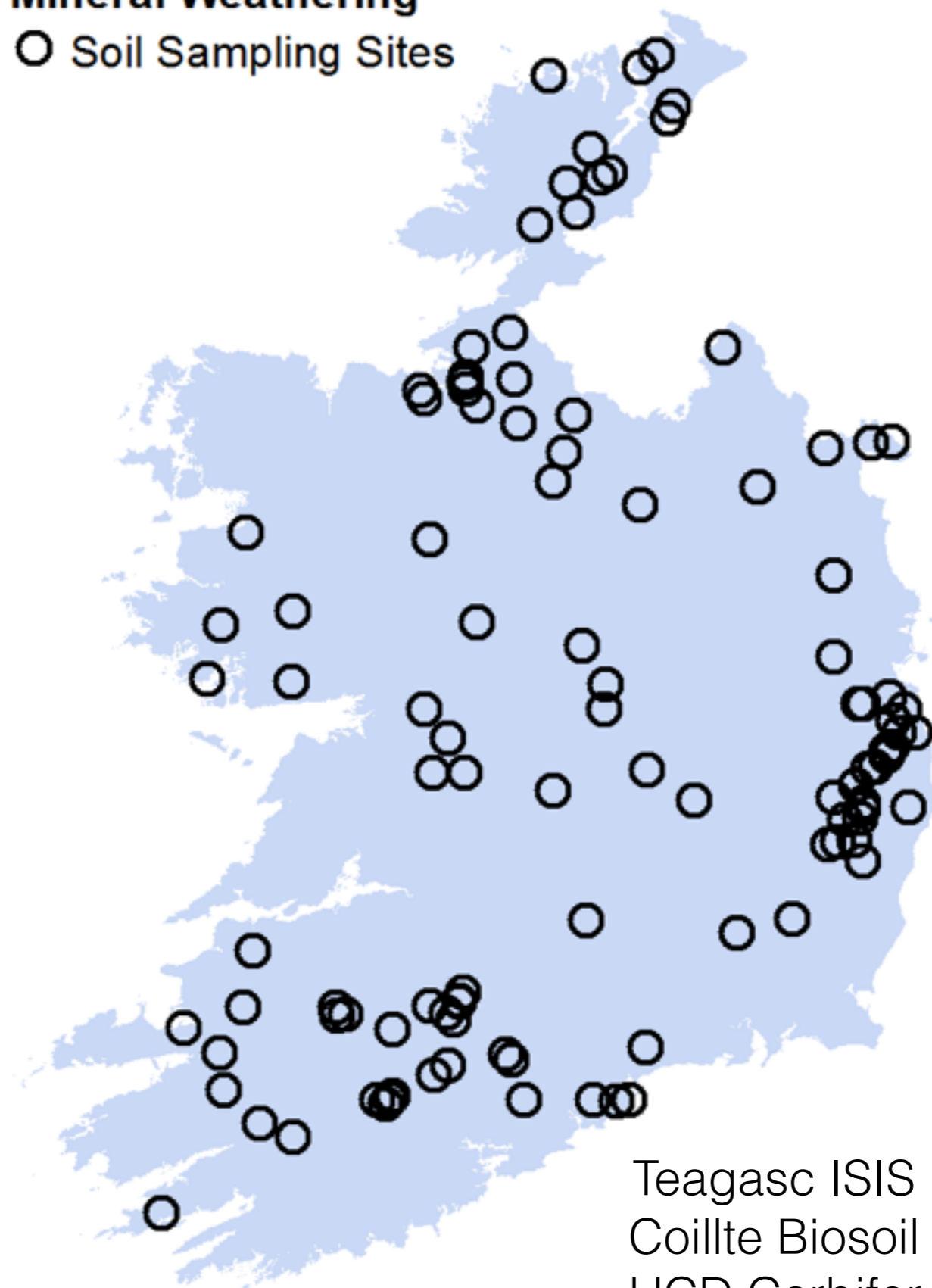
N Deposition
kg N / (ha year)

-  1-3
-  3-6
-  6-9
-  9-15
-  >15



Mineral Weathering

○ Soil Sampling Sites




Teagasc ISIS
Coillte Biosoil
UCD Carbifor
UCD CForRep

Soils


Mineral Weathering Rate


mmol / (m² year)

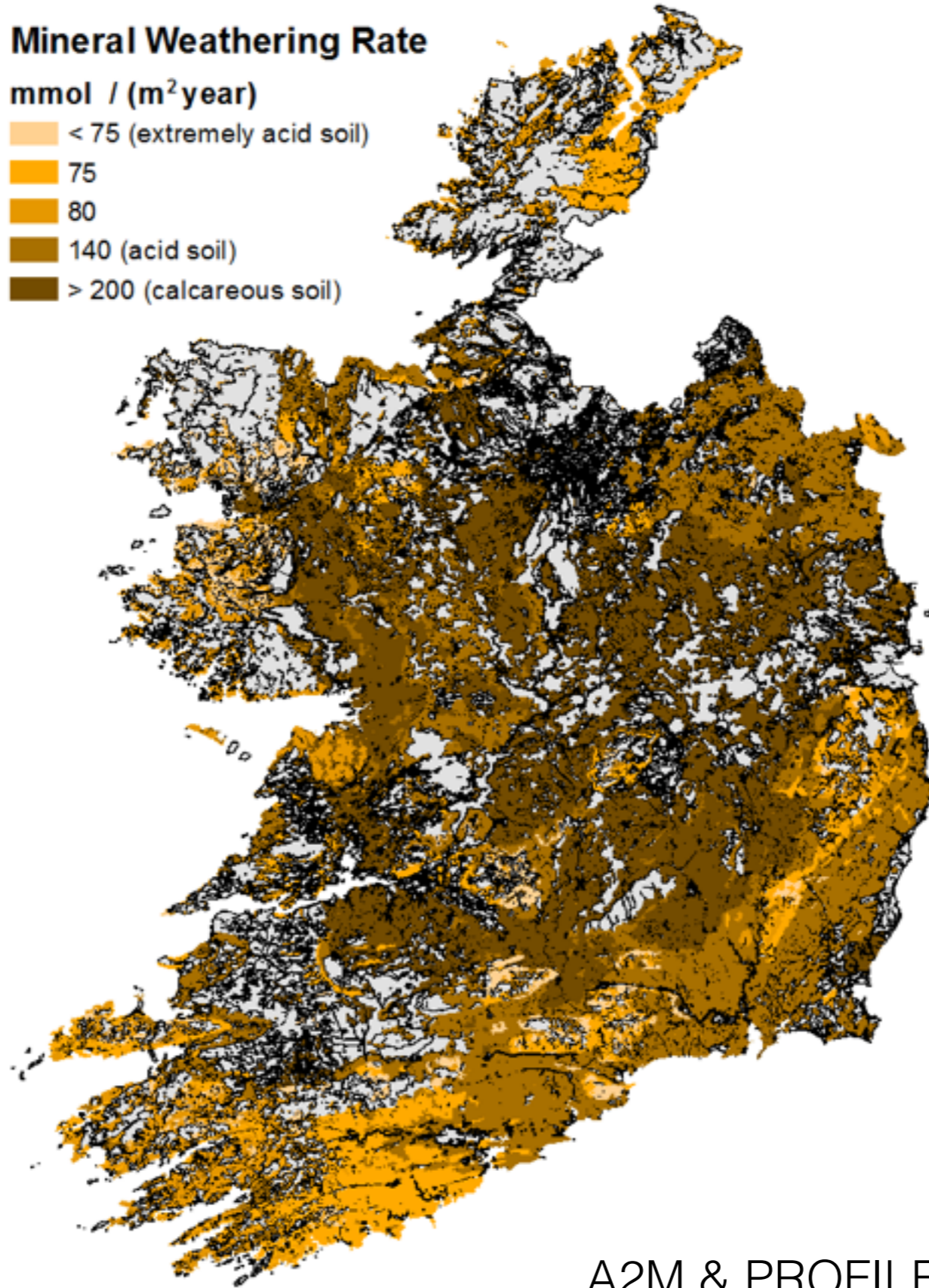
 < 75 (extremely acid soil)

 75

 80

 140 (acid soil)

 > 200 (calcareous soil)

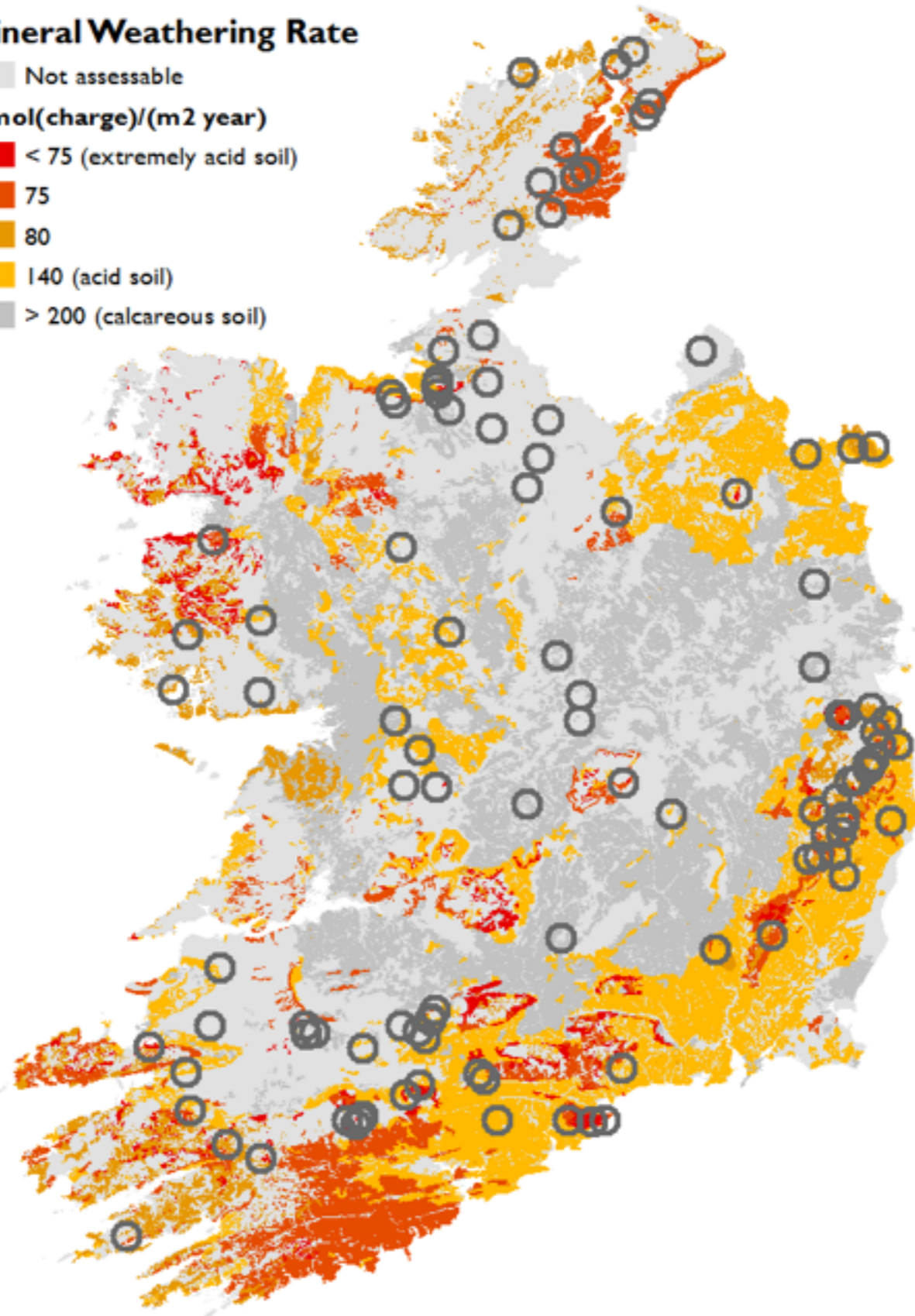


A2M & PROFILE
models

Soils

Mineral Weathering Rate

- Not assessable
- mmol(charge)/(m² year)
- < 75 (extremely acid soil)
- 75
- 80
- 140 (acid soil)
- > 200 (calcareous soil)



Soils

Mineral Weathering Rate

Not assessable

mmol(charge)/(m² year)

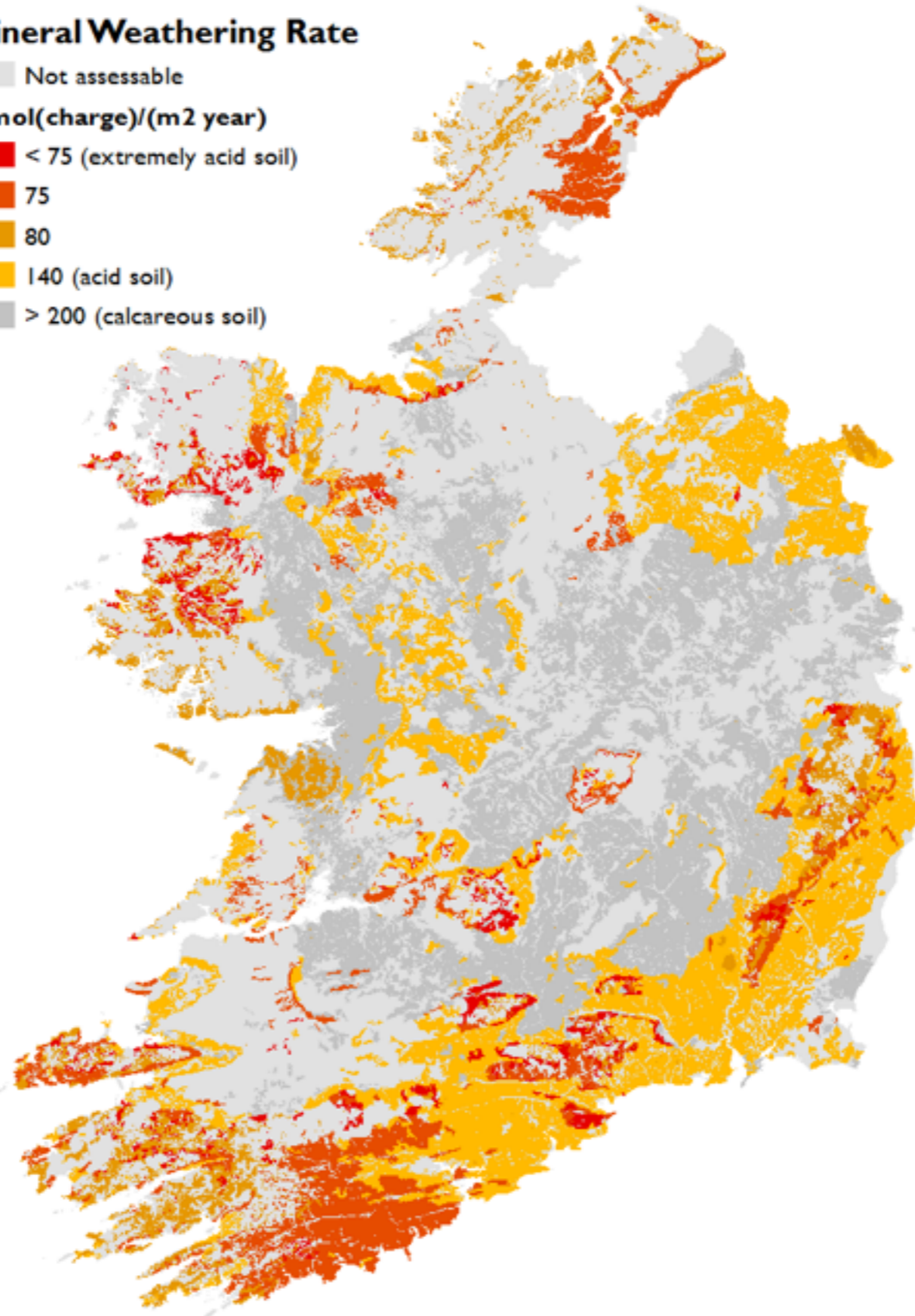
< 75 (extremely acid soil)

75

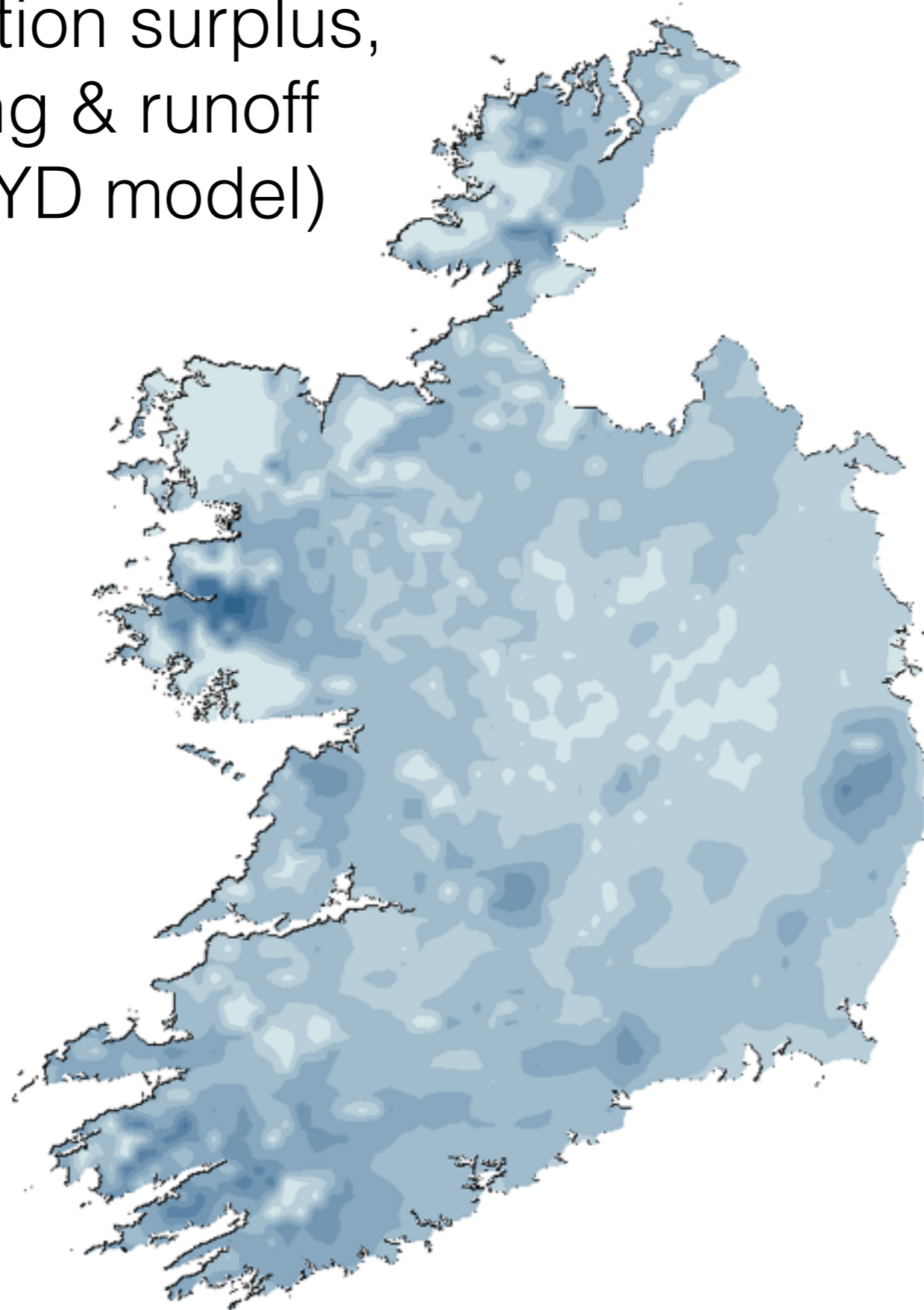
80

140 (acid soil)

> 200 (calcareous soil)



Precipitation surplus,
leaching & runoff
(METHYD model)



Atmospheric deposition



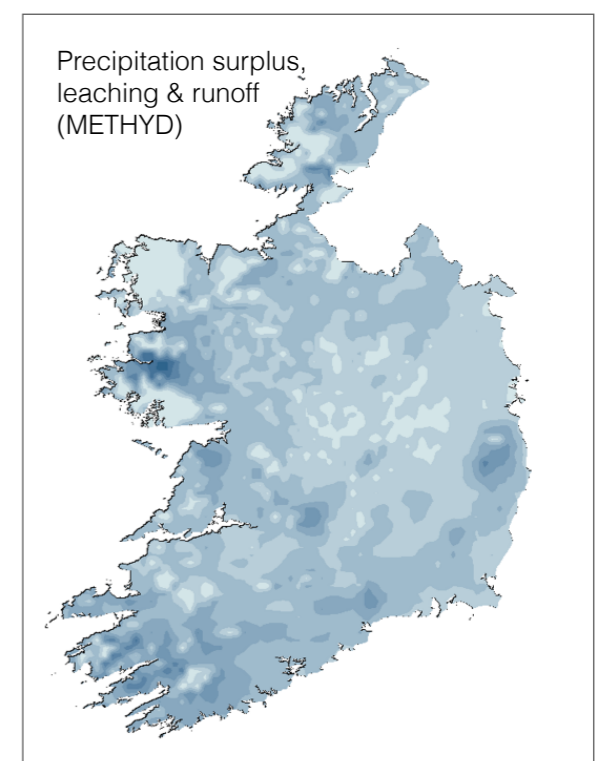
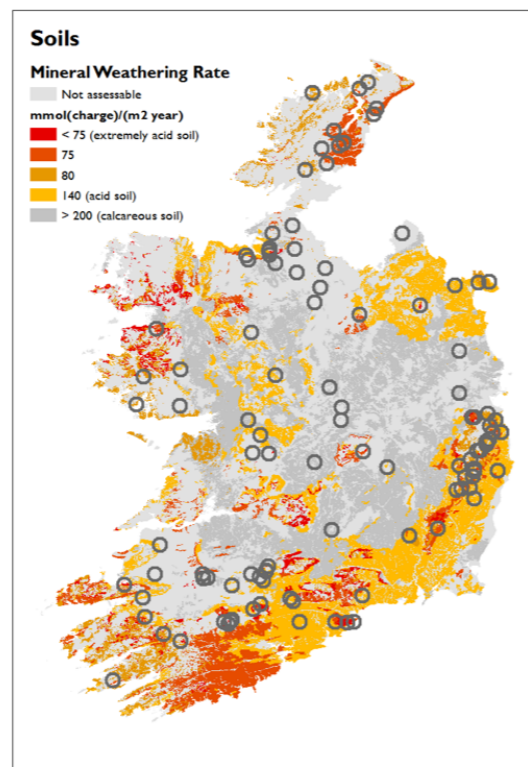
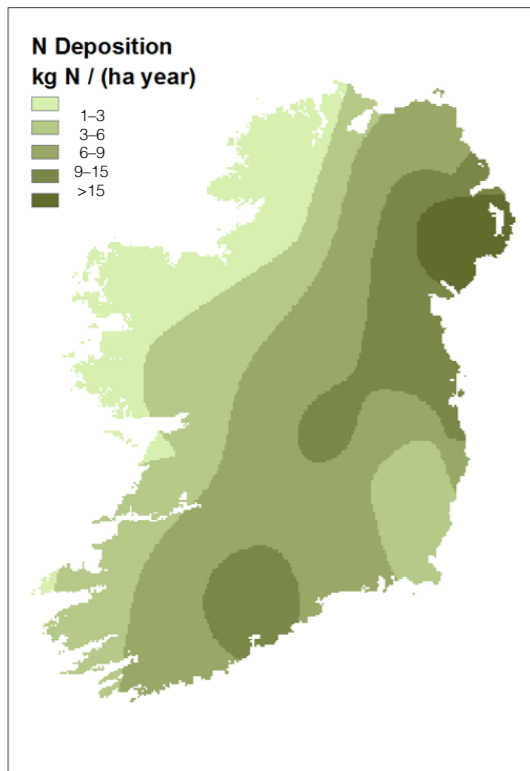
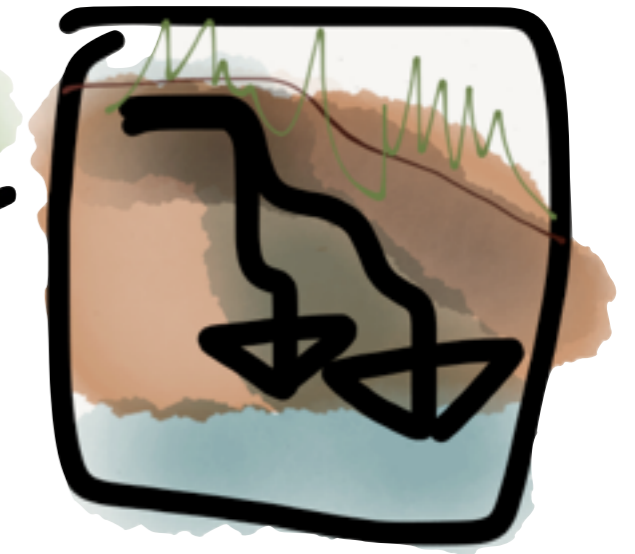
Mineral weathering



Harvest removal



Leaching & Runoff



Component	DBH	
	<i>A</i>	<i>B</i>
Aboveground ^a	0.3635	1.9382
Stemwood	0.2261	1.9030
Branchwood	0.0798	1.9182
Foliage	0.0241	2.2002
Bark	0.0449	1.8097
Deadwood	0.0046	2.5015

$$\text{kg (dry matter)} = A \times \text{dbh}^B$$

Assessing effects of biomass harvesting on nutrients, we suggest:

- Atmospheric deposition is an important source of macronutrients nutrients N, K, Ca and Mg for forests
- A few sites with low mineral weathering and low deposition may be at risk of K and Ca depletion
- Most sites can probably allow more biomass removal while sustaining nutrient supply for subsequent forest stands
- This assessment does not account for fertilisers, nitrogen fixation, gaseous losses, peat oxidation, or mycorrhizal mediation of N & P nutrition

Ecosystem Services for a Sustainable Future

- Biomass production
 - Nutrient supply for growth
 - Buffer against acidification
-
- Biomass fuel to replace fossil fuels





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Thanks to

Jim Johnson
Julian Aherne
Tom Shortle

and many, many others

