Is Phosphorus the Rodney Dangerfield of Sustainability Issues?

University of Florida Water Institute Annual Symposium

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Co-Lead, Sustainable Phosphorus Initiative

Director, CAP LTER Program

Co-Director, Urban Sustainability RCN

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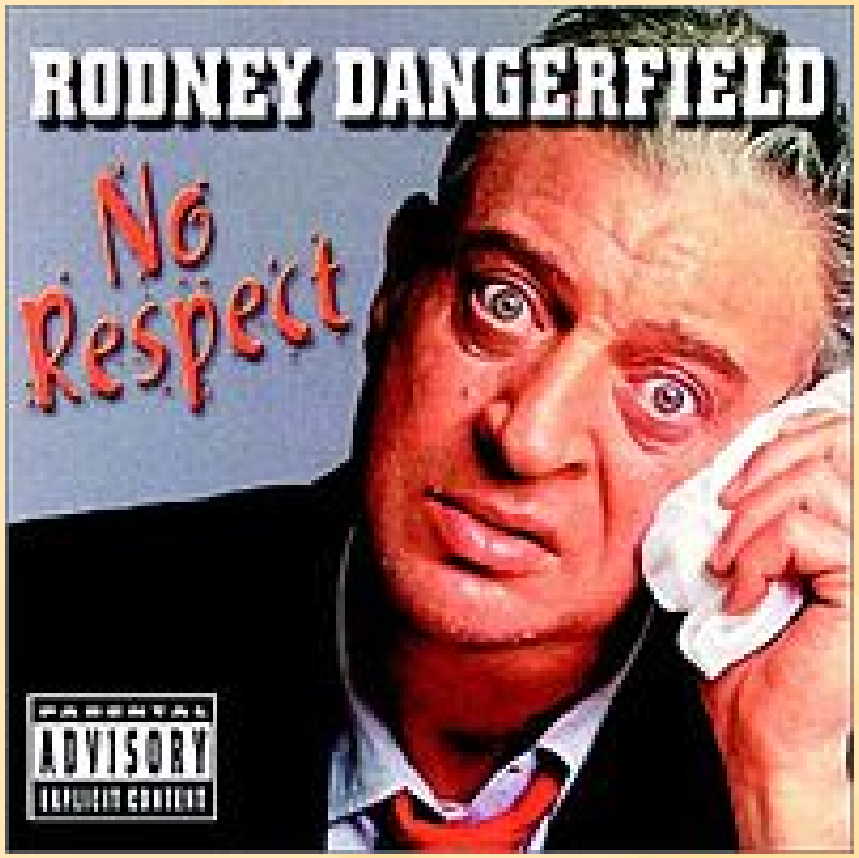
Who is Rodney Dangerfield, anyway?



Outline and Overview

1. **Primer on P as an essential element, the human P cycle, and associated sustainability challenges.**

2. **Two case studies of urban P cycling, storage, and fluxes from the Phoenix Metropolitan Area.**

3. **Addressing P sustainability challenges as a “wicked”, complex, and interconnected resource bailiwick.**

1. Phosphorus is essential to all life

Phosphorus comprises ~9% of the mass of nucleic acids, including DNA and RNA.

Phosphorus is the biochemical and energetic center of ATP, ADP, etc.

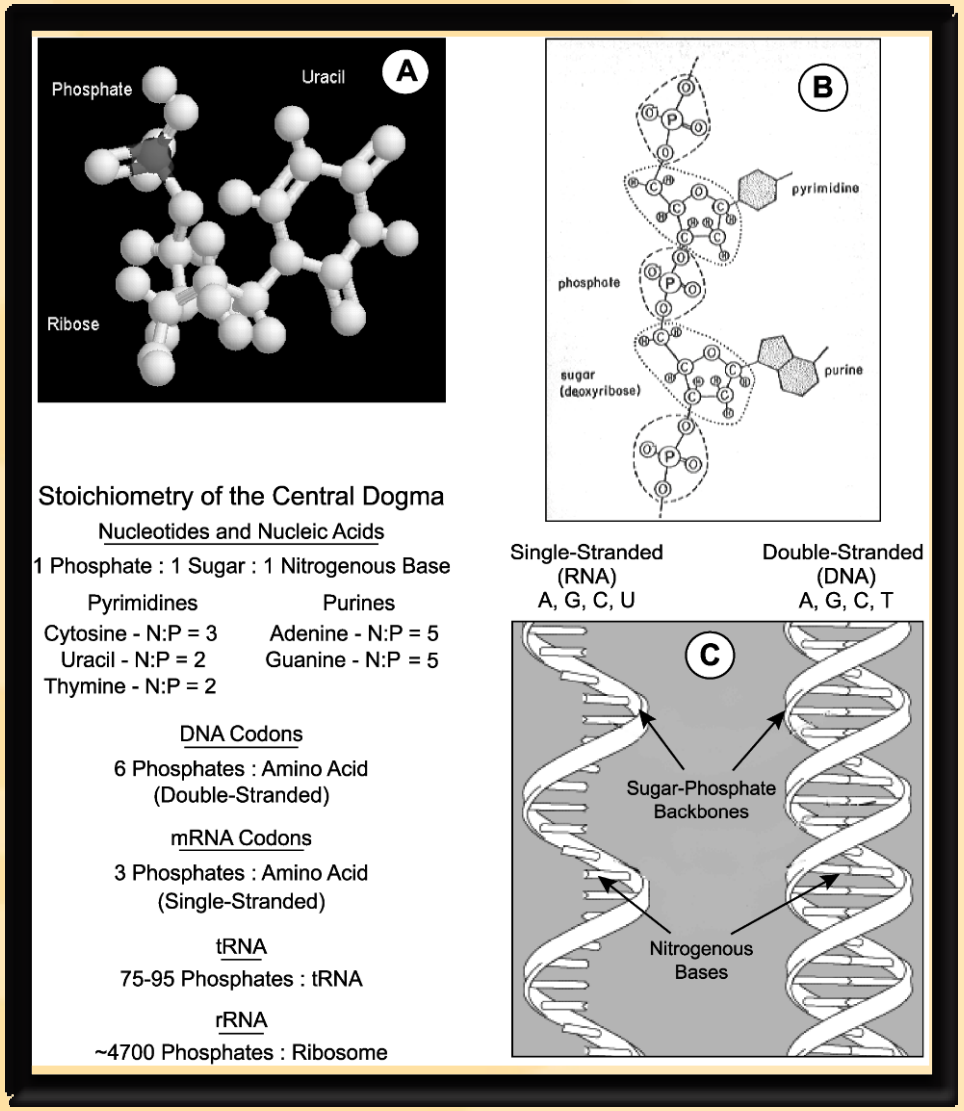


Figure from Sterner, R.W. and J.J. Elser 2002.

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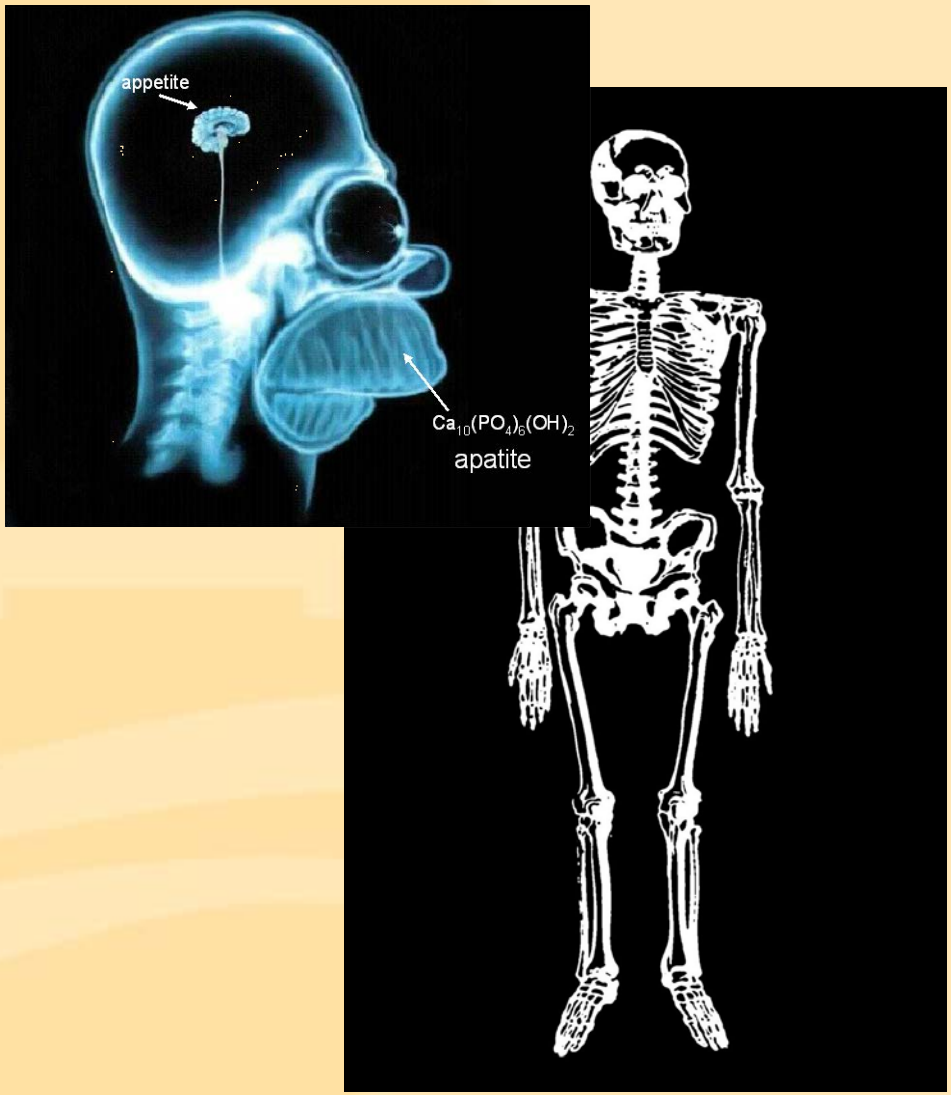
1. Phosphorus is essential to all life

An average adult body contains roughly 1 kg of P, mainly in bones & teeth.

Net input of P is only needed when an organism is growing (i.e. with no weight gain, organismal P flux is in steady state).

The average adult consumes and excretes 1.2 g P every day.

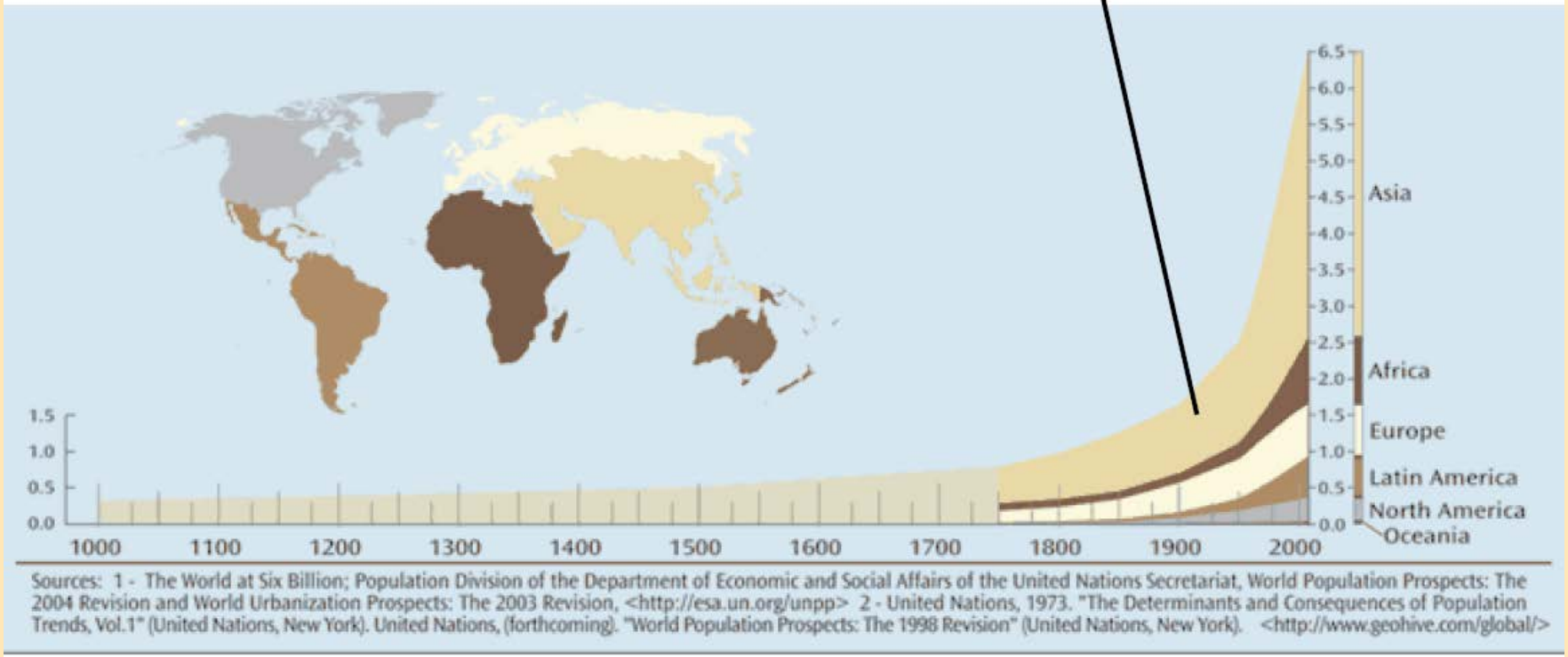


1. Paradox: Phosphorus is both limiting and in over-abundance

1. P, Food, & the Human Population

"Green Revolution"

= high yield crops + water + fertilizer



Sources: 1 - The World at Six Billion; Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2004 Revision and World Urbanization Prospects: The 2003 Revision, <http://esa.un.org/unpp> 2 - United Nations, 1973. "The Determinants and Consequences of Population Trends, Vol.1" (United Nations, New York). United Nations, (forthcoming). "World Population Prospects: The 1998 Revision" (United Nations, New York). <http://www.geohive.com/global/>

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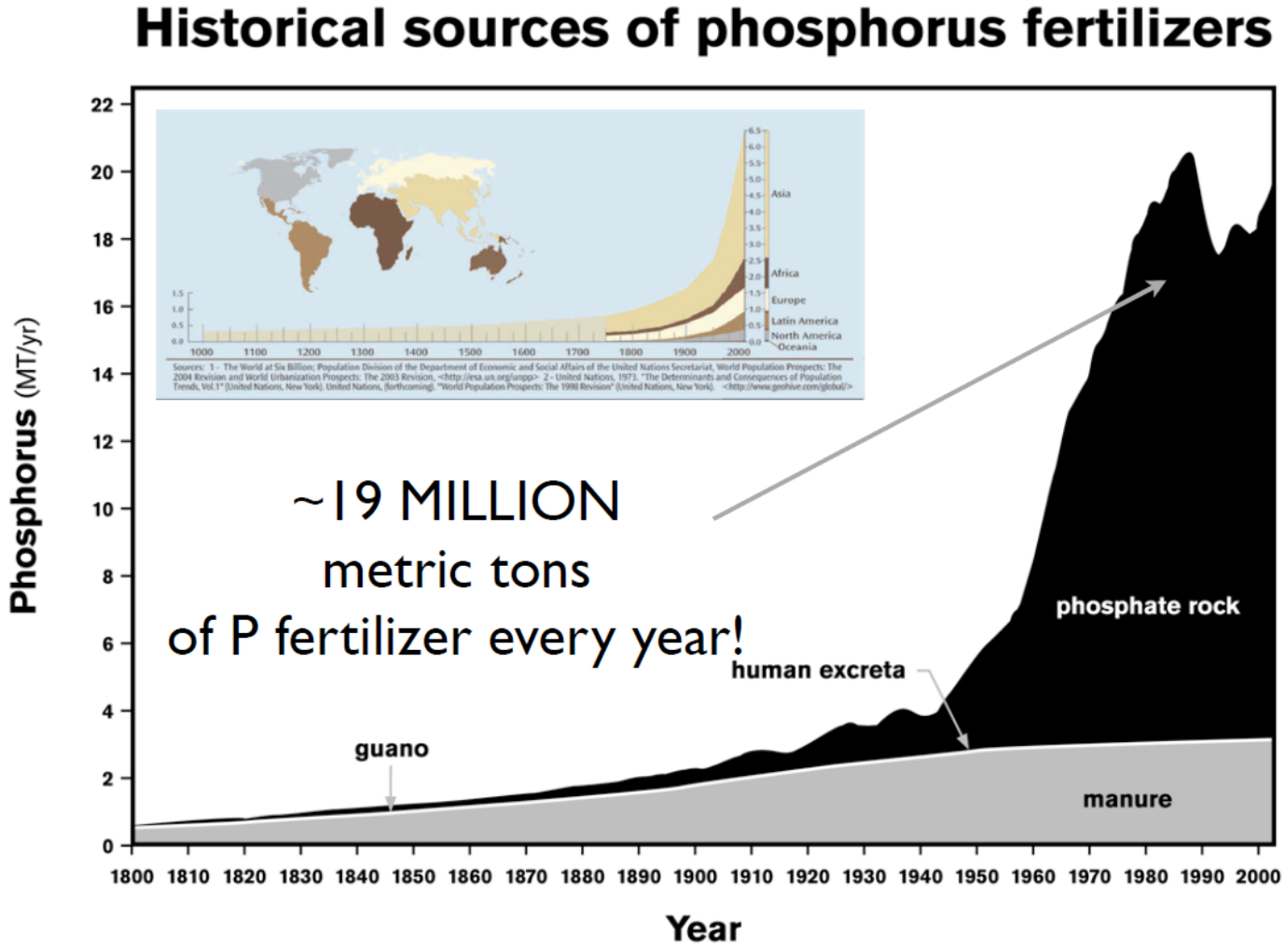

1. The Human P "Cycle"

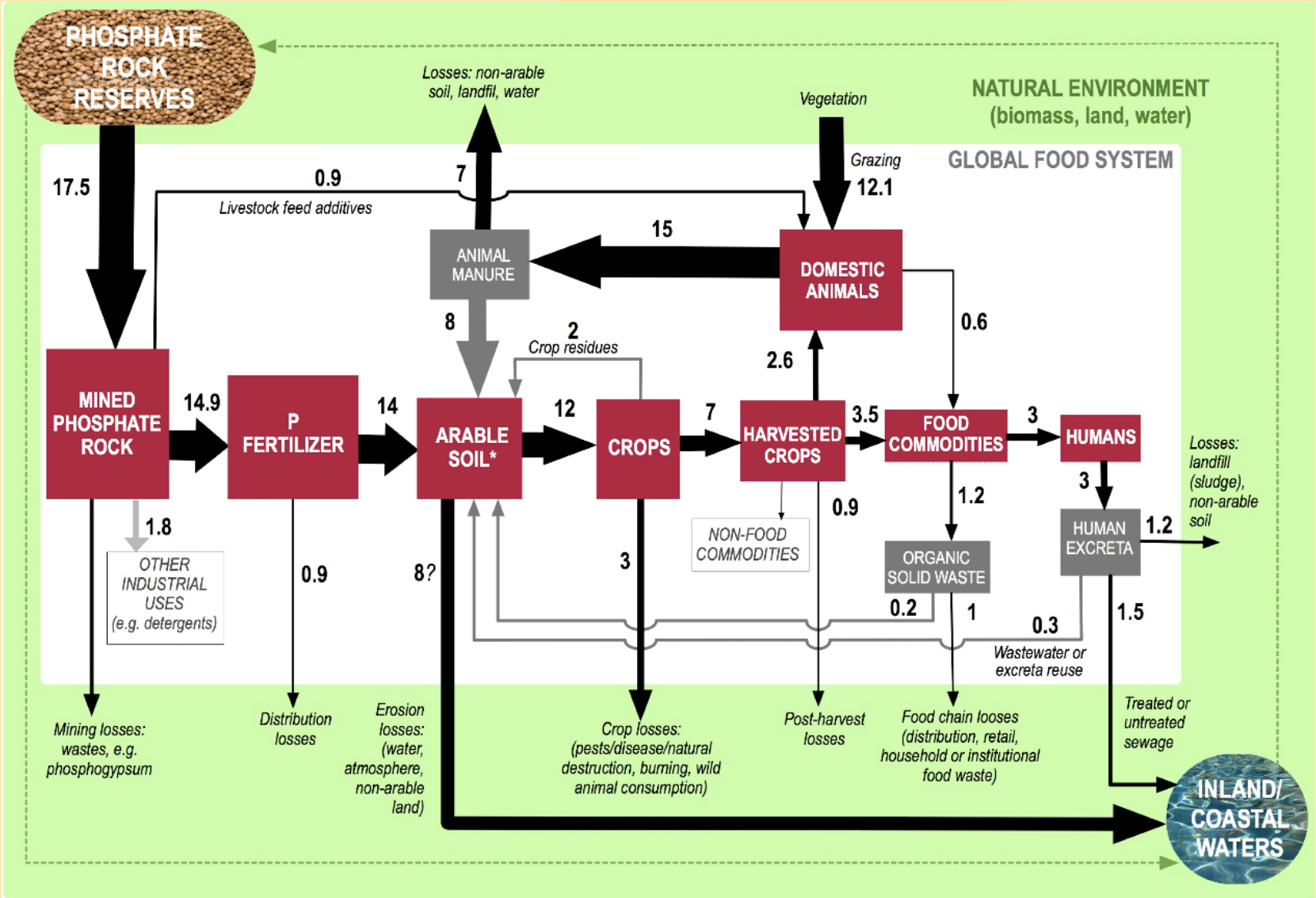

Figure from Cordell et al. 2009.

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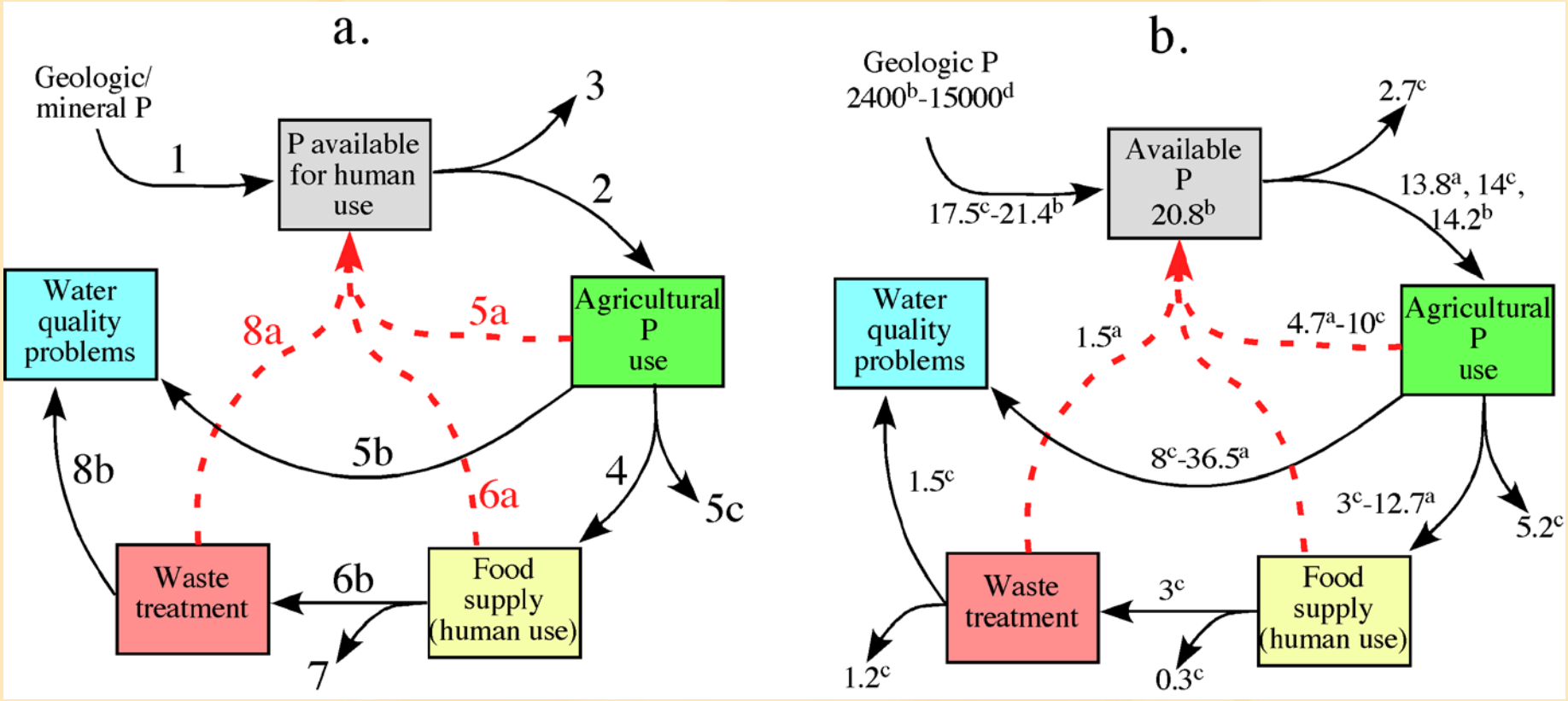

Figure from Childers et al. 2011.

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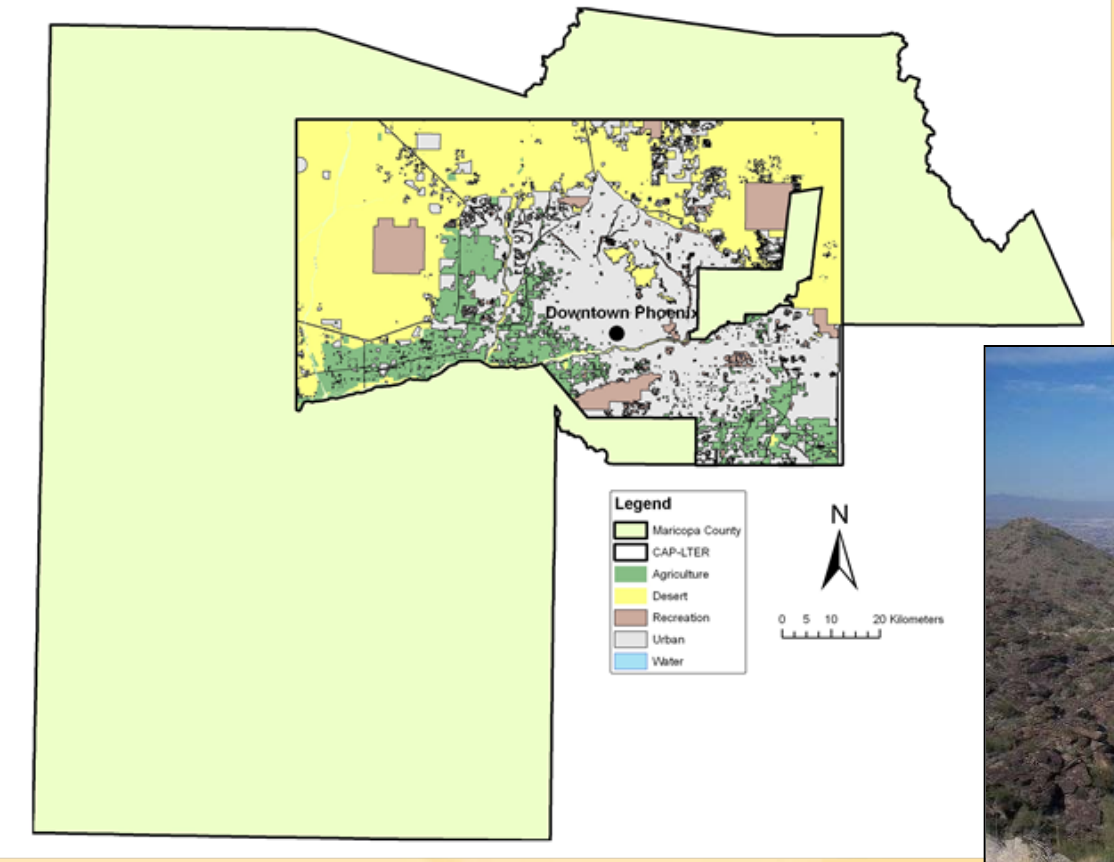
2. Phosphorus in Urban Systems: The Phoenix P budget



Central Arizona Phoenix Long-Term Ecological Research Program (CAP LTER) (http://caplter.asu.edu/)

Figure from Metson et al. 2012. Ecol. Applications

Photo: View from South Mountain by J.Corman

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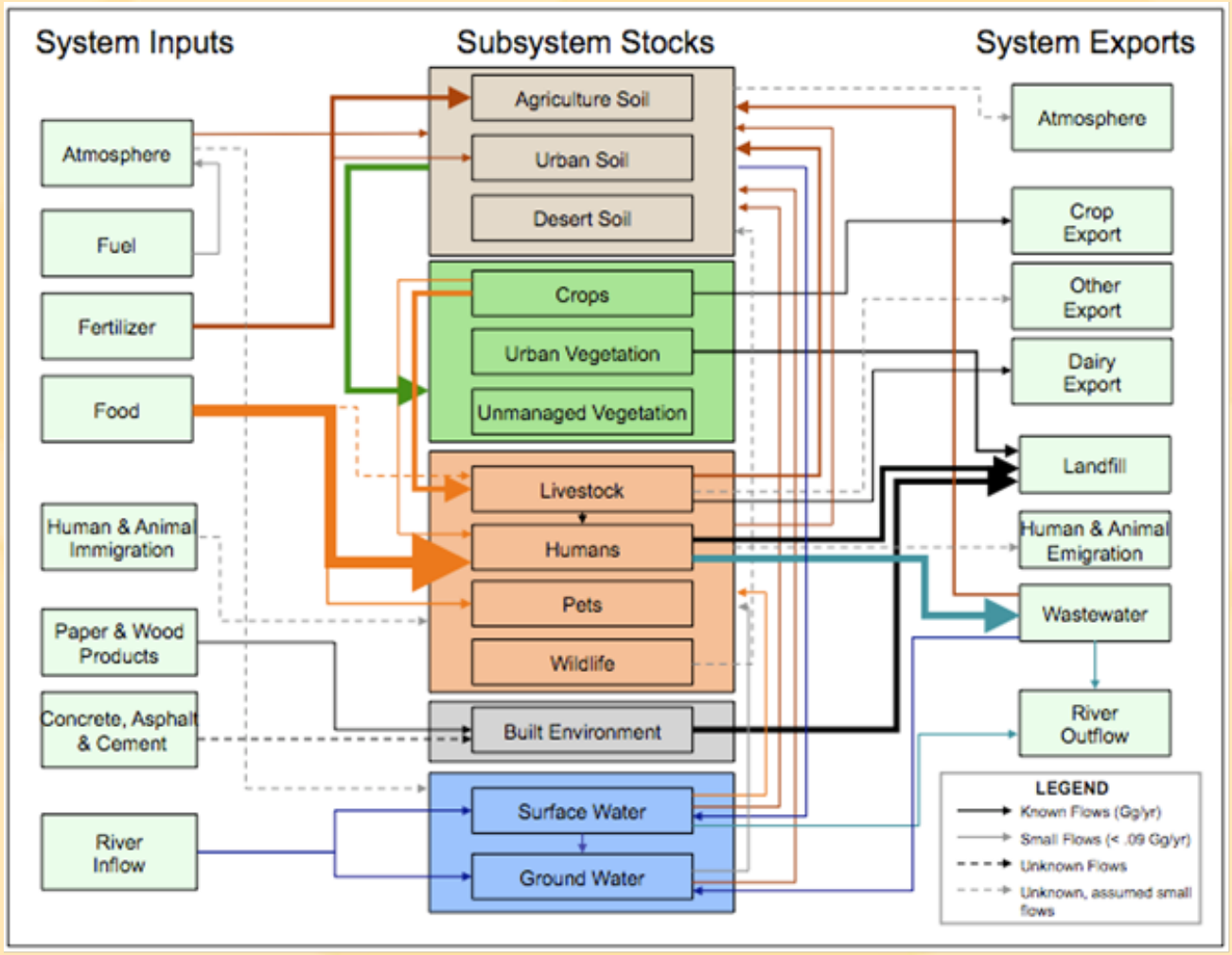

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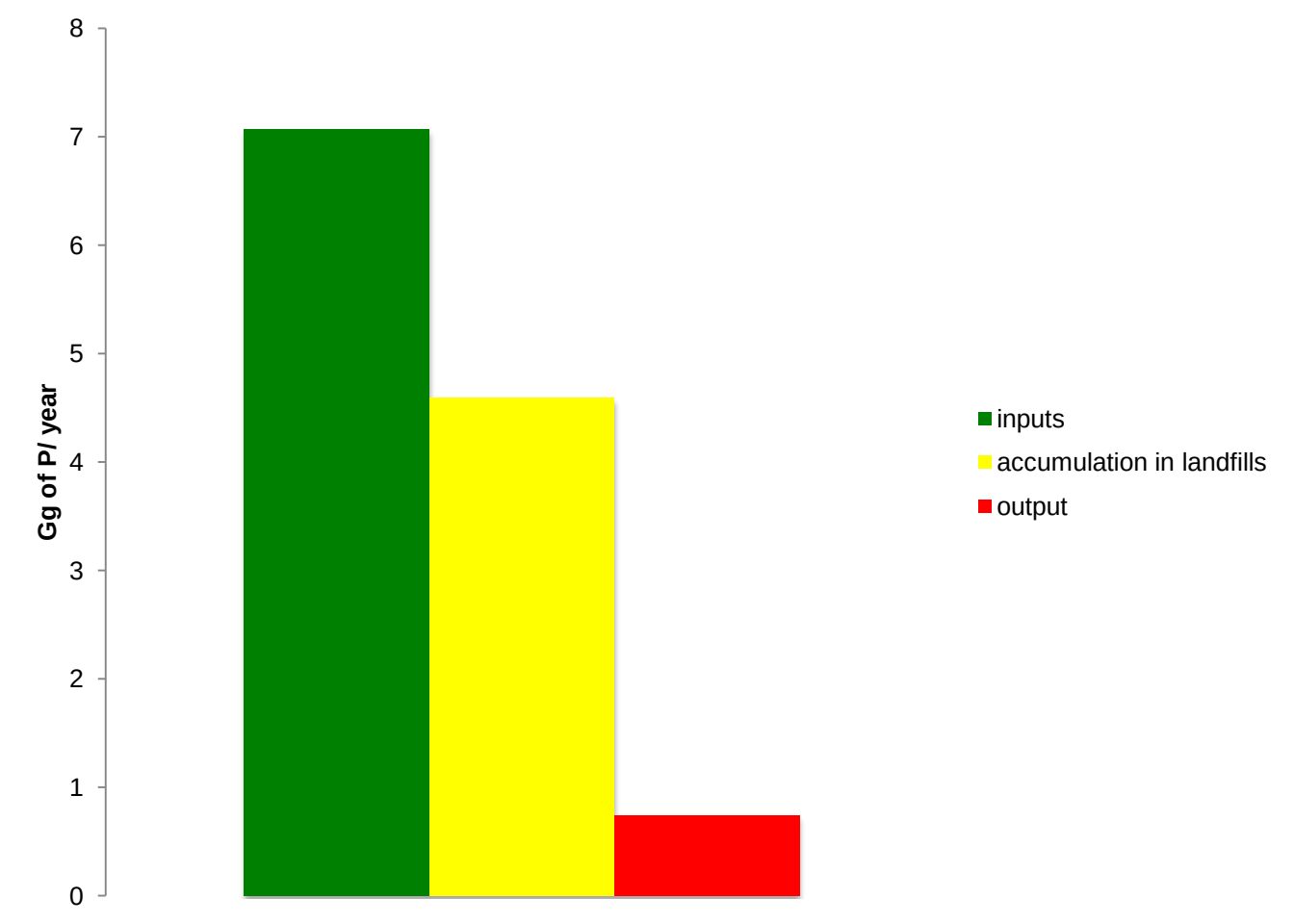

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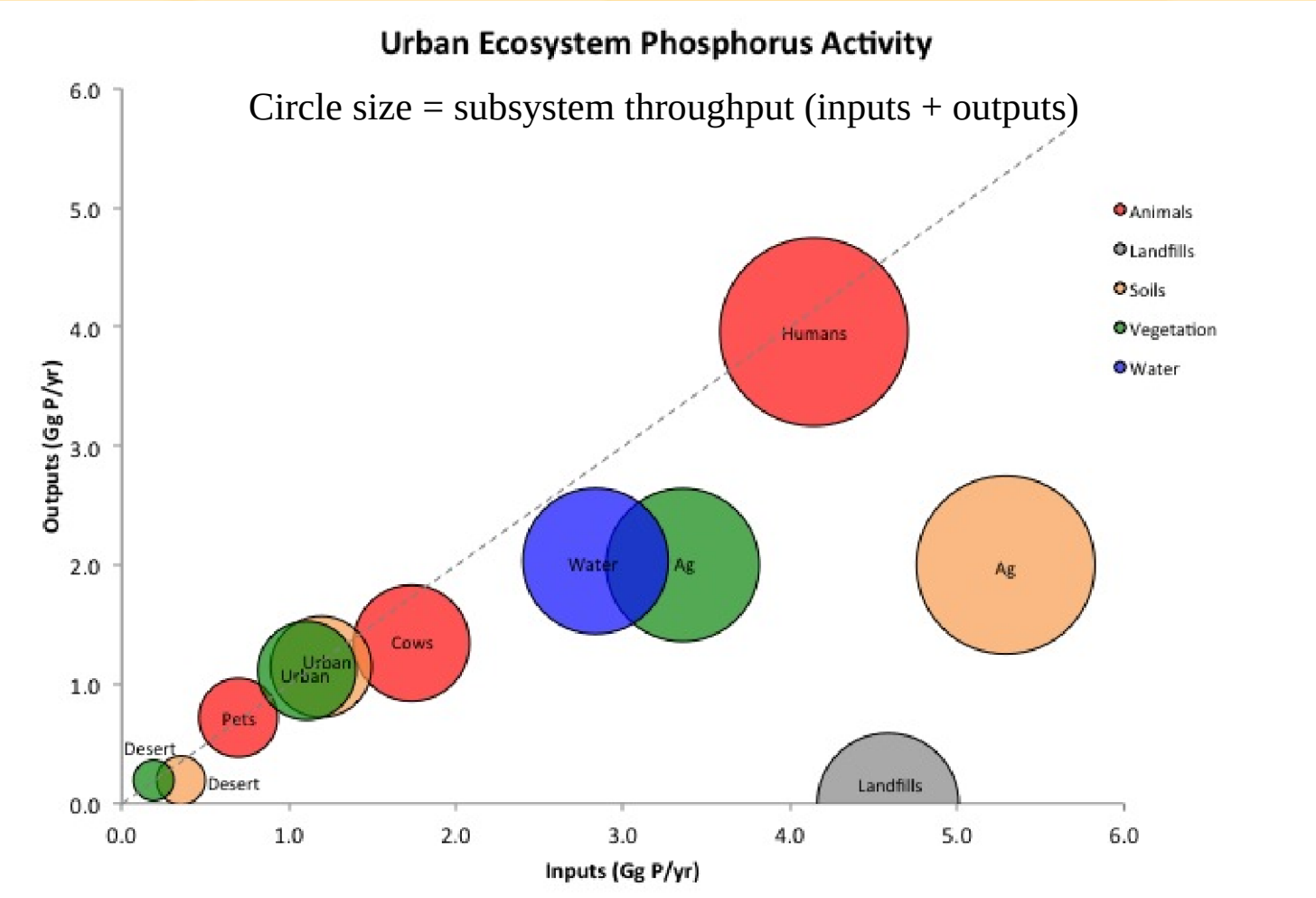

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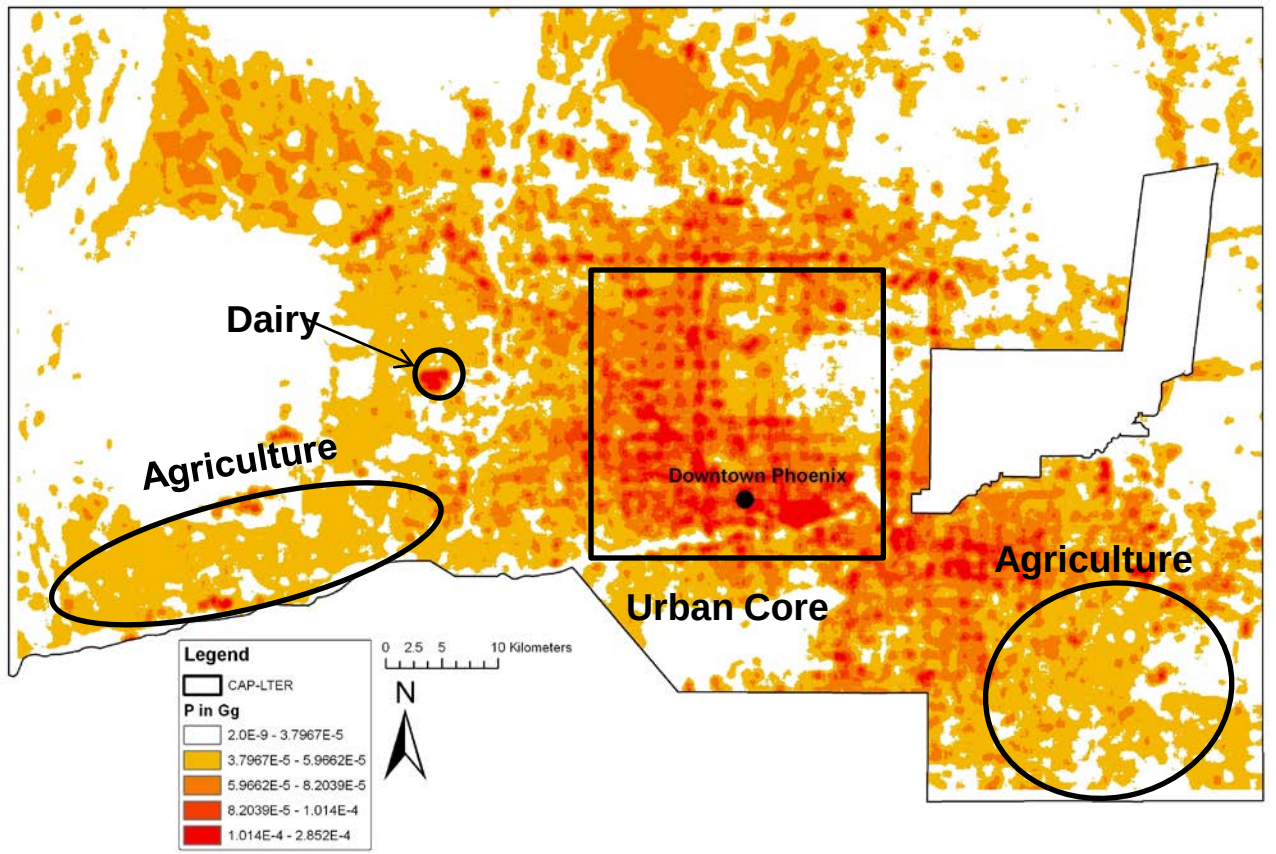

P Stocks: total accumulation in 2005 = 60.2 Gg P (=9.2 kg P ha^{-1})

Figure from Metson et al. 2012. Ecol. Applications

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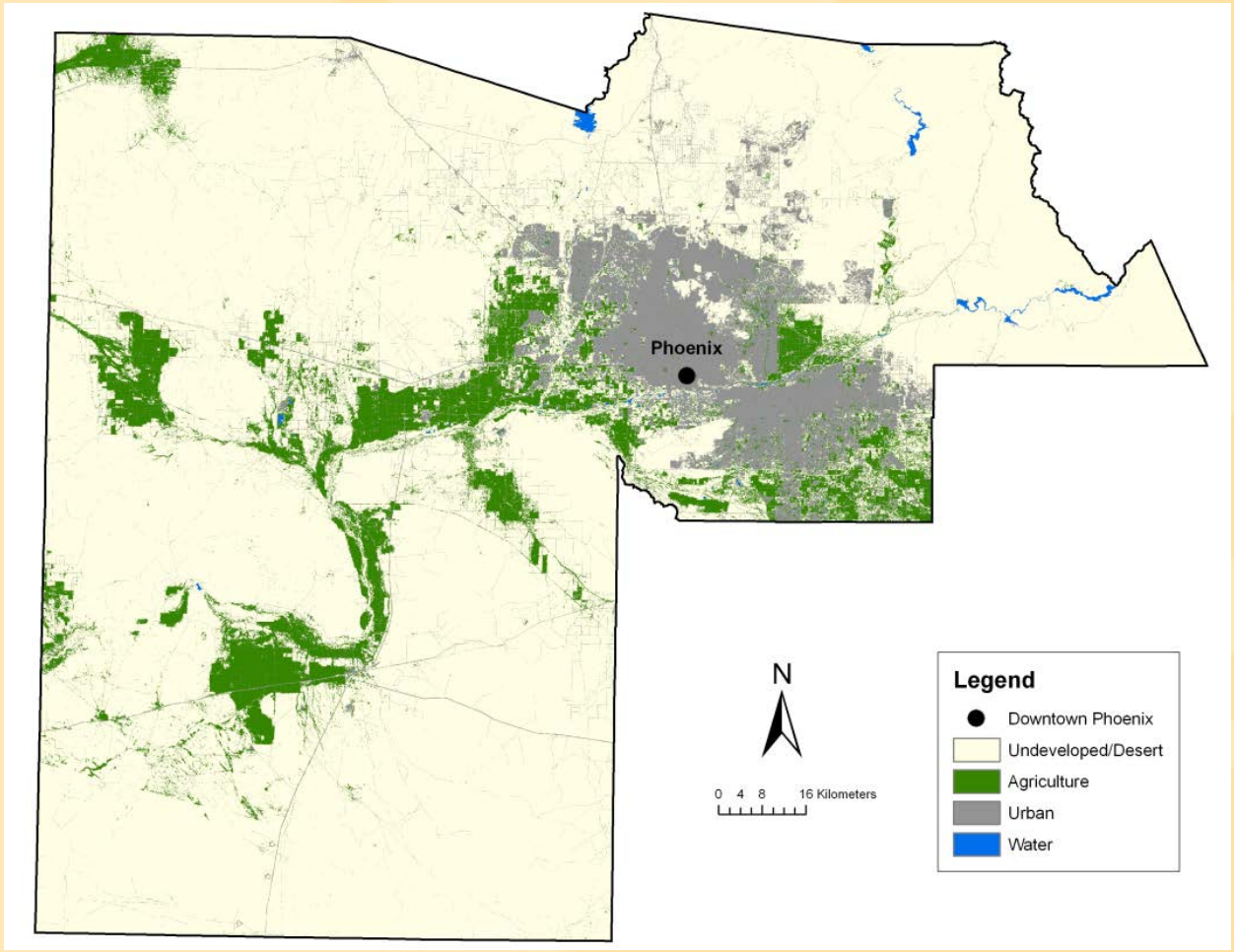
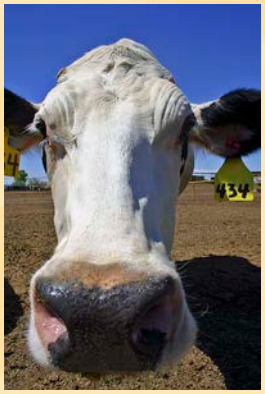
2. Phosphorus in Urban Systems: Ag-urban interface dynamics (1978-2008)



Cotton

Alfalfa



Dairy

Figures from Metson et al. in review. J. Industrial Ecol.

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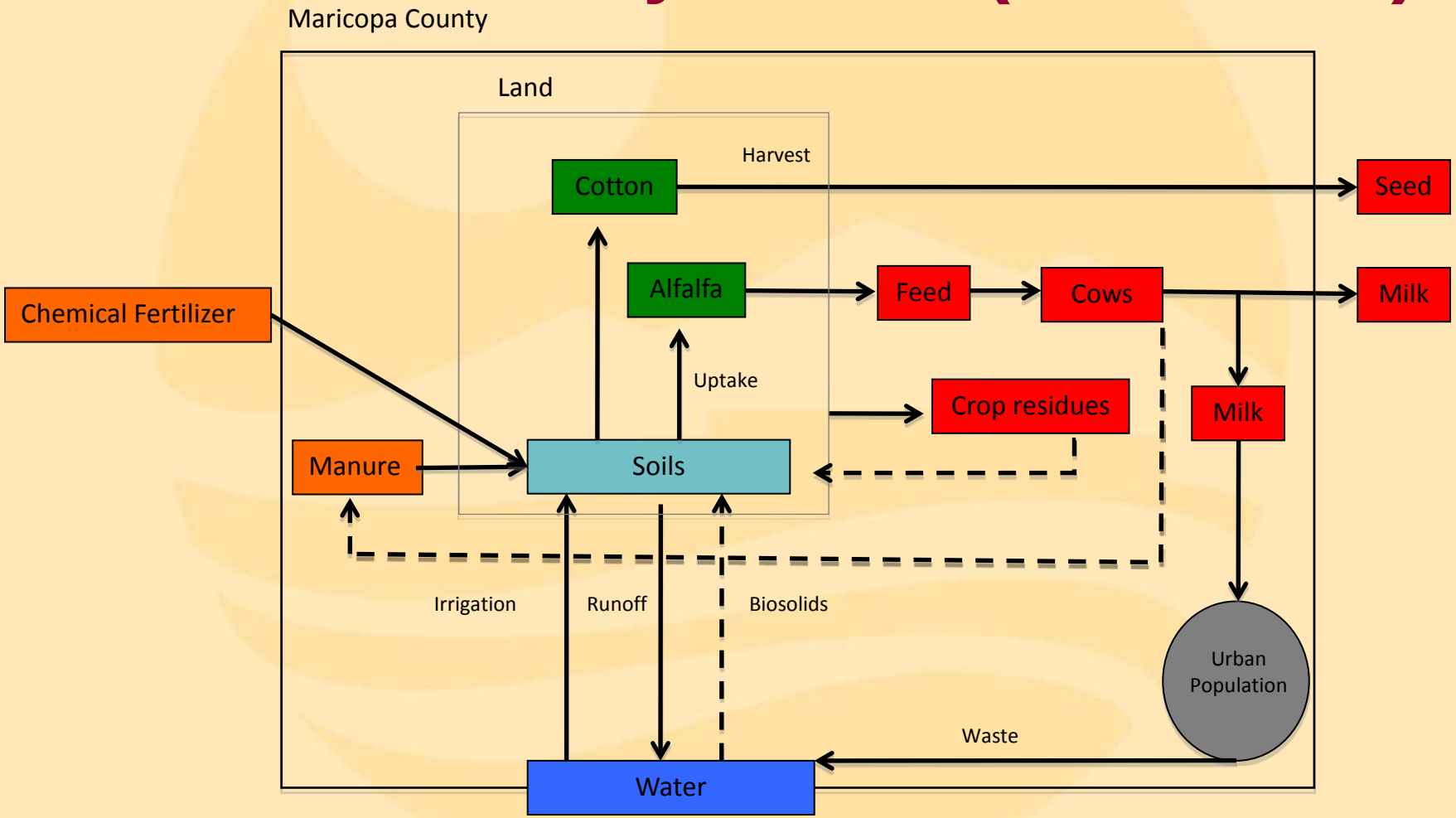

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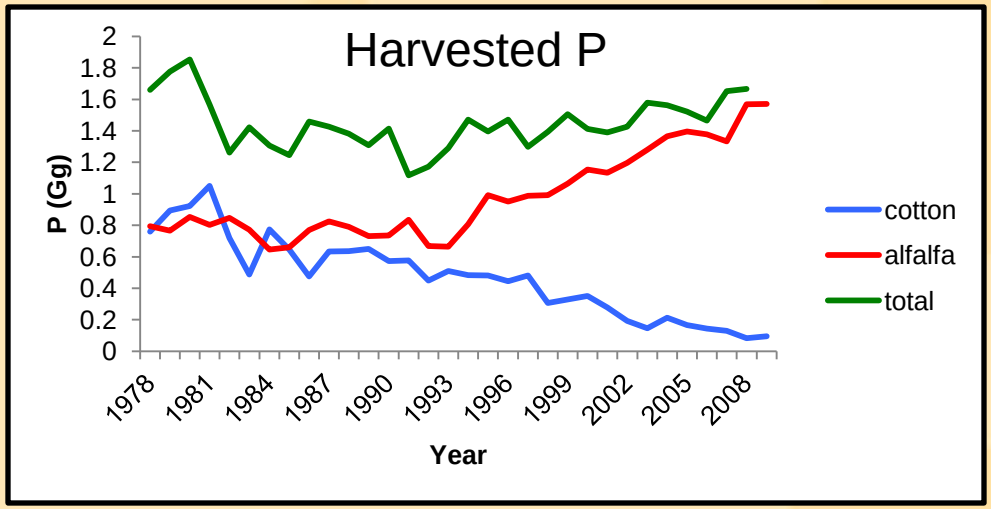

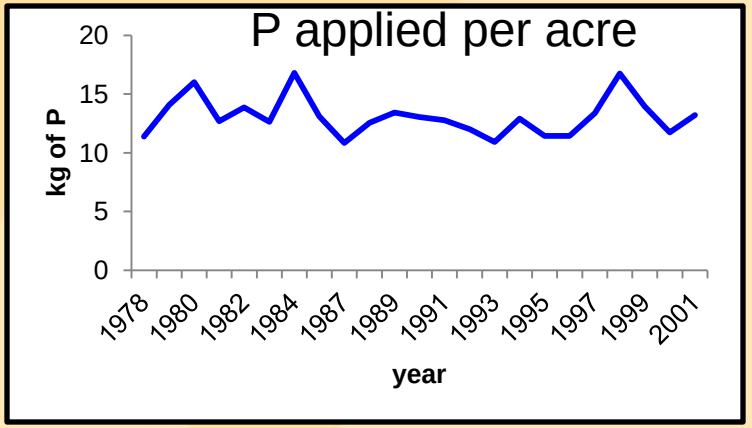

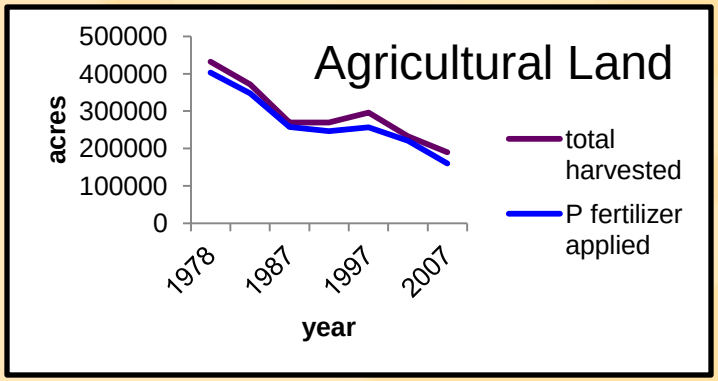

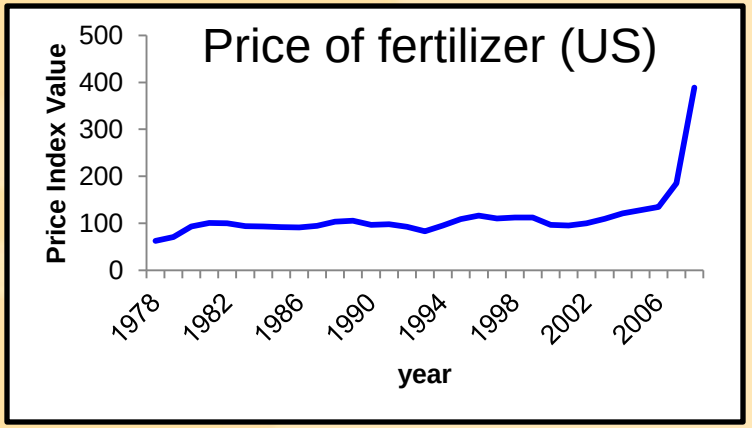

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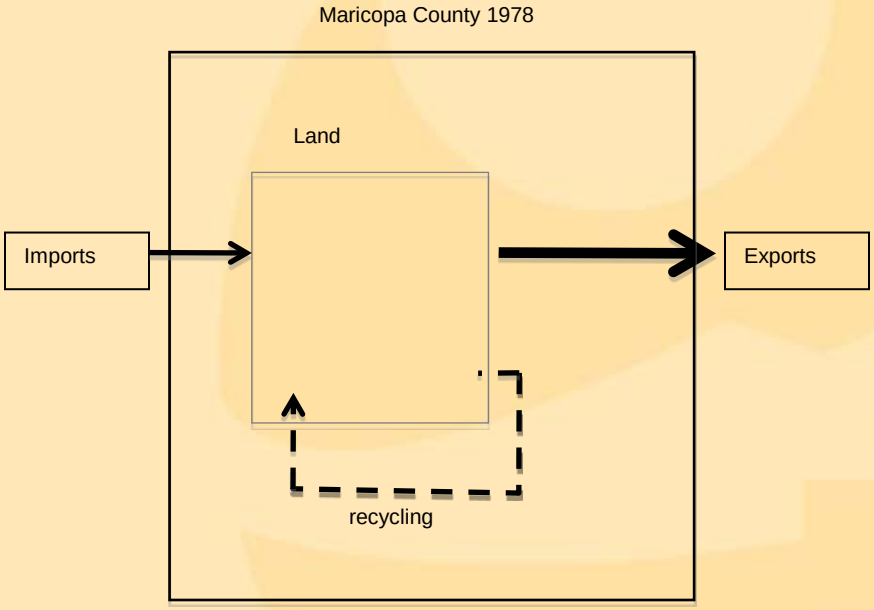

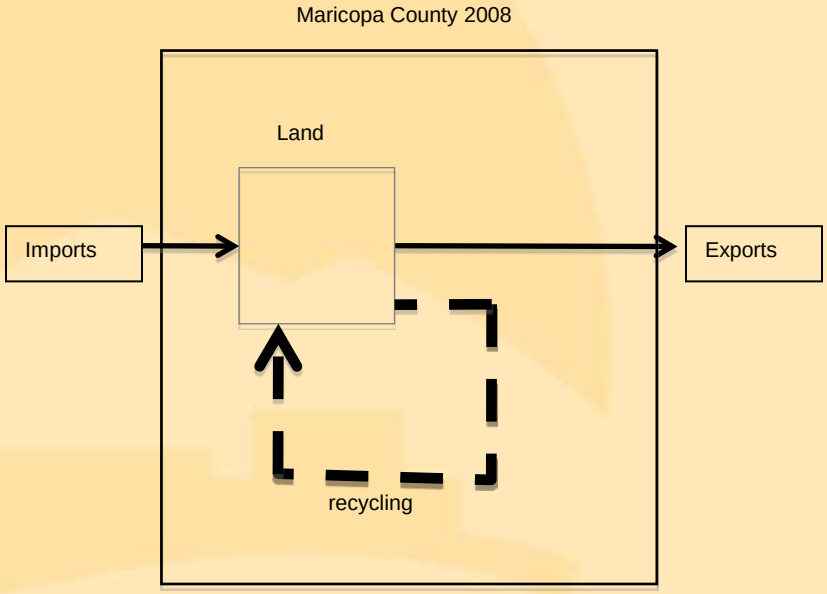

Serendipitous efficiencies achieved through: 1) close coupling of dairy and alfalfa production; 2) recycling of dairy manure back to alfalfa fields; 3) use of reclaimed water to irrigate alfalfa fields; 4) local consumption of local diary and associated meat; 5) lucky market pressures on cotton vs. alfalfa, and; 6) no surface water runoff means no aquatic P export.

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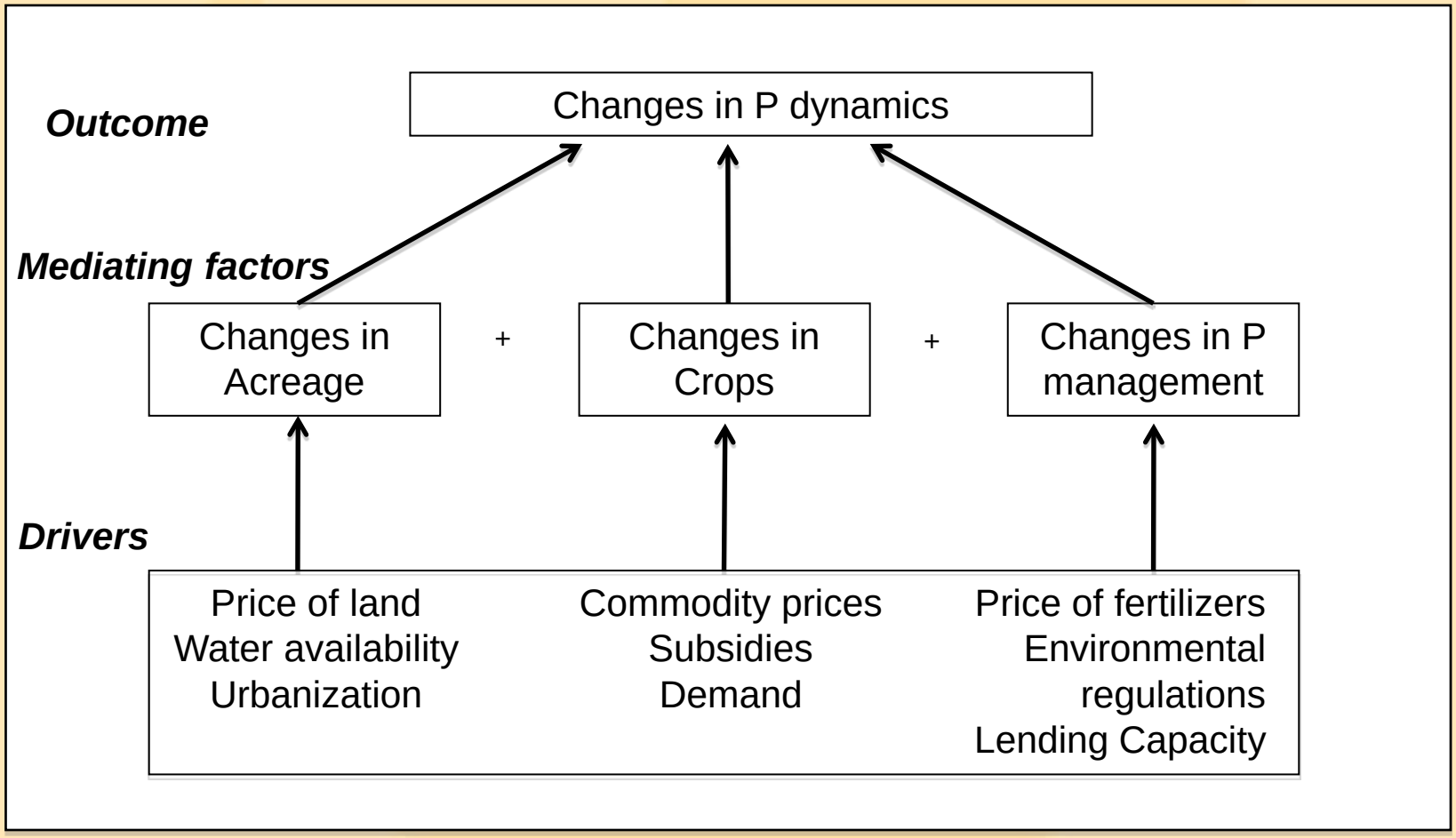

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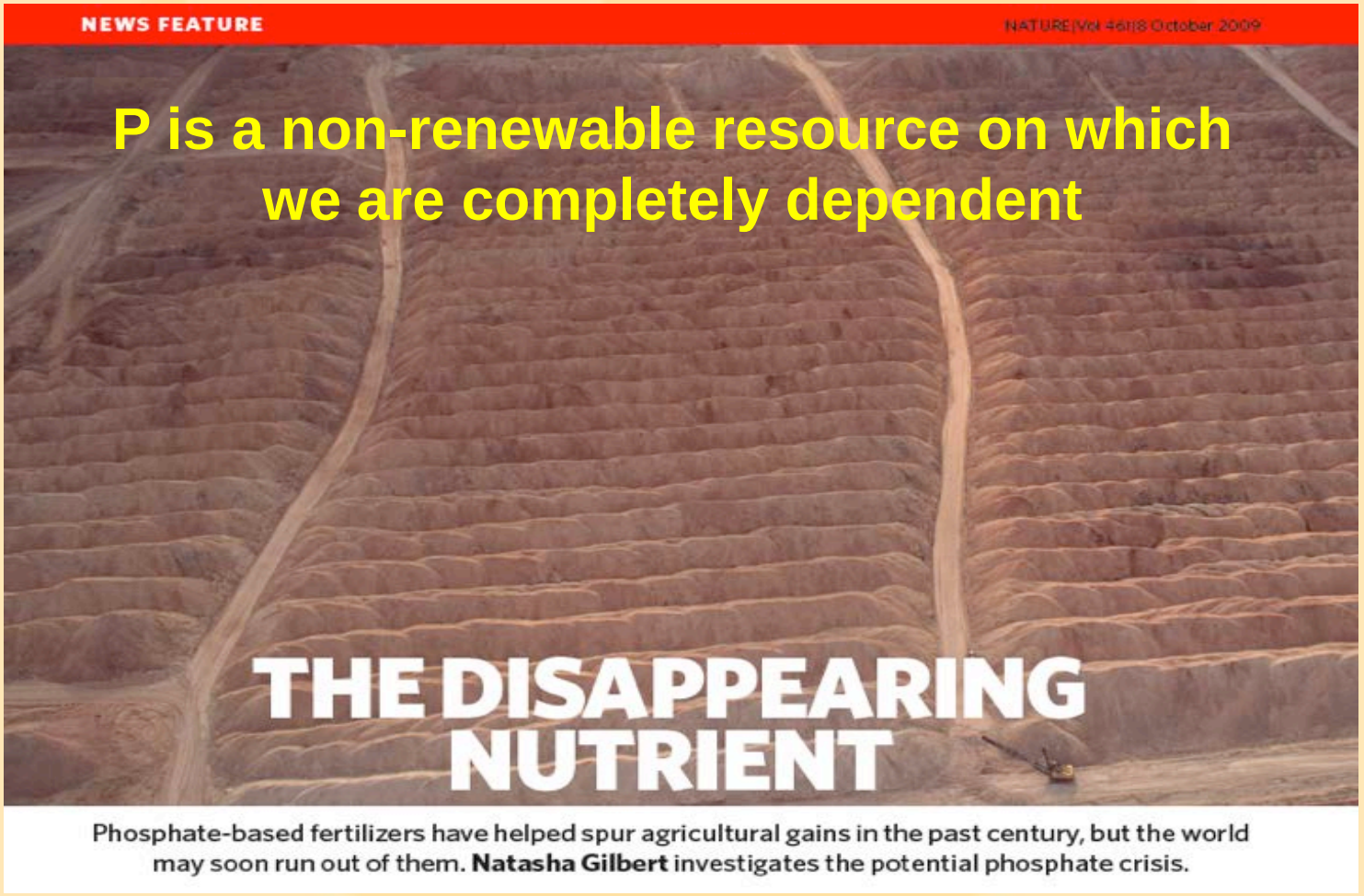
3. Phosphorus Sustainability Challenges: The "wicked" problem



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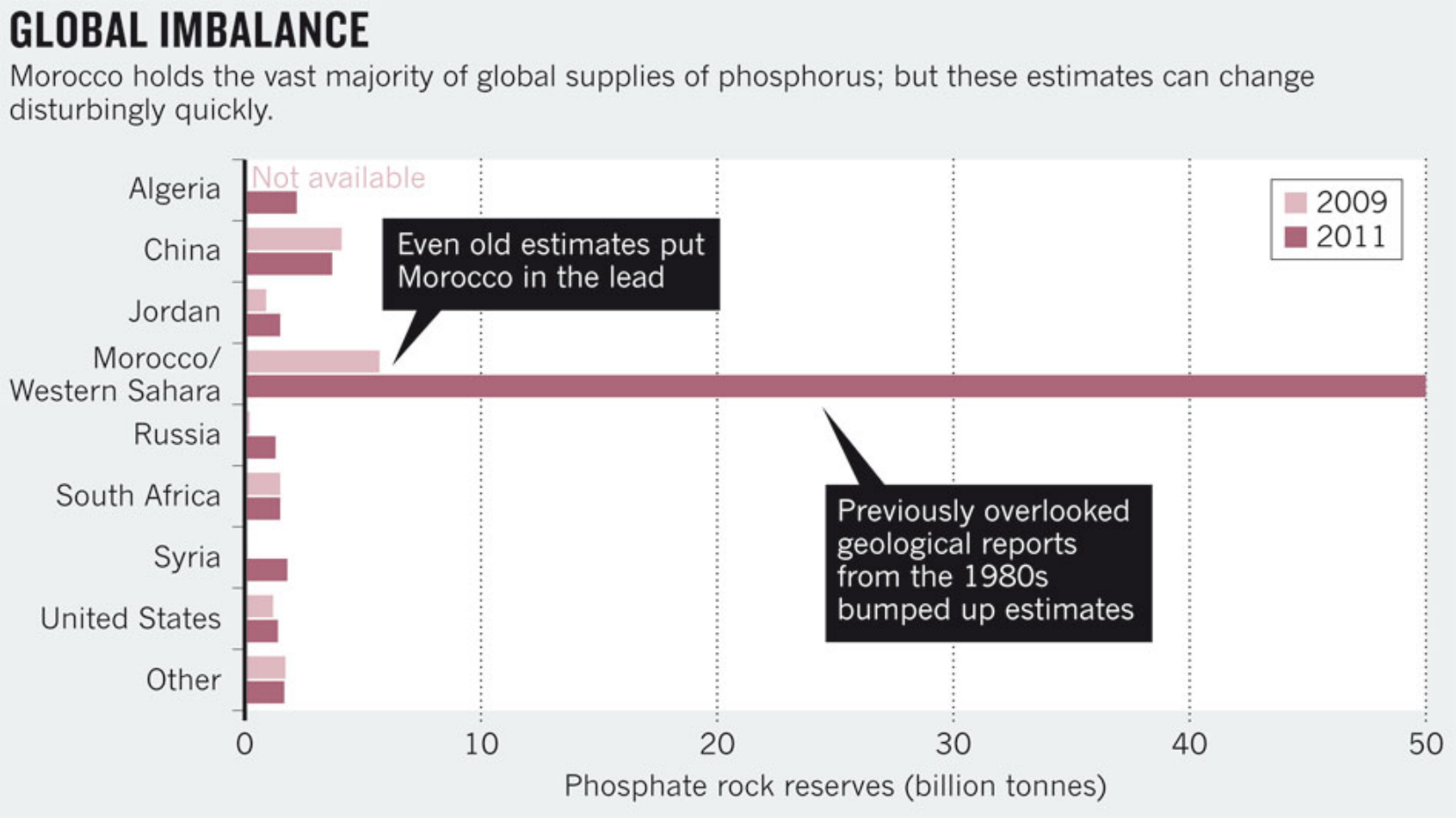

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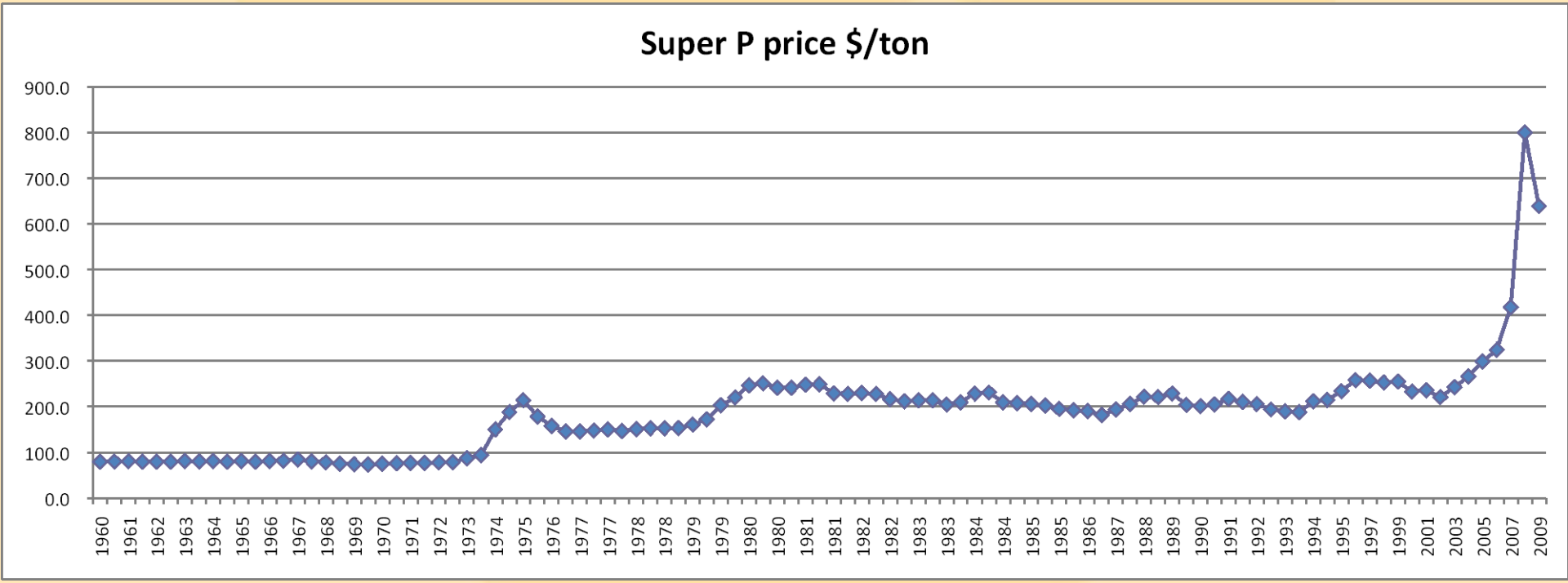
3. Phosphorus Sustainability Challenges: Price vulnerability is highly inequitable on a global basis

Remember the spike in food prices and related riots in 2008?



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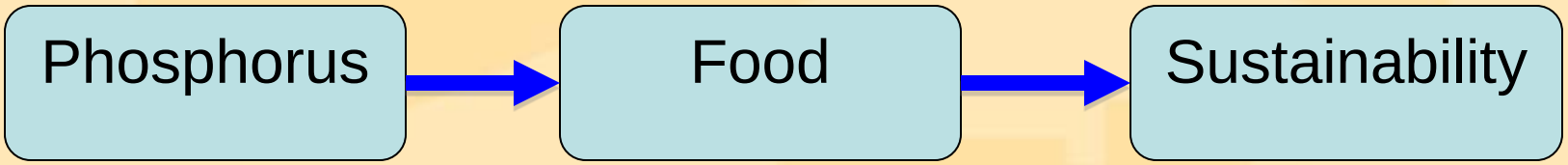

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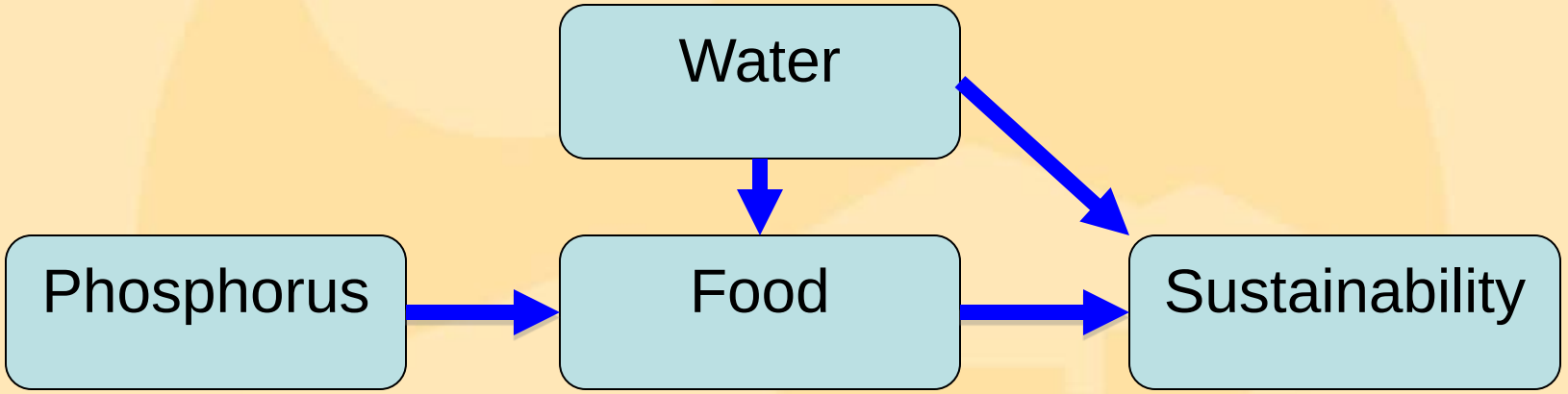

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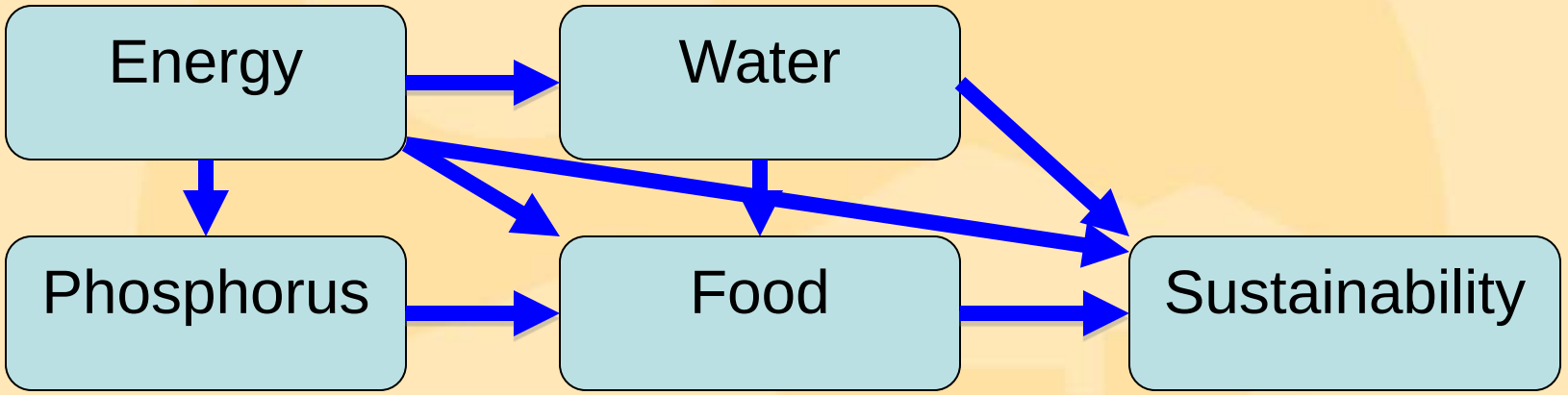

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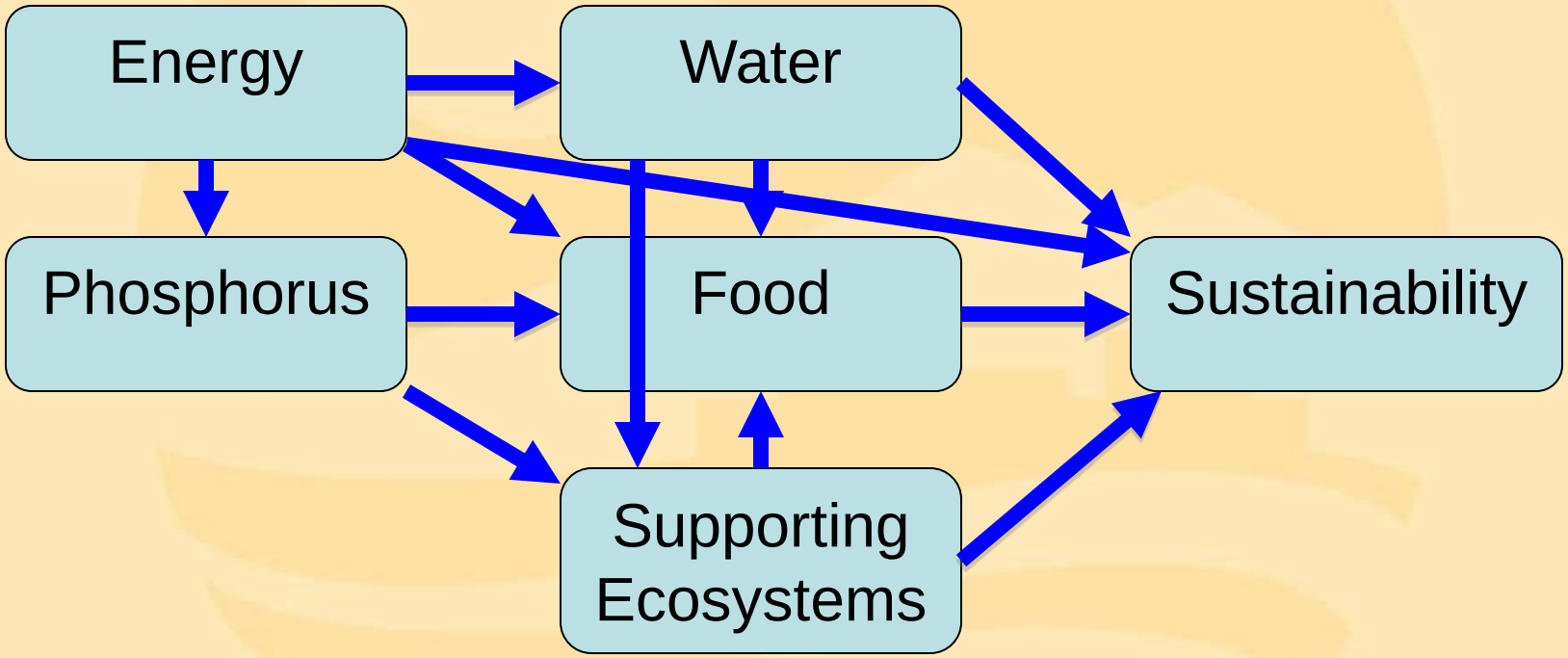

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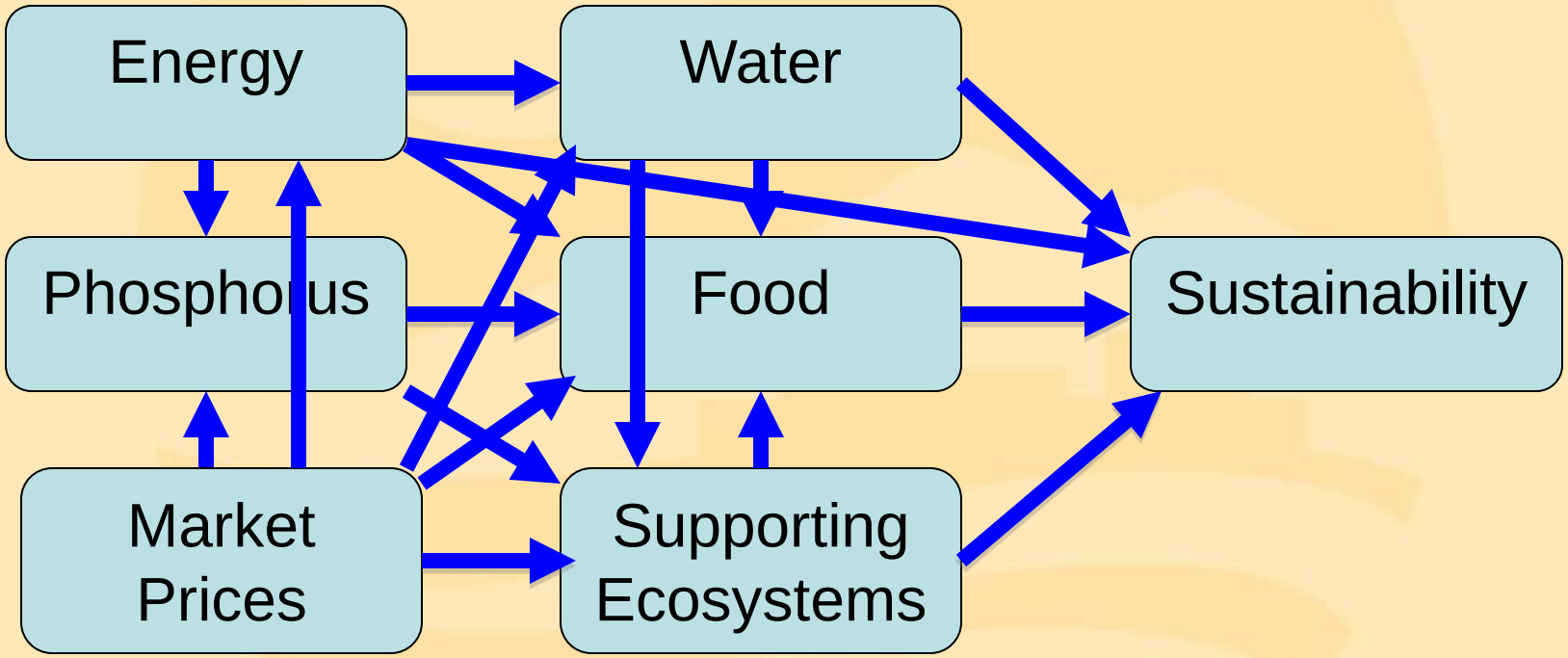

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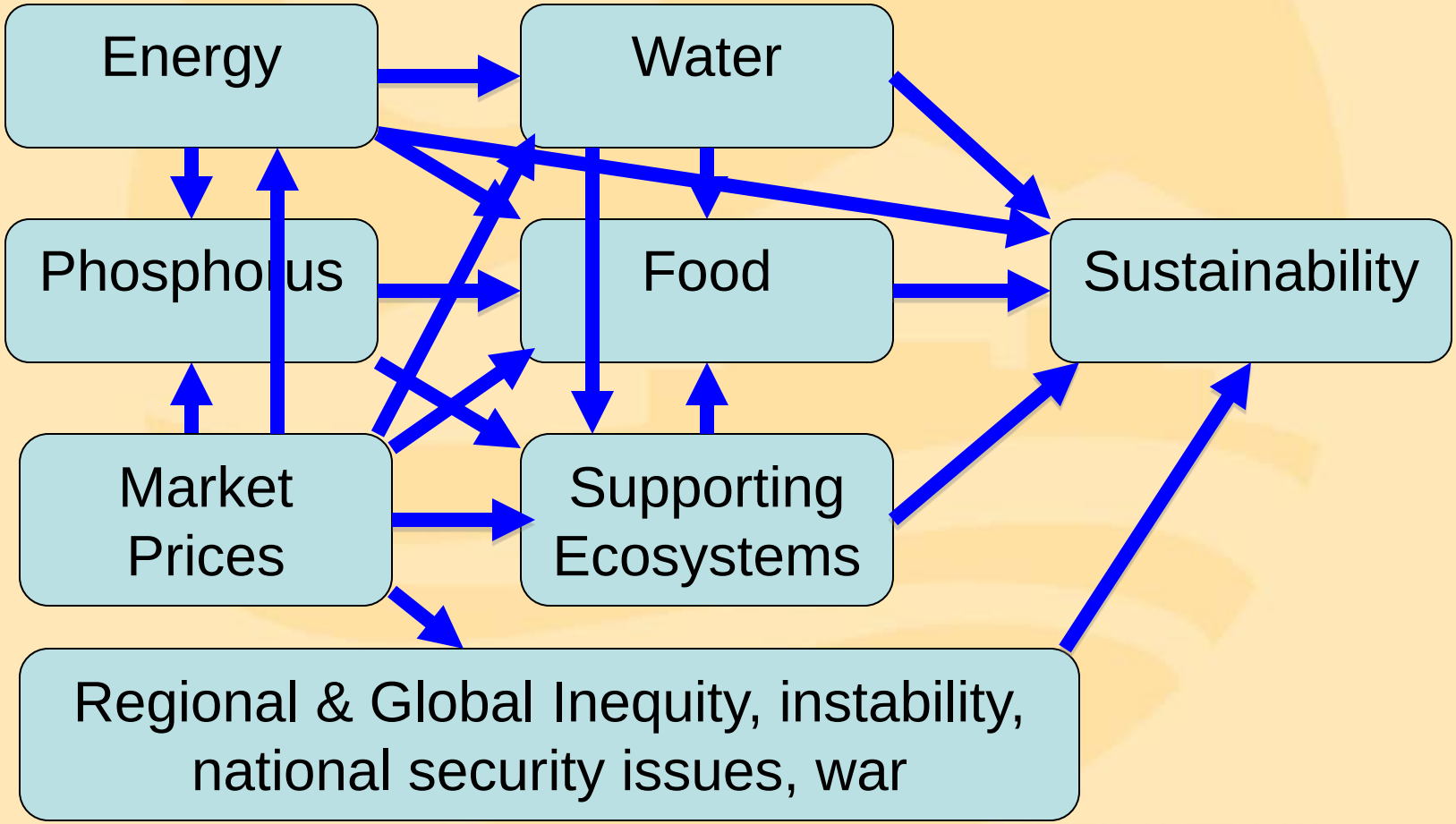

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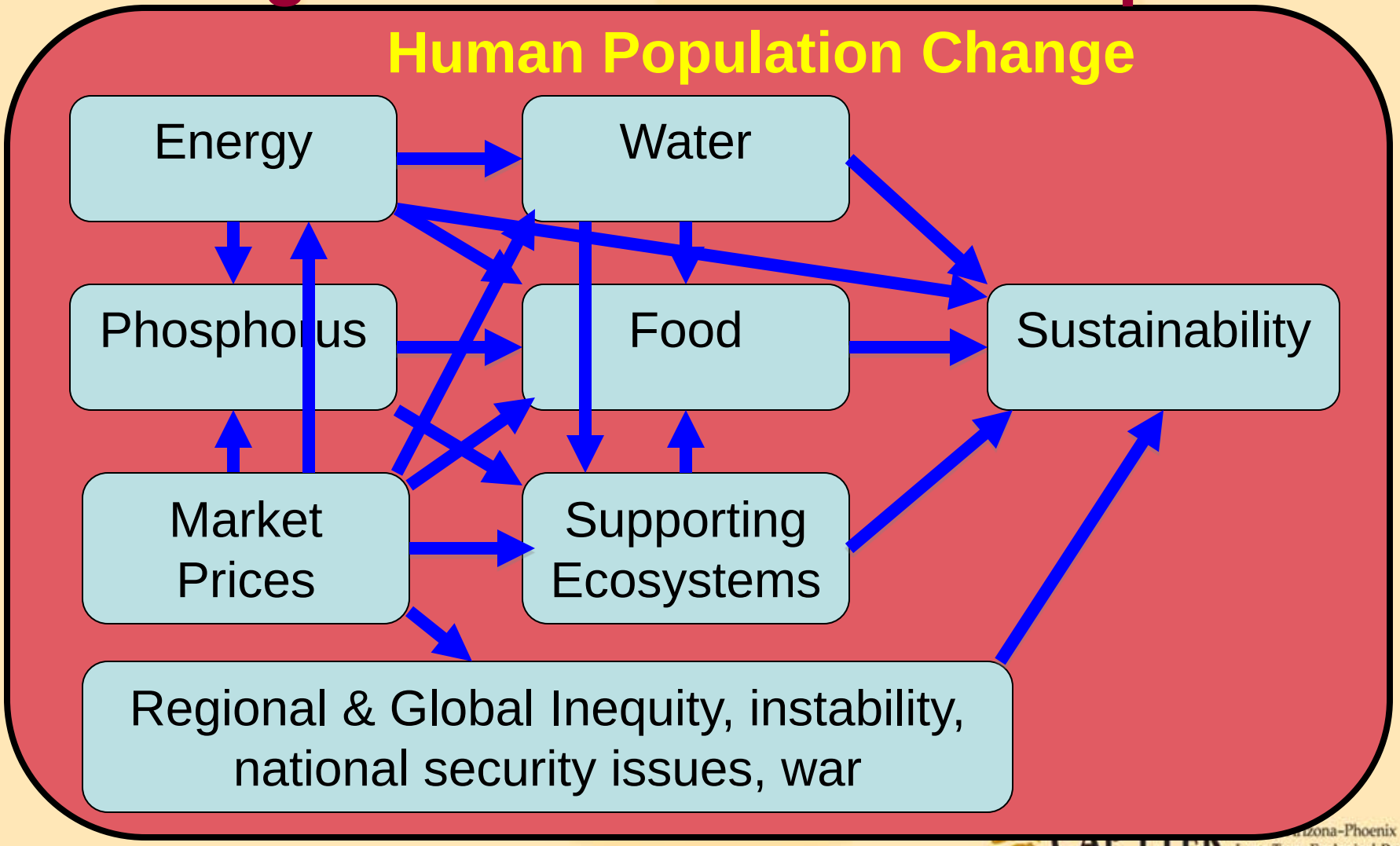

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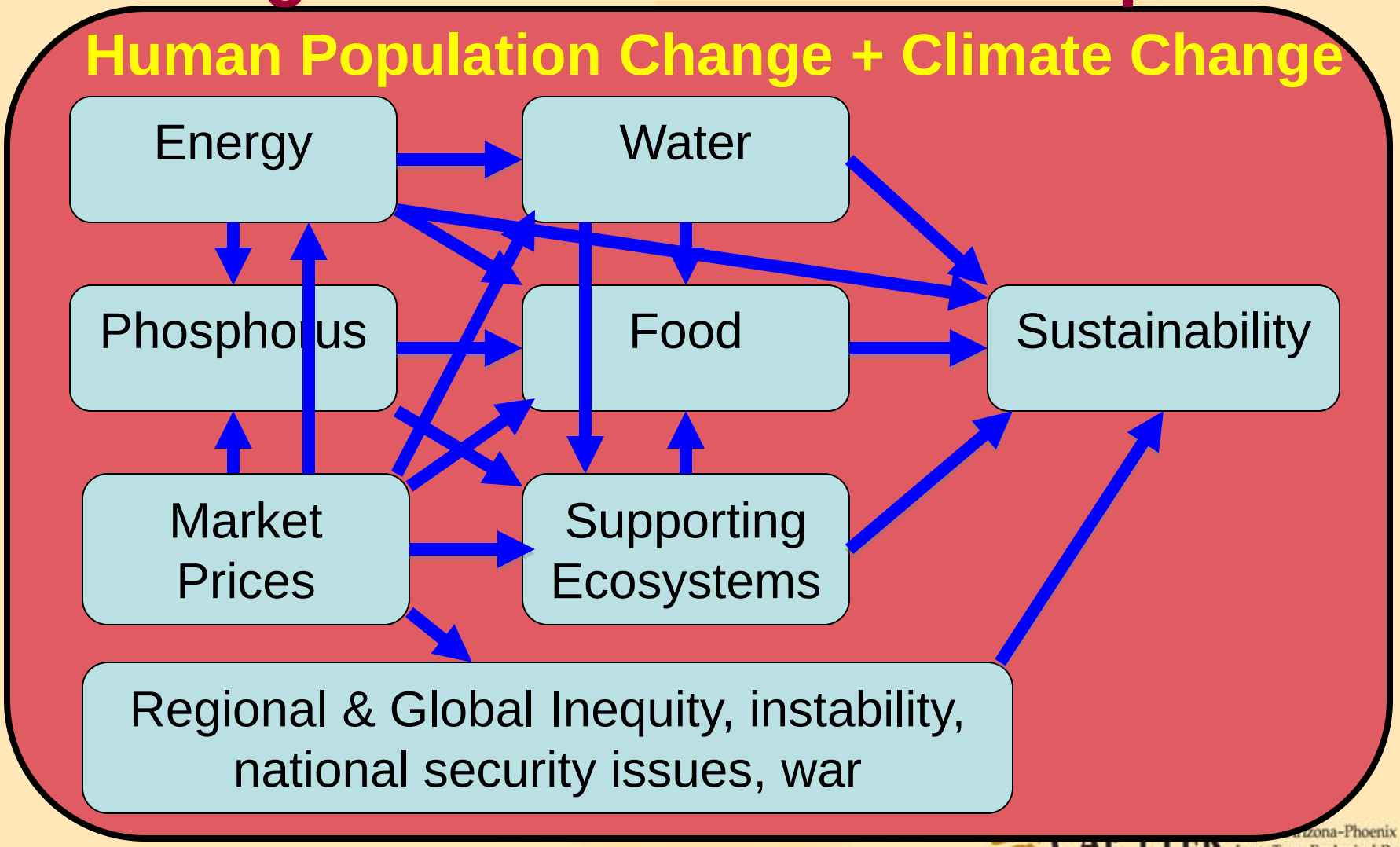
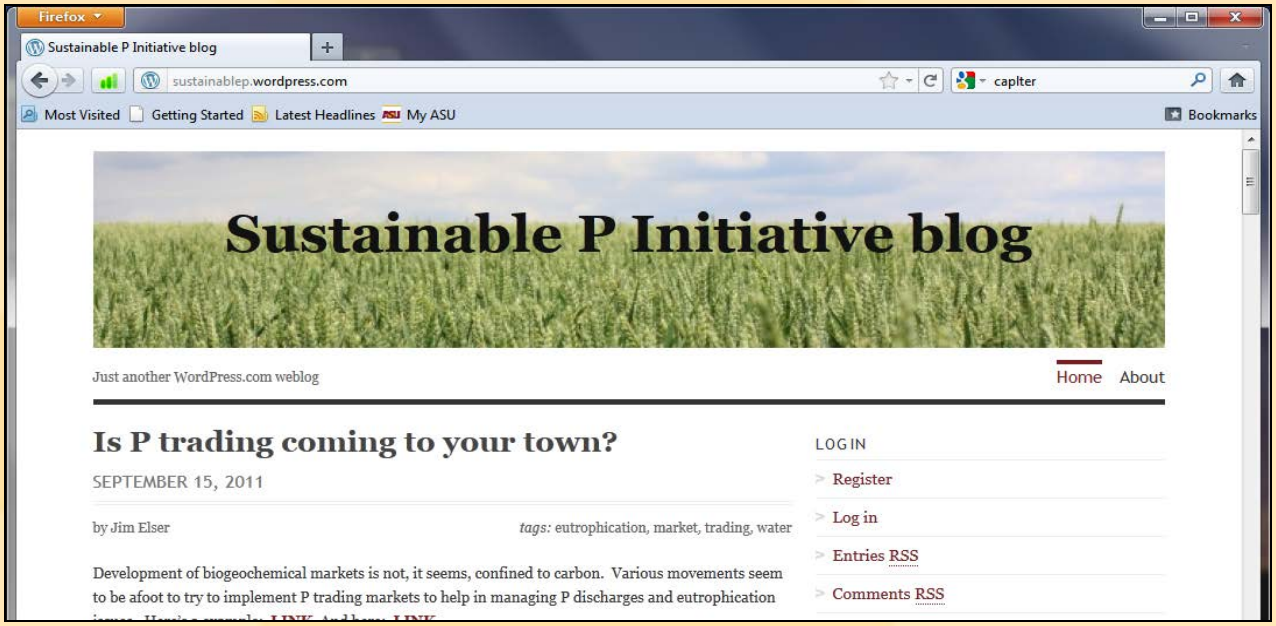
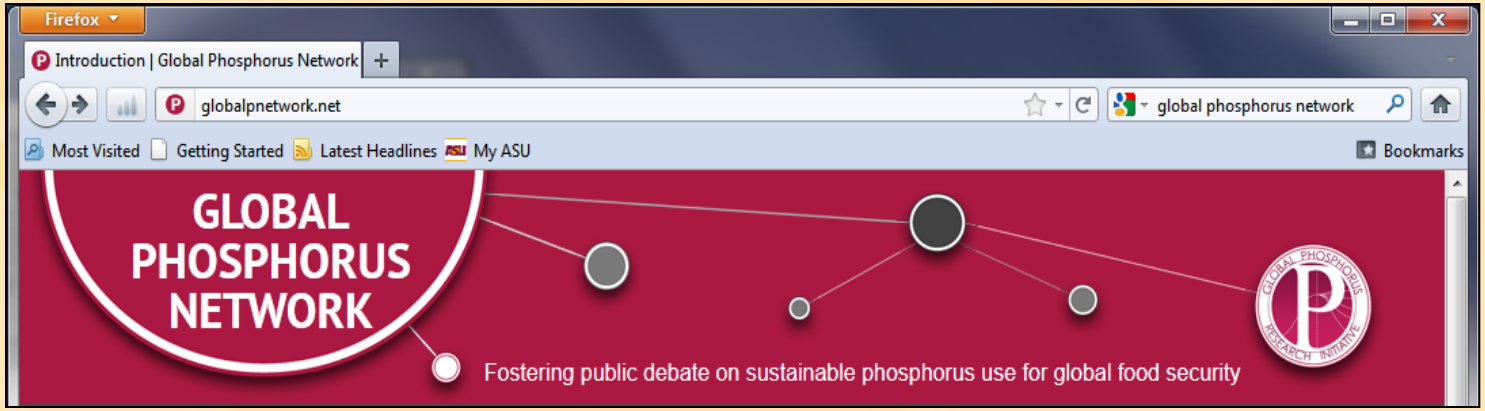


Ways to Learn More & Get Involved

http://sustainablep.asu.edu



http://GlobalpNetwork.net



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