TOWARDS PHOSPHORUS SECURITY THROUGH NUTRIENT REUSE

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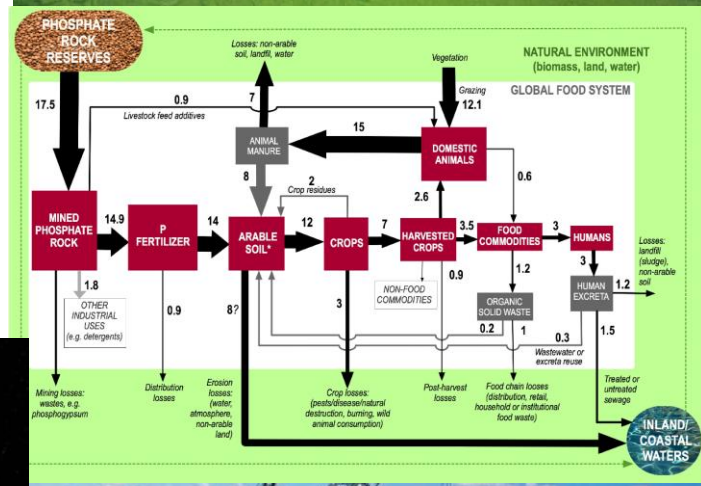
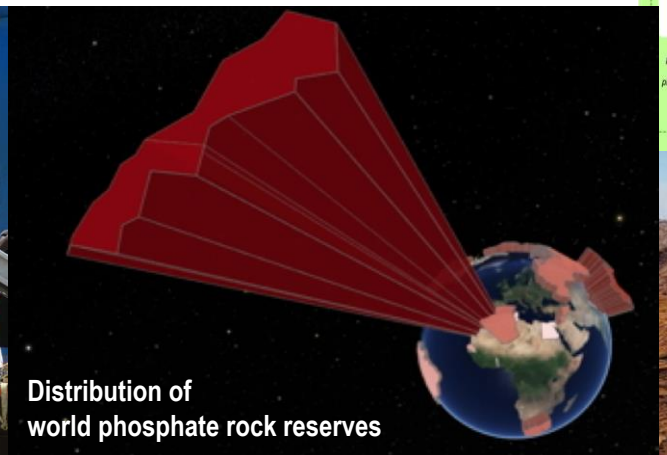
THE GLOBAL PHOSPHORUS CHALLENGE

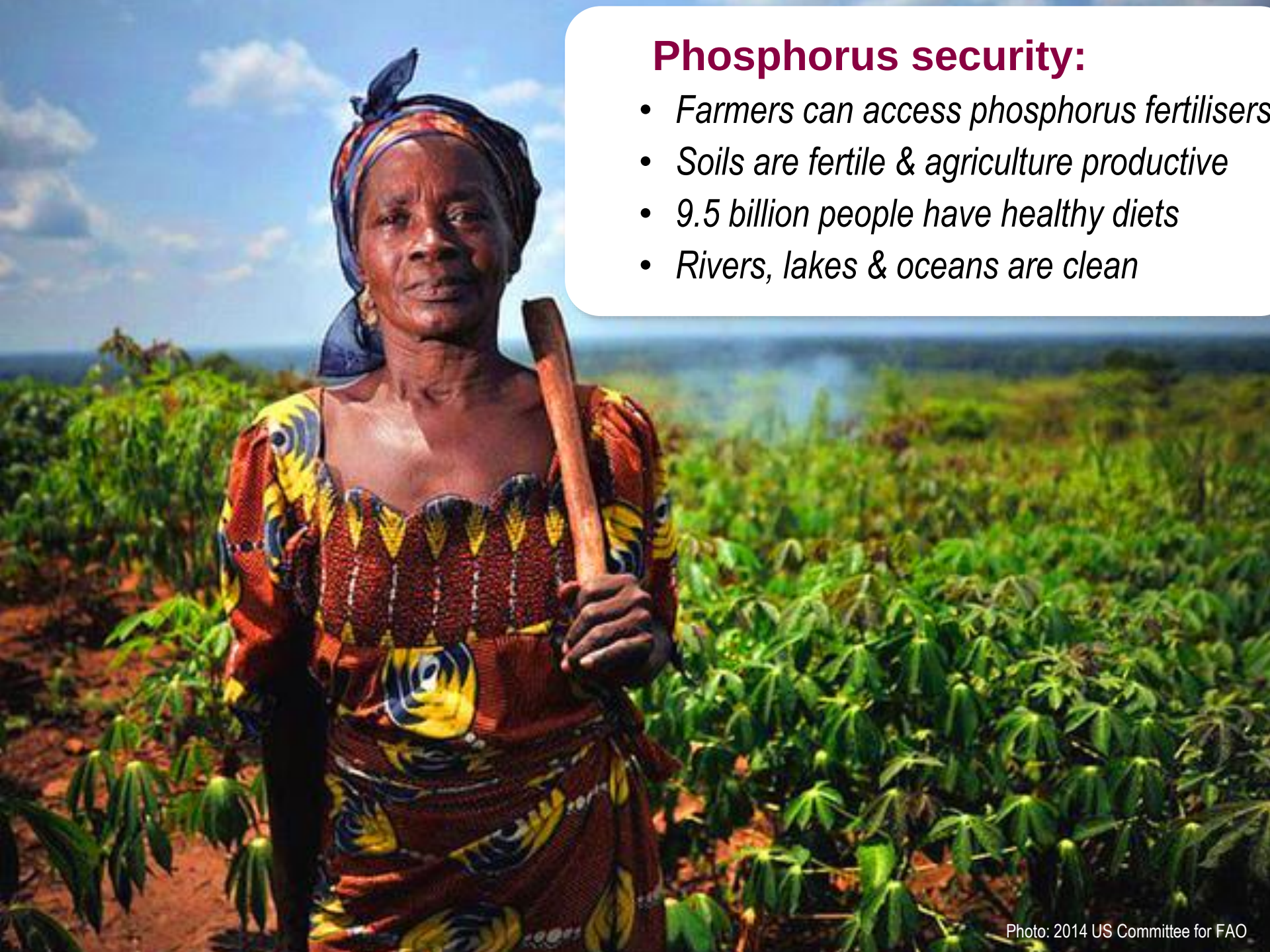
Many dimensions of the phosphorus challenge:

- **Mismanagement:** *80% lost from mine to fork!*
- **Water pollution:** *toxic algal blooms*
- **Physical scarcity:** *finite resource, expensive*
- **Farmers access:** *1 billion lack access to fertilisers*
- **Geopolitical risks:** *5 countries control 85% of P*
- **Governance**: *who is responsible..?*




IFDC


Distribution of world phosphate rock reserves



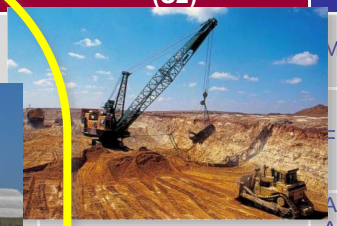
Phosphorus security:

- *Farmers can access phosphorus fertilisers*
- *Soils are fertile & agriculture productive*
- *9.5 billion people have healthy diets*
- *Rivers, lakes & oceans are clean*

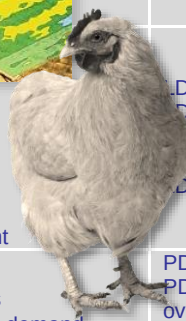
Photo: 2014 US Committee for FAO

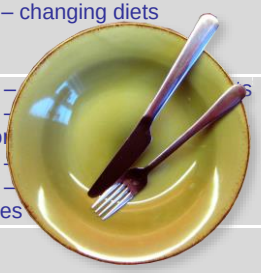
TOOLBOX OF SUSTAINABLE P SUPPLY & DEMAND MEASURES

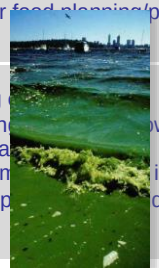
Sector	SUPPLY MEASURE (S)		DEMAND MEASURE (D)	
	Recycling (S1)	New source (S2)	Efficiency (D1)	Reduce demand (D2)
Mining (M)	MS1.1 – mine tailings [h]		MD1.1 – reduce avoidable losses	MD2.1 – *(all other measures)*
Fertilizer (F)			FD1.1 – reduce avoidable losses	
Agriculture (A)	AS1.1 – crop waste [b,d,e]	AS2.1 – *(FS2)* AS2.2 – green manure	A A A A A A	
Livestock & Fisheries (L)	LS1.2 – bone [a,d] LS1.3 – blood LS1.4 – fish [a]	LS2.1 – phosphate rock (supplements) [h]	LD1.3 – application rate LD1.4 – soil testing LD1.5 – erosion reduction LD1.6 – microbial inoculants LD1.7 – phytase enrichment anure P reduction stewater management	LD2.1 – plant selection D2.2 – improved soil aracteristics 2.3 – animal selection D2.4 – changing diets
Food production (P)	PS1.1 – food PS1.2 – cook	PS2.1 – ditive	duce avoidable losses ducing food closer to demand nsumer food planning/preparation	PD2.1 – PD2.2 – overcon PD2.3 – PD2.4 – additives
Wastewater & human excreta (W)			WD1.1 – repairing WD1.2 – minimizin ows WD1.3 – soil mana WD1.4 – avoid dun in water WD1.5 – reduce sp ds on non-ag land	N/A









Cordell & White 2013

PHOSPHORUS RECYCLING OPPORTUNITIES

CASE 1: MALAWI

- **Subsistence farming** (maize)
- Fertiliser **subsidy** – scaling back?
- Vulnerable: **landlocked**, and high dependence on P imports via Mozambique
- Opportunity: P in excreta = P fertiliser imports
- 1 major fertilizer **company** (in Blantyre), 1 product manager
- Overcoming barrier: **economy of scale**
"*don't talk to me about 5 tonnes a day, come back when you have 100 tonnes a day*"

PHOSPHORUS RECYCLING OPPORTUNITIES

CASE 2: Hà Nội, Việt Nam

•Greater Hanoi = 1/3 province, designated **food districts**

•Currently 90% organic waste to landfill, some composted but untreated/untested = **health concerns**

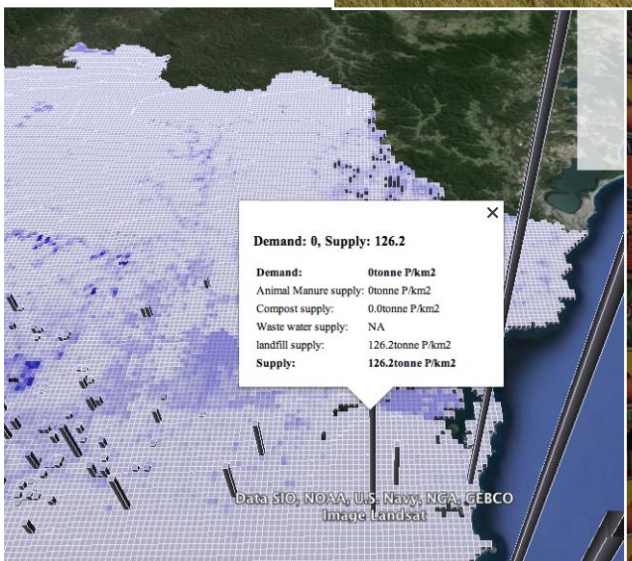
•2030 Master Plan is ambitious & green, e.g. **70% compost**

•Cities: engage **urban planners** to design in nutrient recycling!

PHOSPHORUS RECYCLING OPPORTUNITIES

CASE 3: AUSTRALIA

- Net **food exporter**
- Net **phosphorus importer** – world's 5th largest
- Naturally phosphorus-deficient **soils**
- Invested in phosphorus-intensive agricultural **exports** (beef, live animals, wheat, dairy)
- P excreta = <**5%** P demand
- Cities: phosphorus hotspots
- Fertiliser retailer: from selling products to '**services**'?



IMPLICATIONS OF NUTRIENT RECYCLING FOR FOOD SECURITY, LIVELIHOODS & ENVIRONMENT

Nutrient-recycling systems can and will need to play a critical role in achieving phosphorus and food security:

•Creates locally available '**renewable fertilisers**'
- 3 million tonnes/yr P available in excreta alone

- Facilitates '**phosphorus sovereignty**' for communities with low farmer access to fertilisers
- Reduces **dependence** on imports from geopolitically risky regions, and therefore buffer against future **price spikes** and **supply disruptions**

•Reduces **P waste/losses** & **life cycle energy** in supply-chain

- Reduces **nutrient pollution** and algal bloom potential

PATH FORWARD FOR NUTRIENT RECYCLING

- **Context matters** - assess which of 50+ nutrient recovery technologies are appropriate, cost-effective & optimal
- Product design: need to understand **market end-user** (farmer)
- New potential **partnerships** between fertiliser sector, sanitation sector, urban planners, scientists, etc (whole reverse supply-chain in a circular economy)
- New **business models** – from selling a ‘product’ to a ‘service’ (e.g. nutrient security)
- **Cost-competitive** with fertilisers? Consider not just market price of P, but farm-gate price

PARTNERS

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P-FUTURES: 90 PARTNERS, including:

- *Co-leads*: Genevieve Metson, David Iwaniec
- **VIETNAM**: Institute of Environmental Science and Engineering
  Hanoi University of Civil Engineering
- **MALAWI**: Centre for Water, Sanitation, Health and Appropriate Technology Development (WASHTED), University of Malawi
- **U.S**: Global Institute of Sustainability, Arizona State University
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AUSTRALIA:

- National Strategic Phosphorus Advisory Group stakeholders
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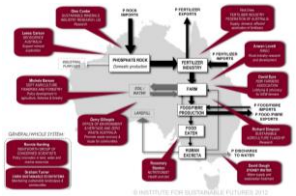

THANK YOU!