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Managing our Human Phosphorus Footprint: The Greatest Phosphorus Sustainability Issue?

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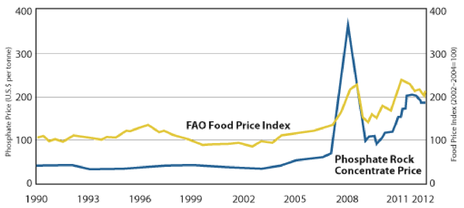
Phosphorus: why do we care?

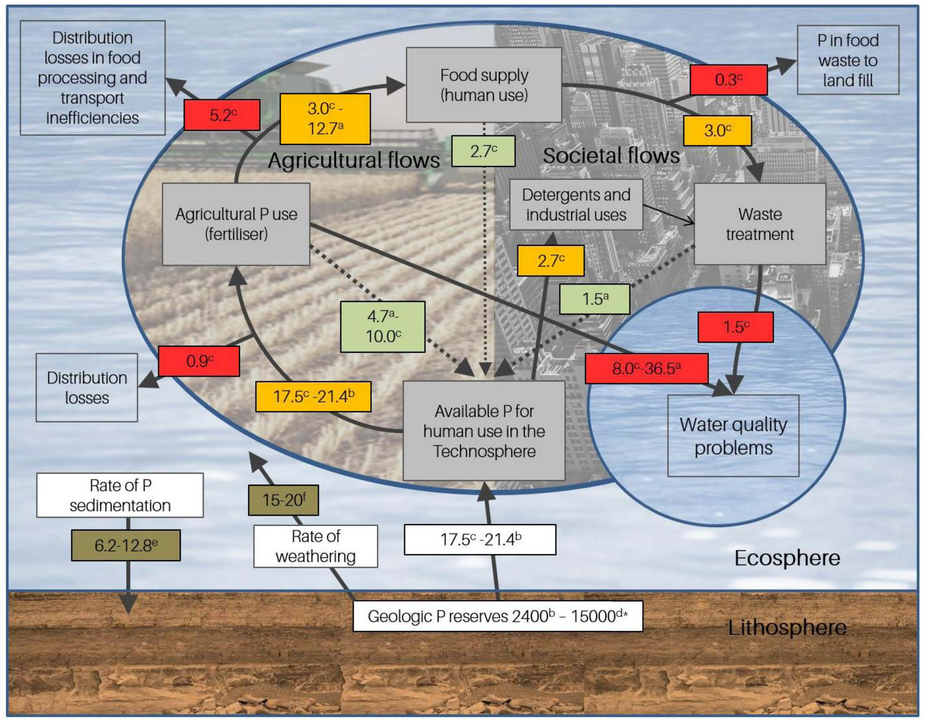
Inefficient use of P threatens global food security and the provision of clean water, because P rock reserves used for the production of P fertilizers are relatively scarce, while P losses pollute the aquatic environment, respectively.



Peak Phosphorus. Energy Bulletin (2010)


Eutrophication resulting from elevated phosphorus inputs

To date, efforts to address this have **focussed on increasing P use efficiency in agriculture** (i.e. mitigation of the symptom). Based on analysis of the key flows, we argue that these advances should be viewed as partial components of the whole system, but not as a global panacea. **Alone, they are insufficient to achieve P sustainability, as the primary motor currently driving this cycle is food consumption by humans.**



The global human P cycle. Solid arrows represent flows of phosphorus (P), dashed lines represent recycling of. Figures in boxes represent estimates of P flows in million tons (MT) year^{-1} (*estimated P reserves in MT). Superscripts correspond to the data source for each P flow estimate: a) Liu et al. 2008, b) Villalba et al. 2008, c) Cordell et al. 2009, d) Gilbert 2009 e) Pierrou 1976 f) Bennett *et al* (2001)

Unintended losses
Intended flows
Recycling P flows
Natural fluxes

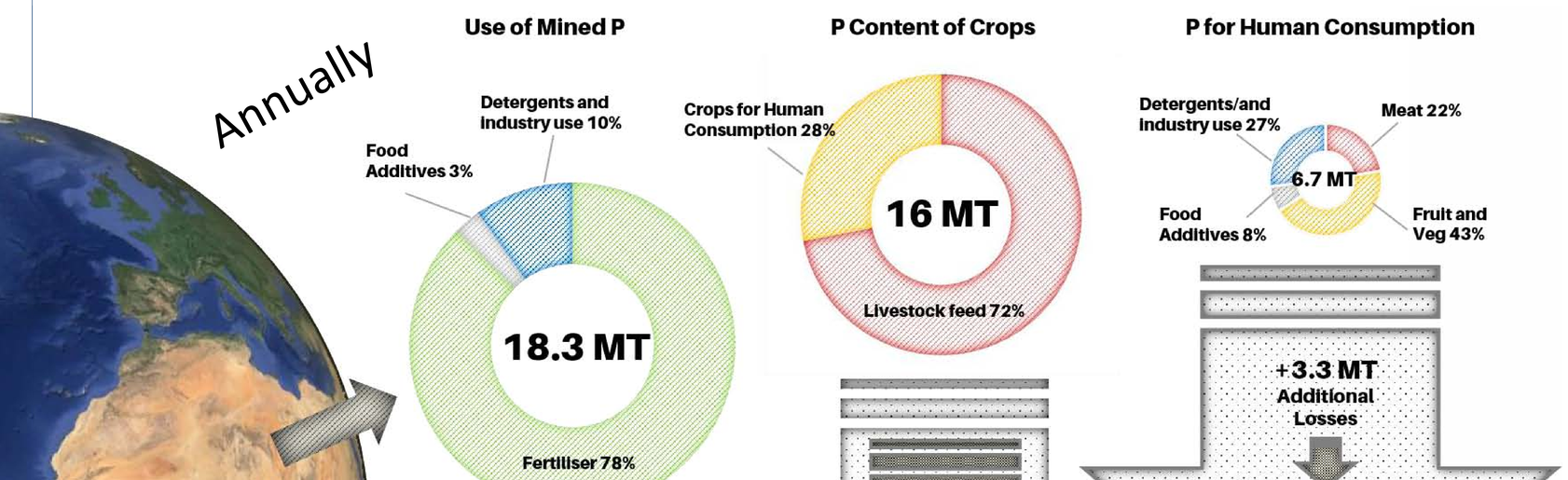
What societal changes are needed?

Demand adaptation via societal change has been overlooked in favour of mitigation (i.e. increasing fertiliser use efficiency) in order to reduce societies P requirements.

Although both strategies are necessary and naturally compliment each other, societal adaptation could potentially have a much greater impact on reducing the global cycle of P, than current mitigation strategies used increase agricultural nutrient use efficiency (although manure P, and animal-derived P residues (i.e. bone P) are large P sources that are currently not recycled and used efficiently).

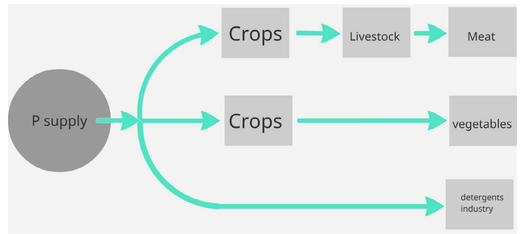
By reducing the consumption of foods with high P footprints (e.g. meat), use of P additives in foods that are present in many processed foods and the use of P containing detergents, it is possible to affect a change that will cascade through the global P cycle resulting in a much greater reduction in global P cycling. This would also contribute to increasing 'economy wide' nutrient use efficiency.

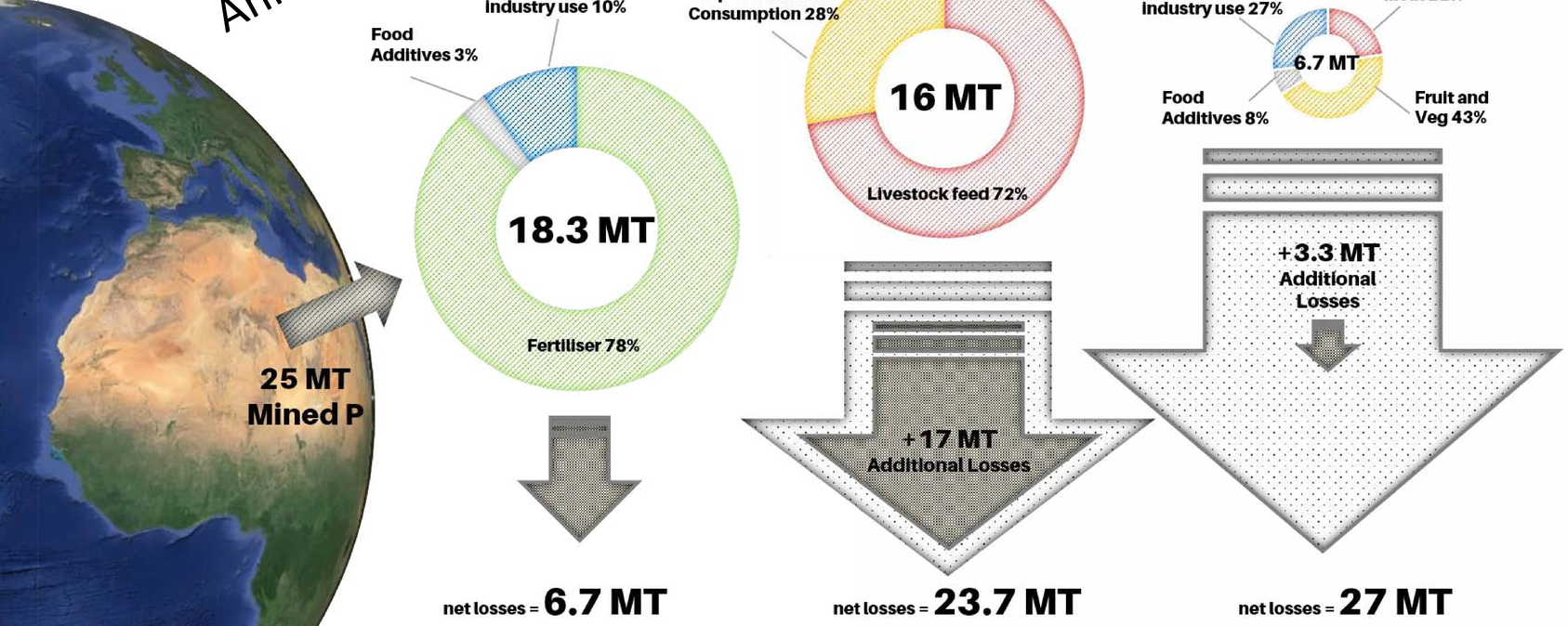
Our global P footprint



How do we make a change

The per capita P footprint increased 38% between 1961-2007, with considerable variation between countries (i.e. China increased by 400% whilst Canada decreased); **meat consumption accounted for 72% of the global average footprint** *(Metson et al 2012)*





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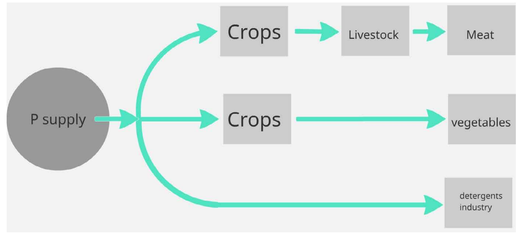
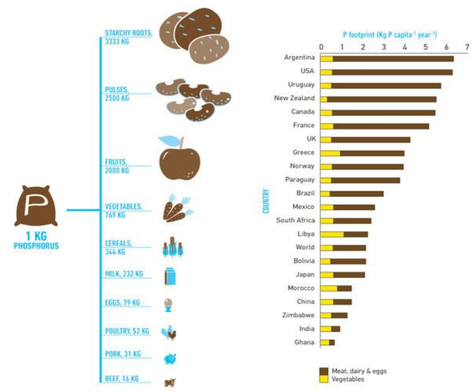
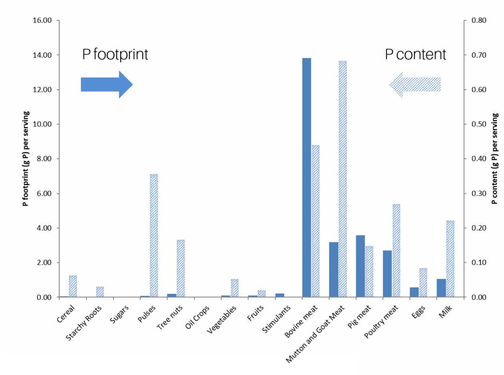




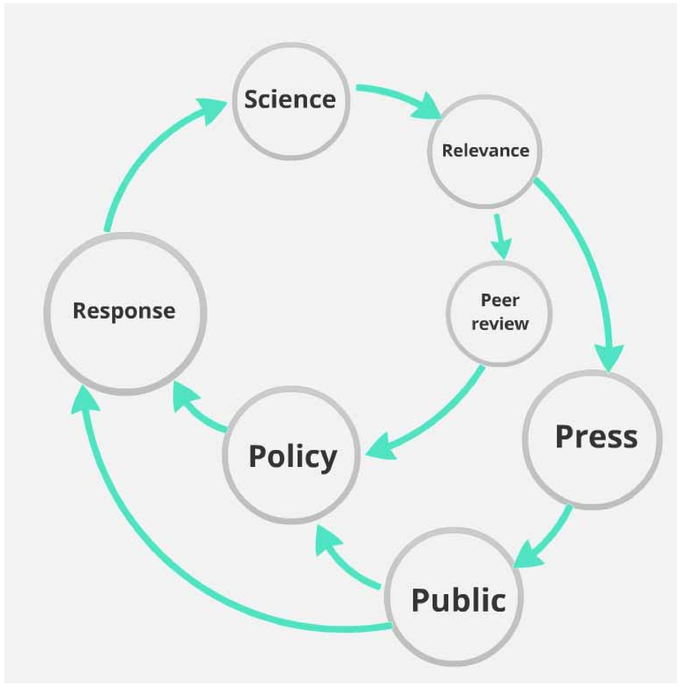
Human vs Environmental Health

Reducing dietary P consumption also offers societal co-benefits through reducing health risks associated with high serum phosphate concentrations, which can cause tissue damage, cardiovascular disease, renal impairment and bone loss (Calvo *et al* 2013, Uribarri and Calvo 2014).,

Although it is highlighted that a **high P diet, (which can harm the individual), may not be the same as a diet which has a high P footprint, (which can harm the planet).**



Communication is key



Conclusions

The many benefits of eating less meat are well documented (↓C, ↓GHG's, ↓N, water footprints, ↑human health). But a**spirational goals must be achievable. It is not about not eating meat, it is about eating less meat.** *Meat free Mondays, the demitarian approach, flexitarianism, reducetarian* are all examples of this maxim**.**

Communication of this message must be multi-directional, recognising the importance of both policy makers and the public in activating change.

Whilst a variety of strategies have been used to address regional or global scale environmental issues, few attempt to reduce use of P by changing societal behaviour. Yet this is in many cases the most effective and sustainable long term solution. A **continued focus on technical mitigation strategies is not sufficient to achieve P sustainability. If overlooked, the combination of environmental impacts and food security risks associated with access to limited P reserves, can be expected to result in growing trans-boundary geo-political tensions**.

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