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Phosphorus

Food security and food for thought

Jan-Olof Drangert, Linköping university, Sweden

Our Globe sets the scene

Reflecting over water and plant nutrients

- Water molecules cannot be manufactured or destroyed
- Water is renewable (sun-driven cycle)
- Water available in soil and replenished annually by rain
- 70% of global H_2O use is for crop production
- A balanced diet results in a **loan** of 1300 m^3/yr p person based on current practice. This is 70 times greater than the 50 l/d per person for basic water needs.

- Phosphorus (P) cannot be manufactured or destroyed
- P is immobile and mined in only few countries
- Nutrients available in soil and depleted by crops
- 90% of global P extraction is for crop production
- A balanced diet results in depletion of 22.5 kg/yr of phosphate rock or 3.2 kg/yr of P per person based on current practice, of which 0.5 kg is found in the food.

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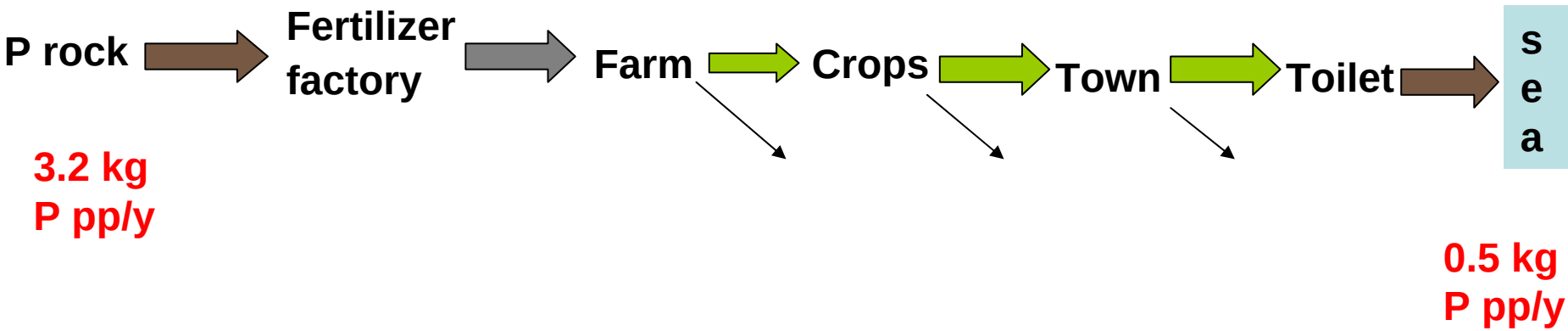
P resource is abundant, if...



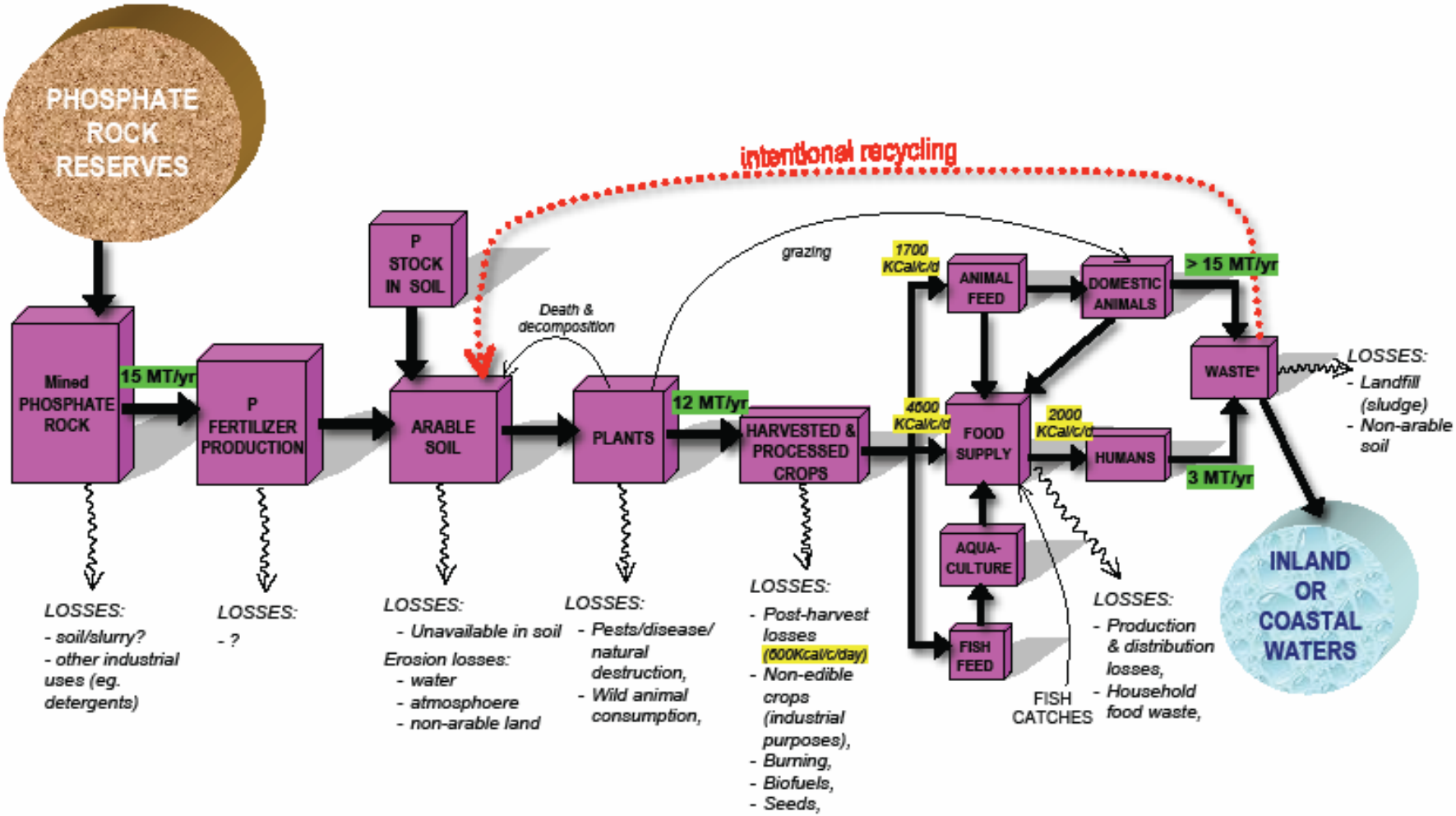
linear flow will finish P rock in USA in 30 years,

in the world in a century ≈ 100 years

Dana Cordell

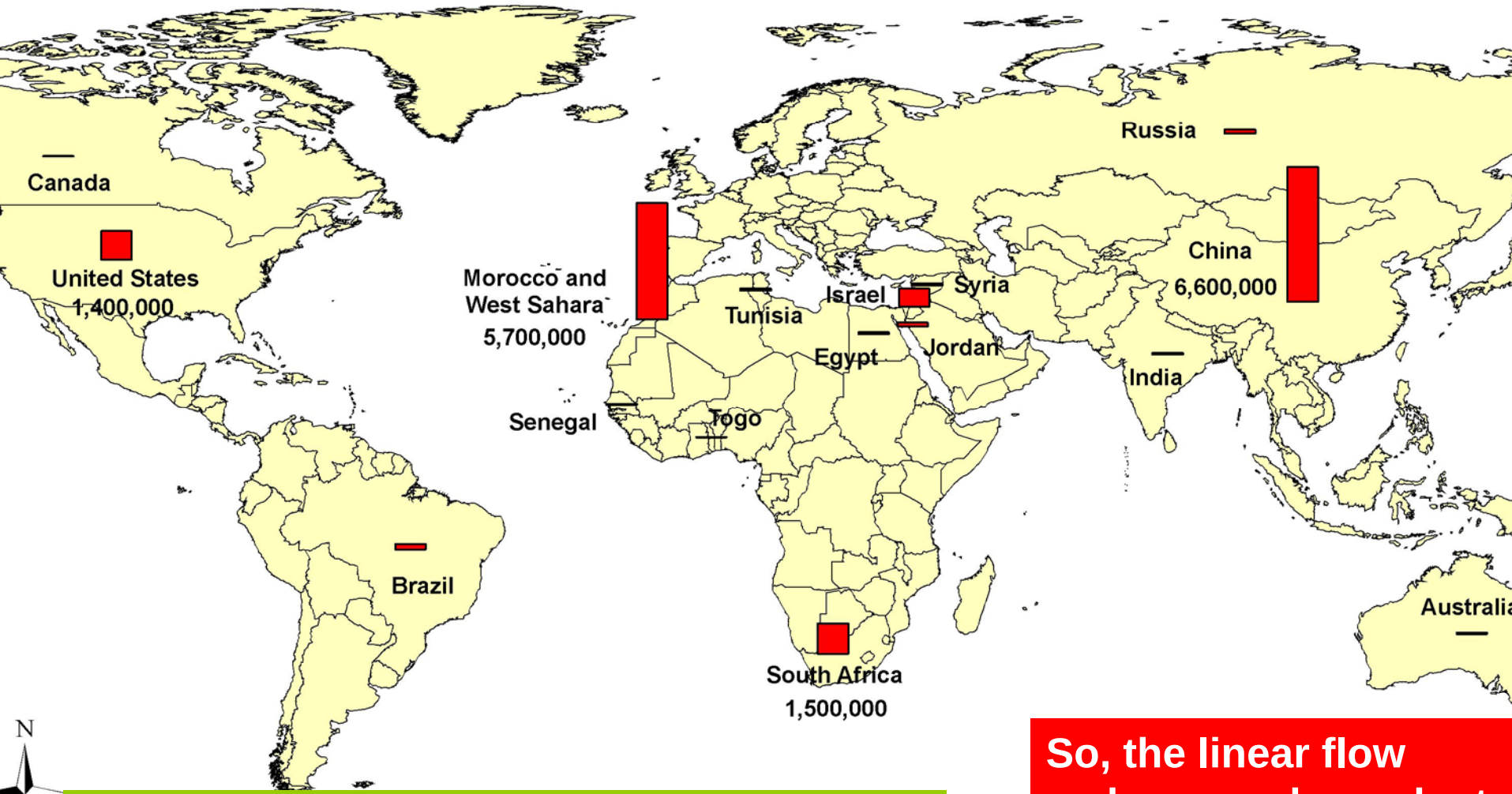
14 December 2006

GLOBAL PHOSPHORUS FLOWS IN THE FOOD SYSTEM



* Animal and human waste can include faeces, urine, body parts, blood, bone, ash, etc.

Phosphate Rock - Worldwide Reserve Estimates (thousands of metric tons)



P scarcity is worse than oil scarcity because P CANNOT be substituted in food production

So, the linear flow makes you dependent economically and politically

e: USGS and ESRI

What can we do?

Consumption type	Human body excretes P (most in urine)	P content in post-harvest food preparation	P content in harvested crops	Total rock P extracted[50]
Vegetable-based diet	0.3 kg/p/y	0.45 kg/p/y [if 2/3 eaten and 1/3 is organic waste]	1.8 kg/p/y [if 1/4 becomes food and 3/4 organic waste]	0.6 kg/p/y or 4.2 kg rock phosphorus [if rock P is being added to 33% of the farmland]
Meat-based diet	0.6 kg/p/y [49]	0.8 kg/p/y [if 3/4 eaten and 1/4 is organic waste]	8.0 kg/p/y [if 1/10 becomes food and 9/10 is organic waste/animal feed]	1.6 kg/p/y or 11.8 kg of rock phosphorus [if rock P is being added to 20% of the farmland]

Stay veg-based, return farm waste, return your excreta, collect organic waste in the city, etc.

Epilogue

The green revolution in 1950s saved the world from hunger - by using water and chemical fertilizers

Next revolution is recirculation of nutrients to food production!

"*Two major opportunities for increasing the life of expectancy of the world's phosphorus resources lie in recycling by recovery from municipal and other waste products and in the efficient use in agriculture of both phosphatic mineral fertilizer and animal manure*" European Fertilizer Manufacturers Association 2006

Historical sources of P fertilizers