Peak Phosphorus – The Next Inconvenient Truth

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Mini-Seminar
Phosphorus Shortage: European Challenges
European Parliament Brussels
March 4, 2010

EcoSanRes

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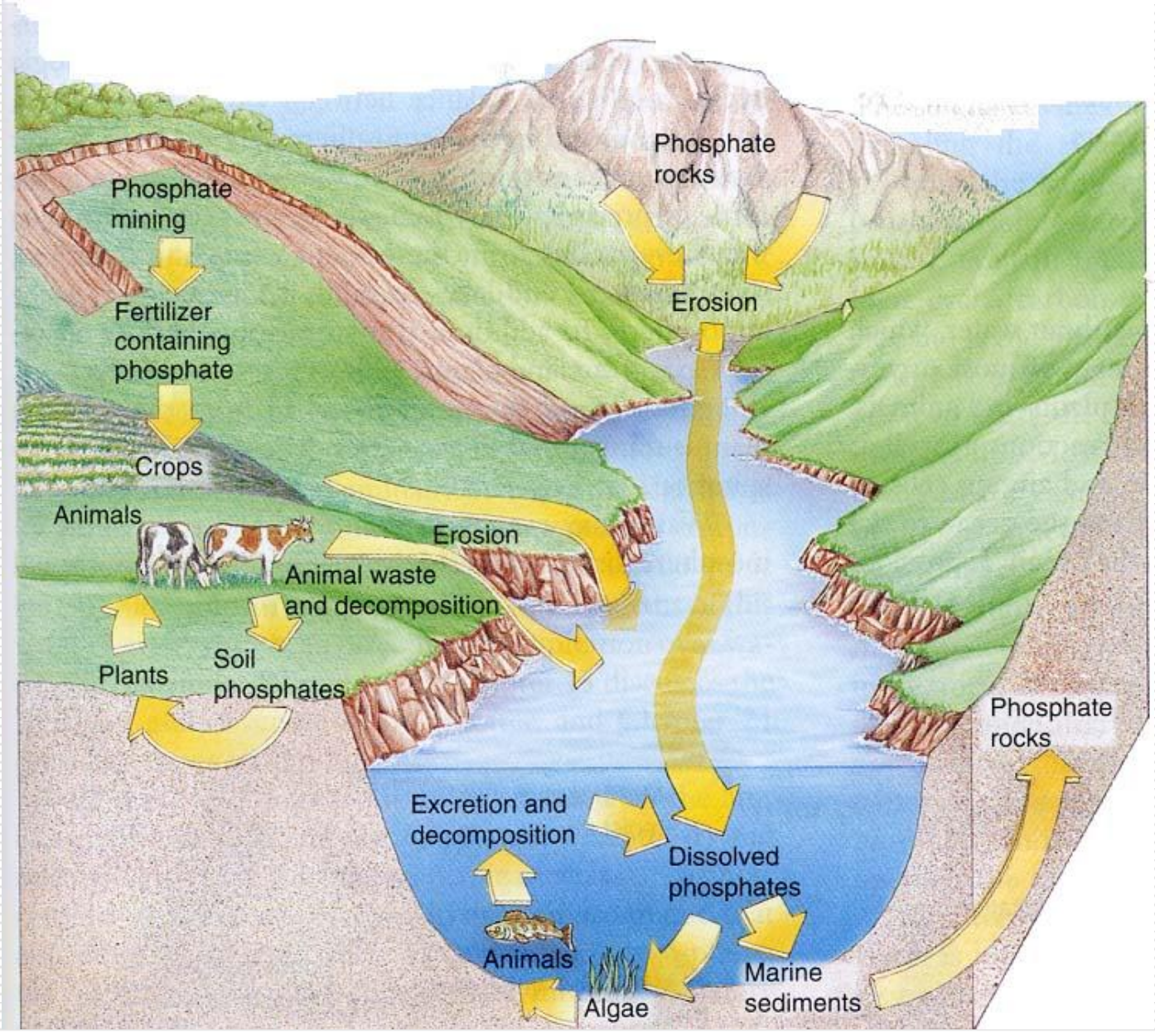
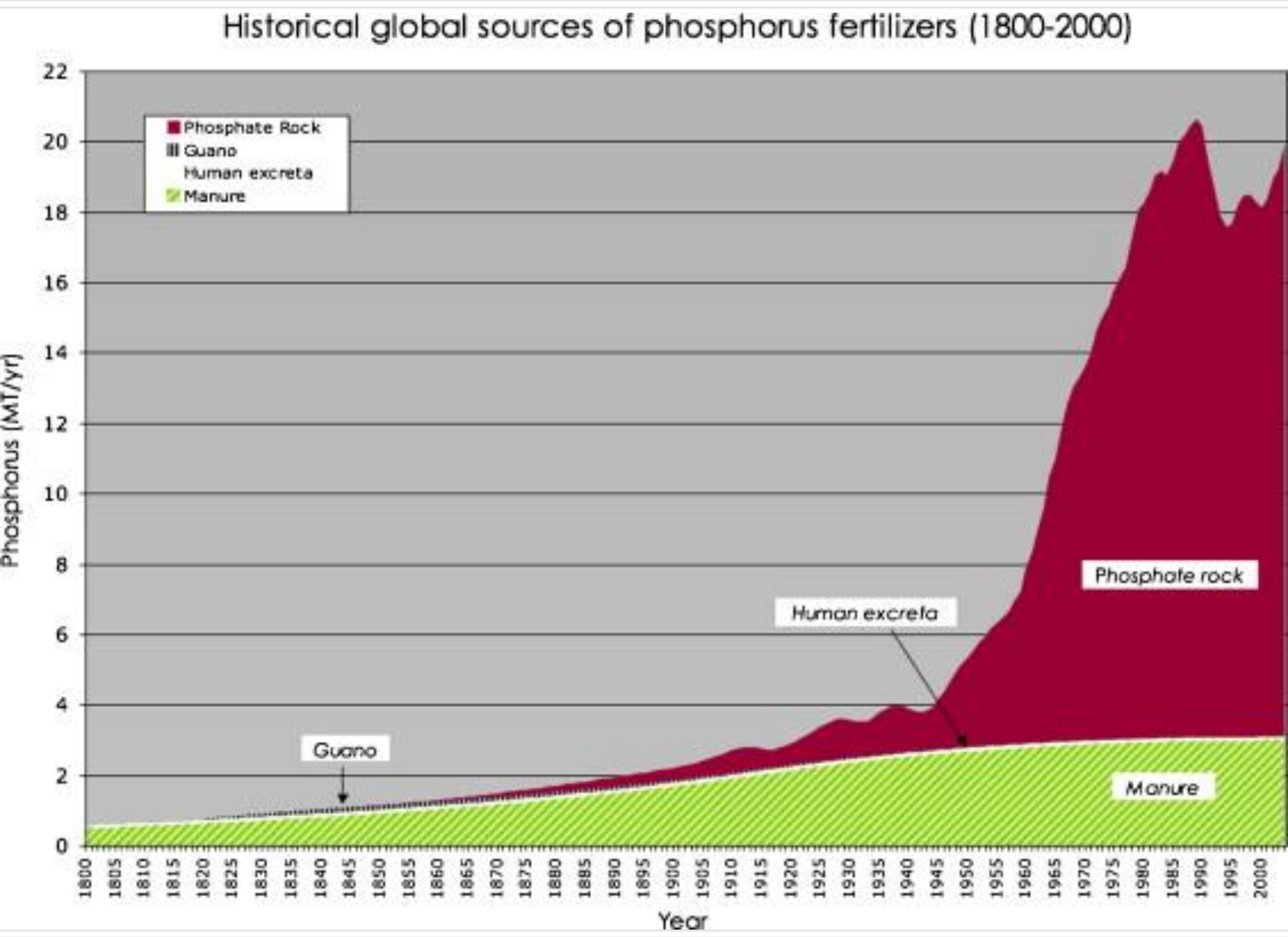
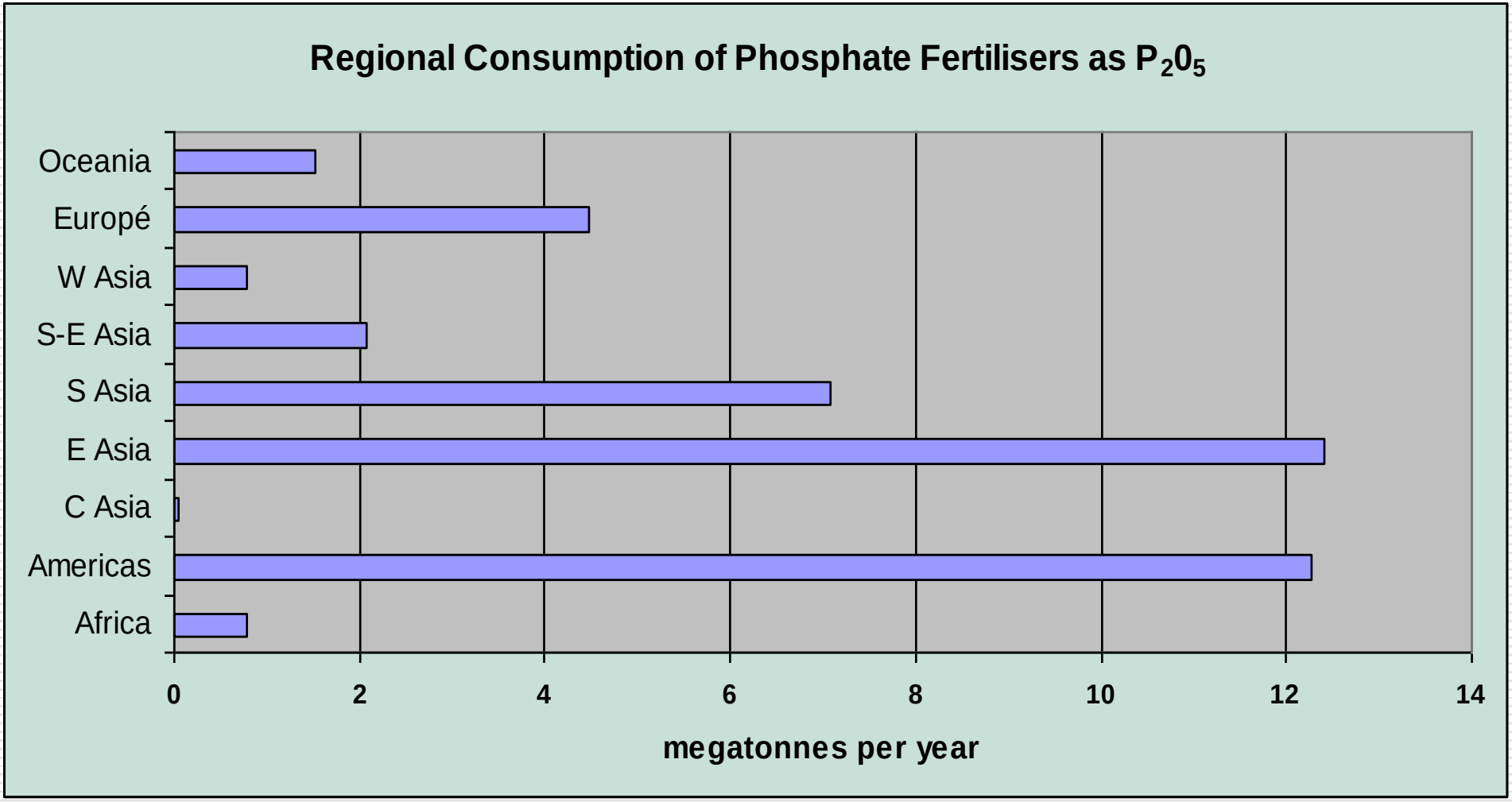
The linear path of phosphorus in modern times (Princeton Univ.)





Cordell, 2009



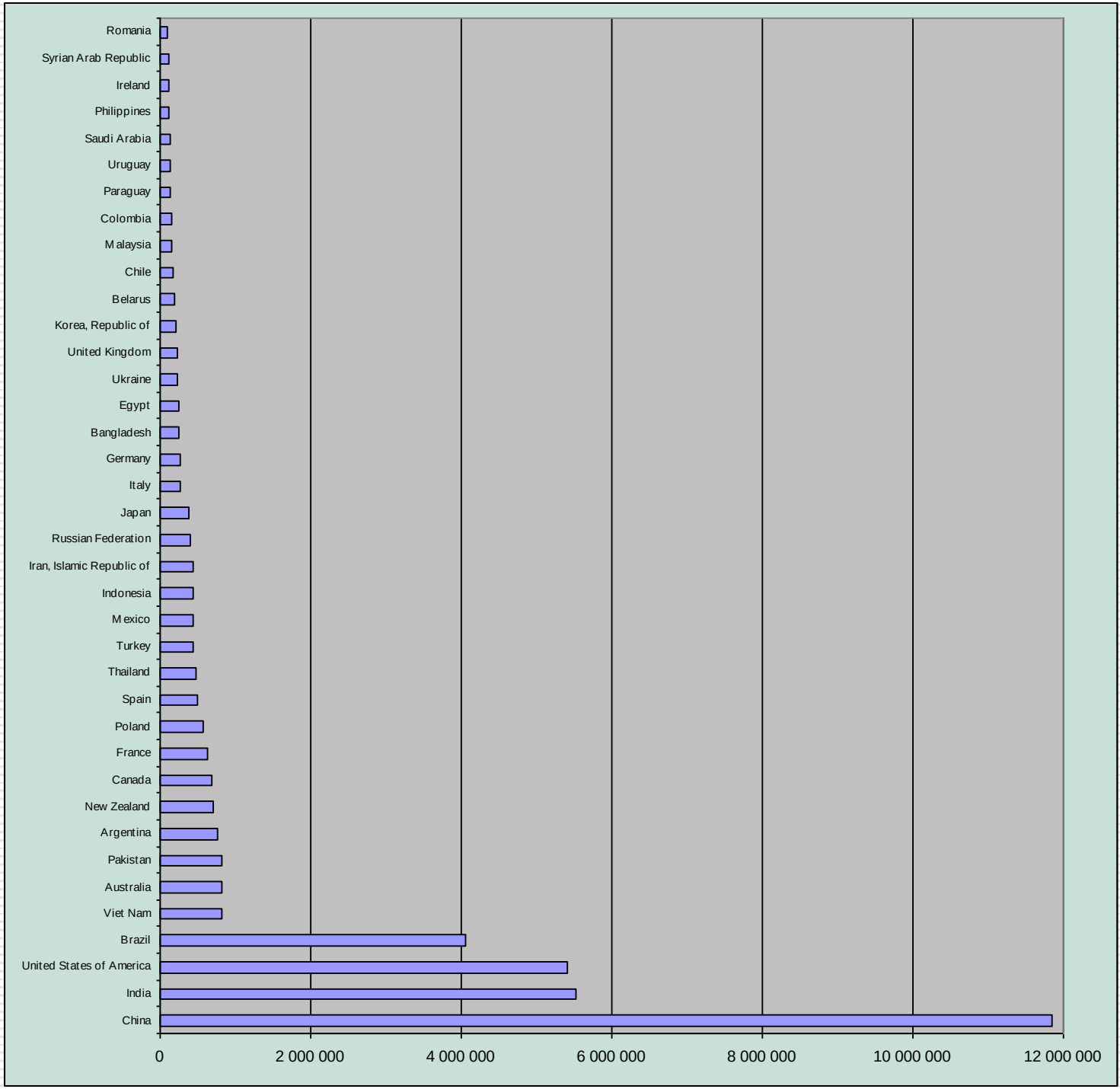
Dominated by East Asia, the Americas and South Asia, followed by Europe

Poverty indicator: Africa uses 2-3 Kg P/ha compared to world average of 35

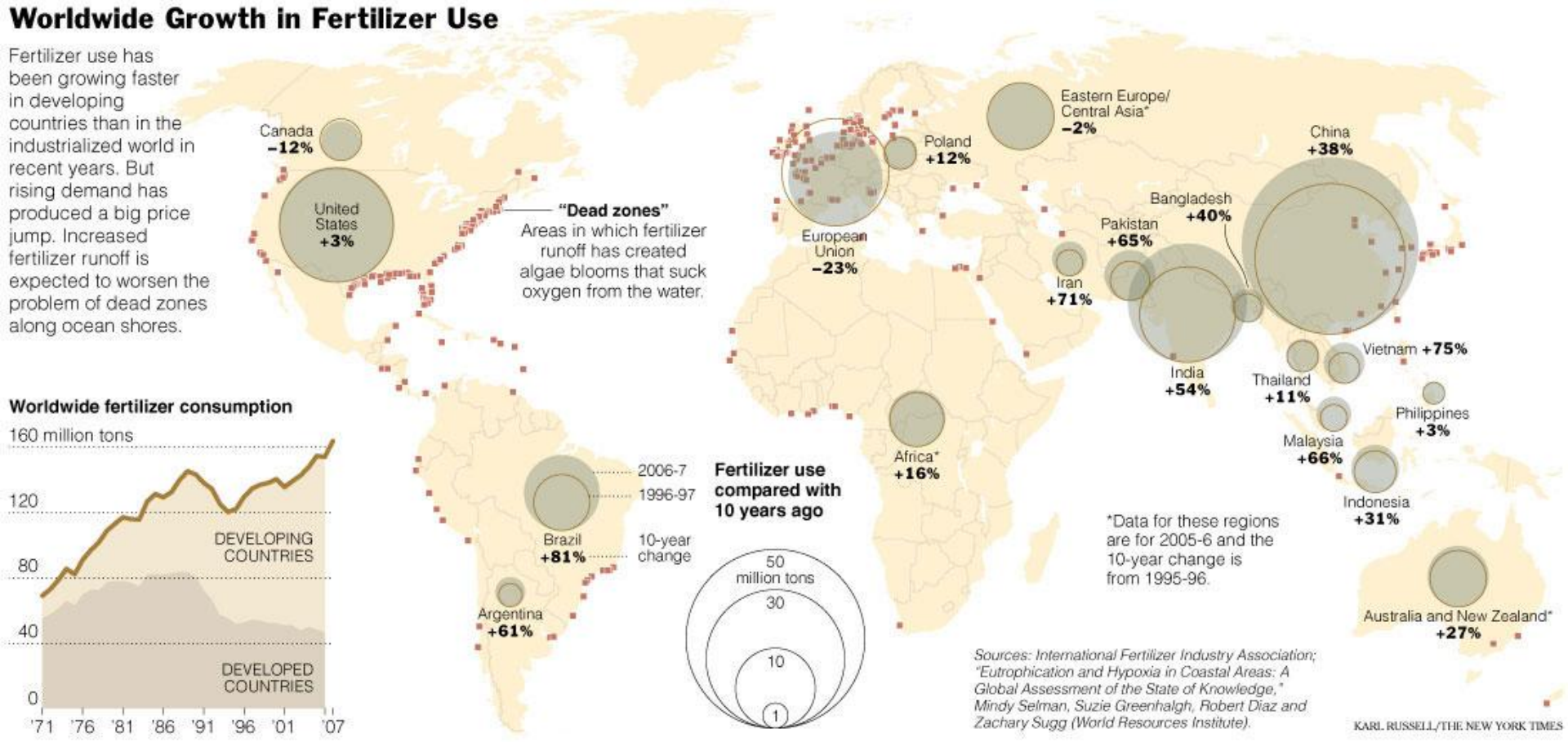
FAOSTAT, 2009

2007 consumption tonnes P_2O_5/yr

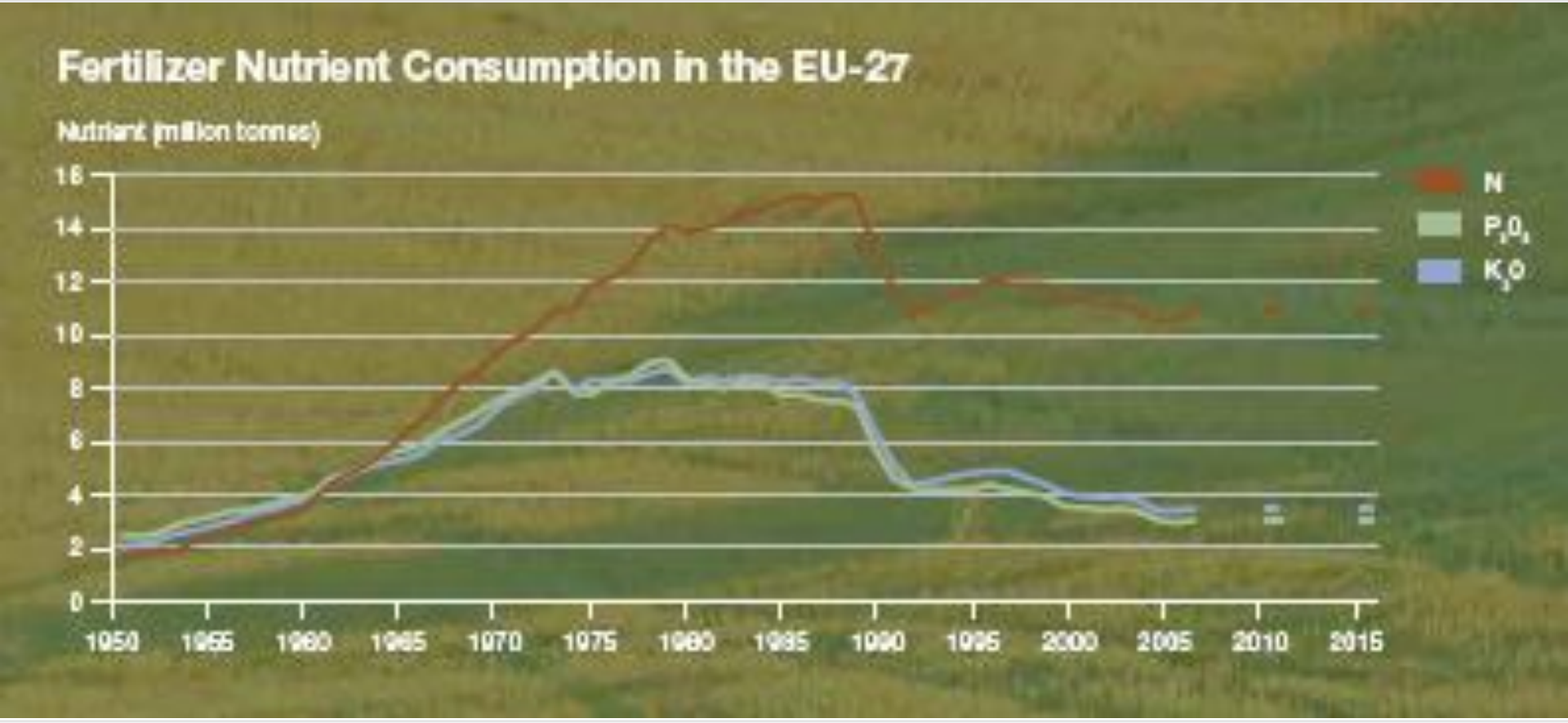
(FAOSTAT, 2009)



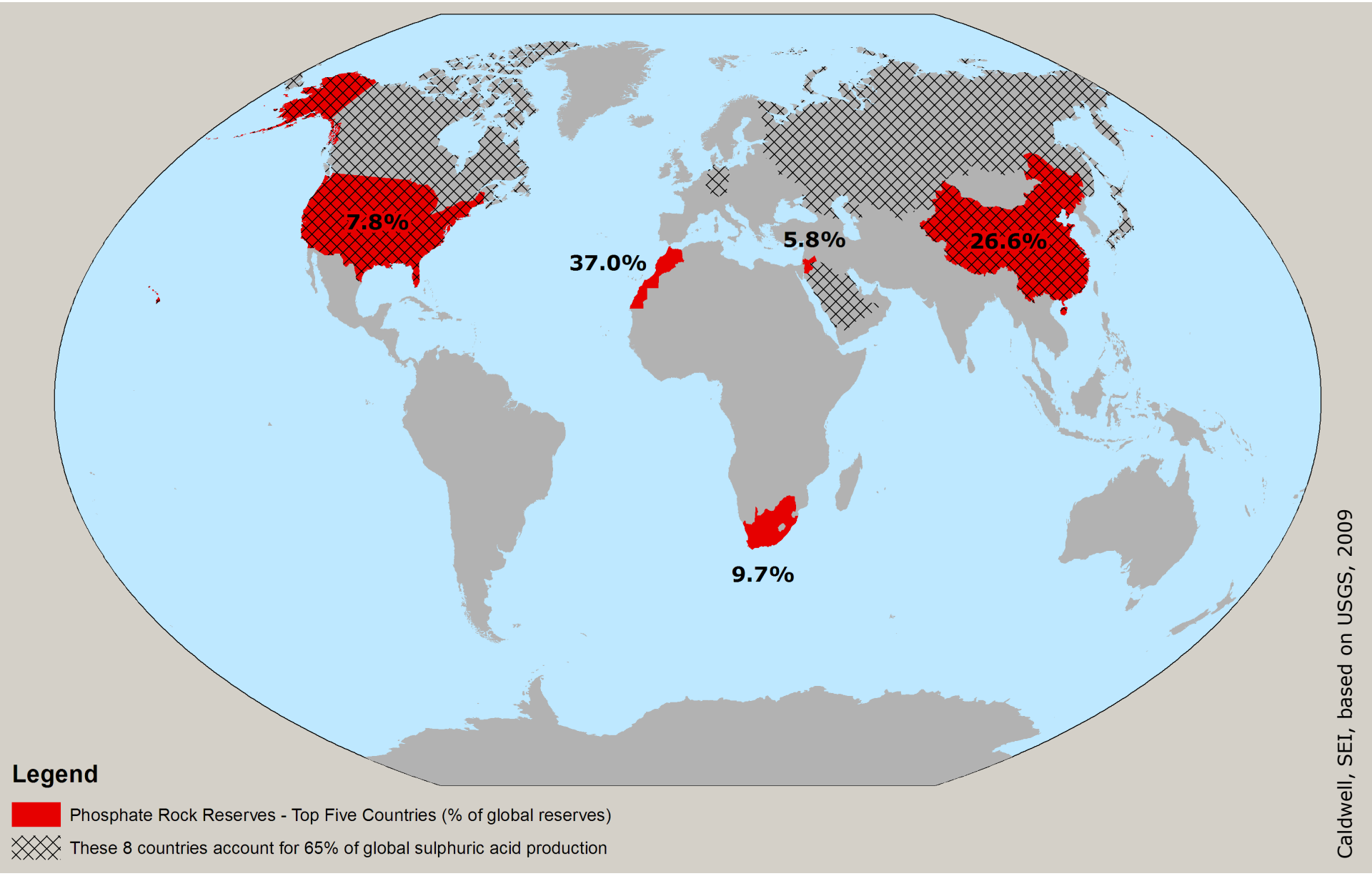
Trends in Global Fertilizer Use



Trend in Fertilizer Use in the EU

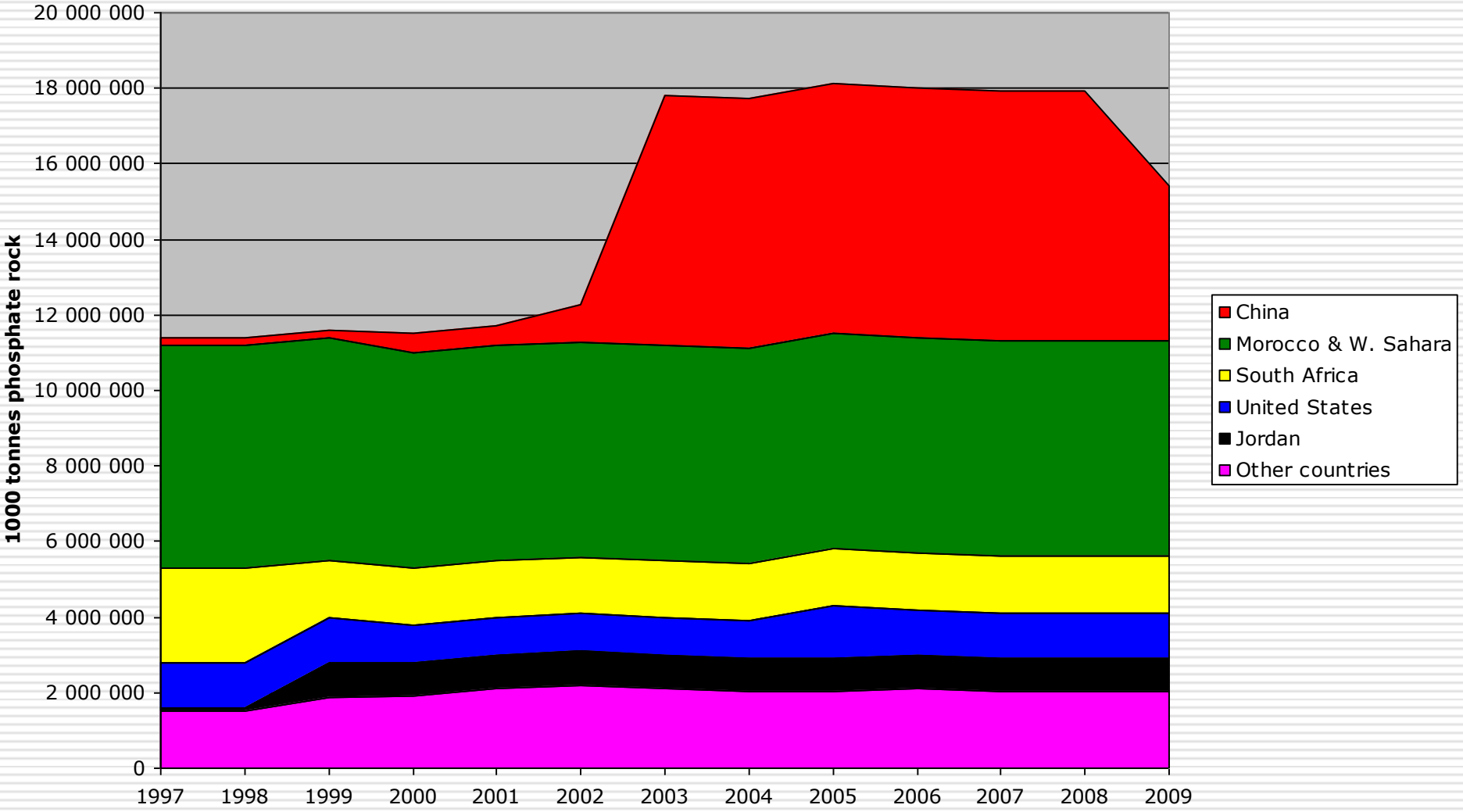


90% of the Phosphorus Reserves are in 5 Countries



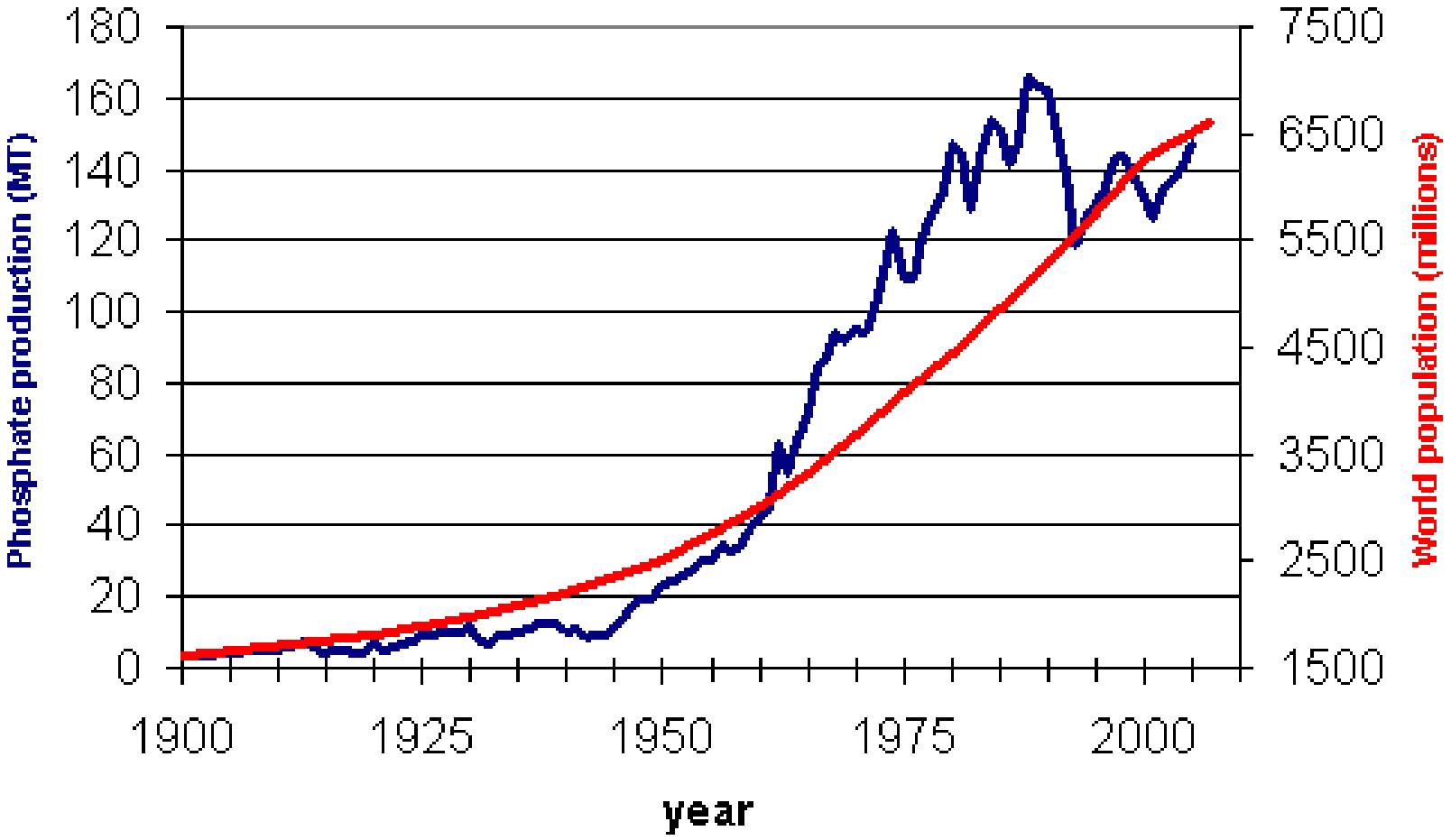
Sulfuric acid which is used in extracting the phosphorus is found in a limited number of countries as well, mainly in the north; so there are several geopolitical challenges ahead of us

Phosphate Rock Economic Reserves, 1997-2009
(from USGS summaries)

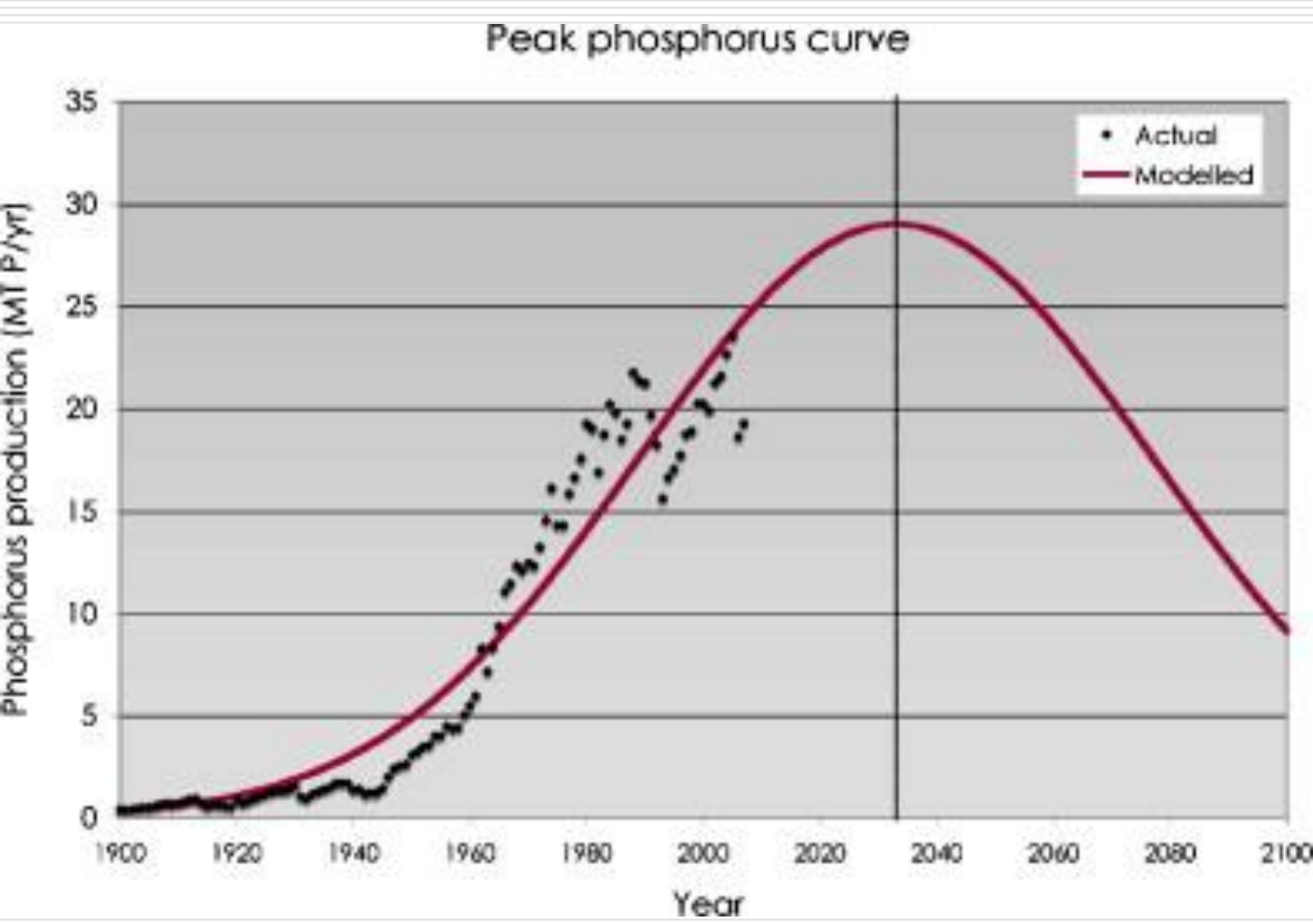


The definition of economic rock reserves is not standardised. China has changed the definition twice after joining the WTO in 2003. In 2009 they downgraded their economic reserve by 30%. There is a need for a world standard and global governance – still non-existent.

World rock phosphate production vs world population

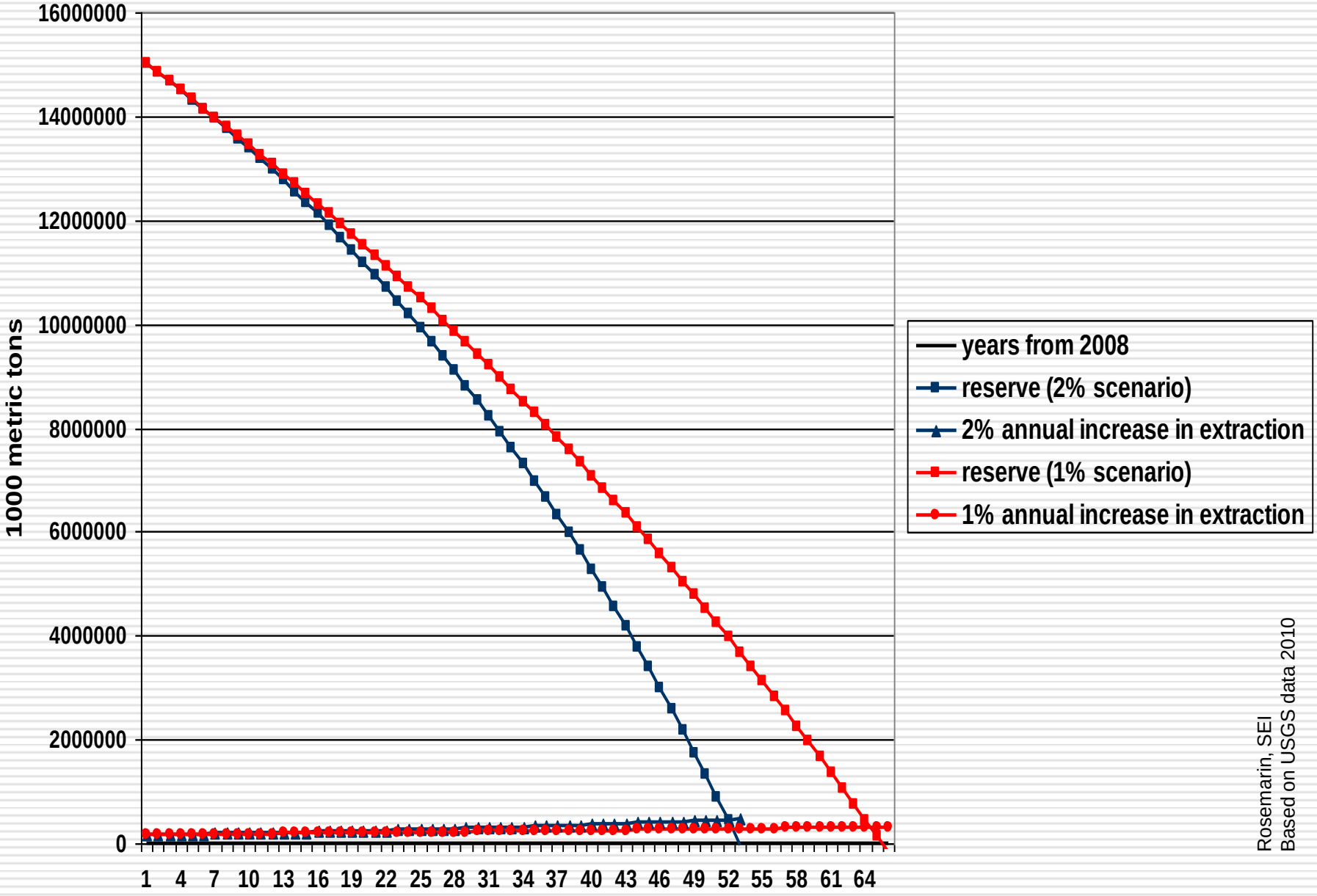


Vaccari, 2009



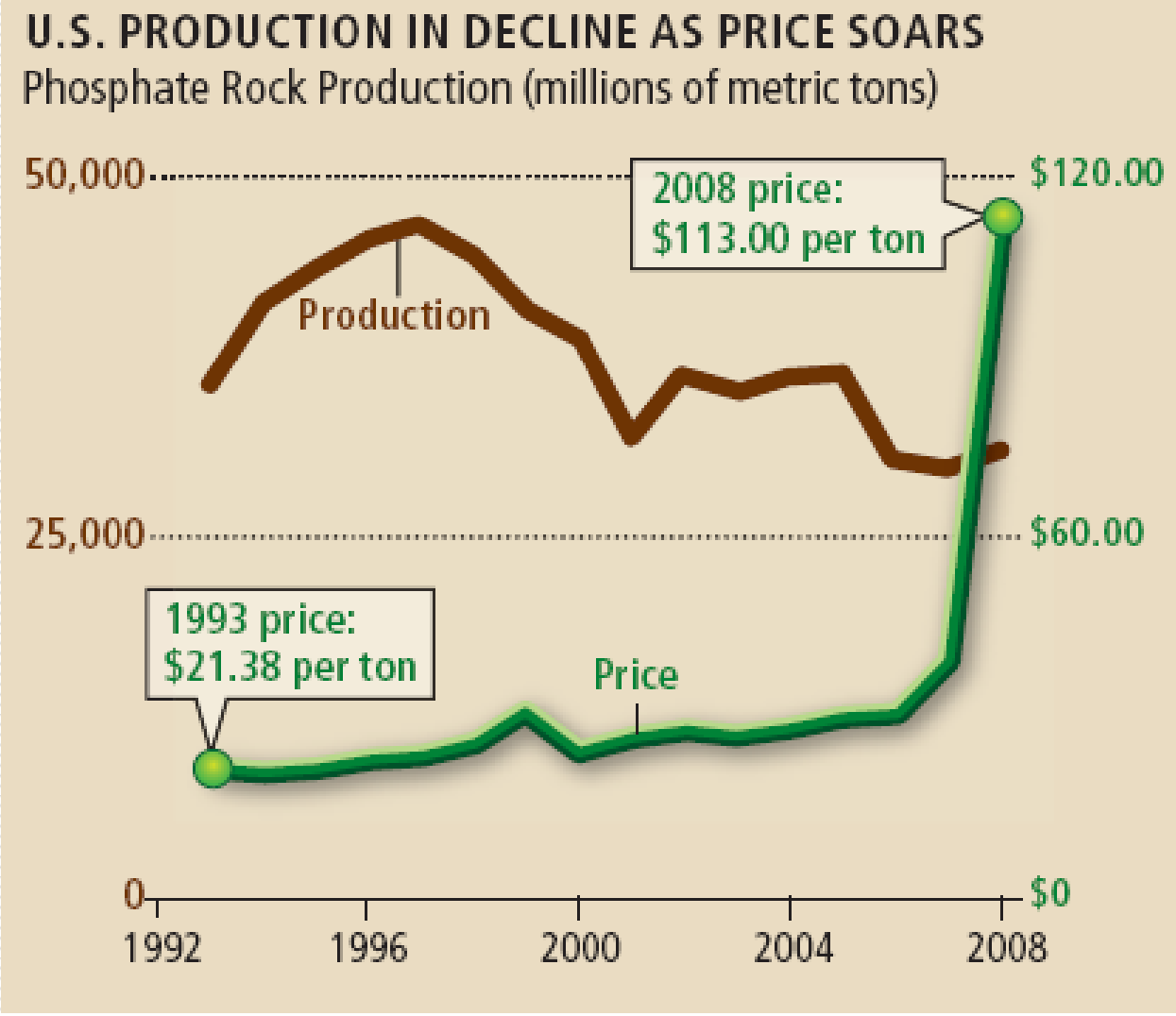
Cordell, 2009

Depletion of Global Economic Phosphorus Reserves



Rosemarin, SEI
Based on USGS data 2010

Phosphate Rock Production and Price Development
(Vaccari, 2009)



The experience of 2008 showed how volatile the phosphate prices can be, this time brought on by the biofuel market when oil was running at 140 USD per barrel; this created a global food security problem which only eased off with the Wall St crisis.

The Scenario Ahead

- the US will deplete its commercially-viable reserves within 25-30 years
- the global reserves at present extraction rates will last less than 75 years
- phosphorus production from rock could peak by 2030 – after which demand will exceed supply
- 90% of the reserves are in 5 countries (geopolitical insecurity)
- as fertilizer prices rise, falling farm output and growing food insecurity are likely to provide challenges for which the world is unprepared
- so far UN agencies, governments and international NGOs have failed to acknowledge, let alone respond to the problem

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Challenges Ahead

- efficiency of extraction is 50% to 70% and needs to be increased
- efficiency of use: 17 Mtons of P are produced per year for fertilizer and only 20% ends up in foodstuffs and most is not recycled
- agricultural reforms
  - reduce livestock density to avoid accumulation of P in feedlot areas
  - erosion and runoff control to reduce P loss
  - reduction of over application of P fertilisers
- recovery and reuse of phosphorus from organic waste sources
  - animal manure
  - human excreta and ”biosolids” from sanitation systems
  - household organics (green bag programmes)
  - other organics from solid waste
- necessary changes in food consumption including less beef
- slash and burn practices to mineralize the bound P in agrosoils will cause significant air pollution and even global cooling

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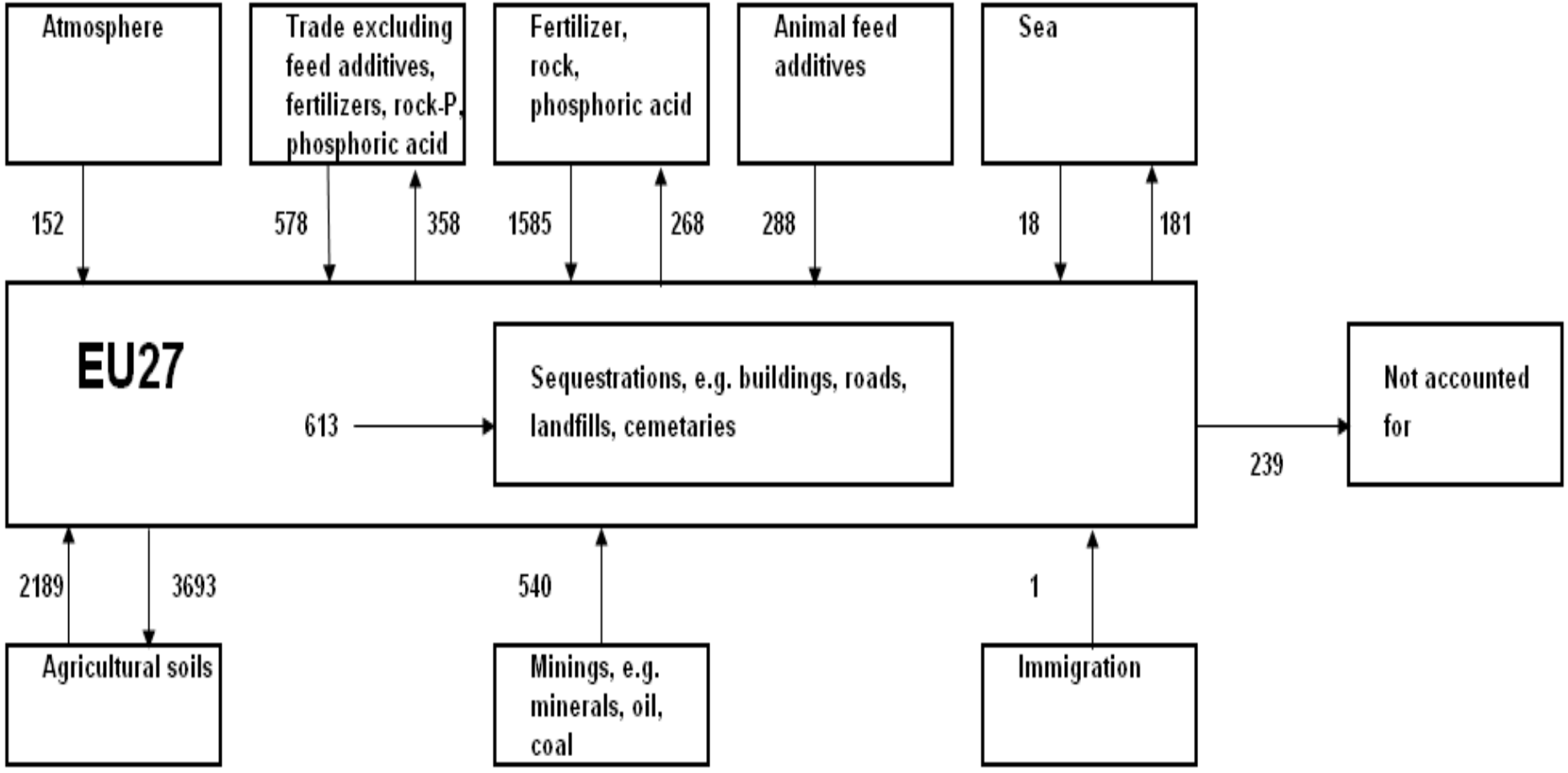
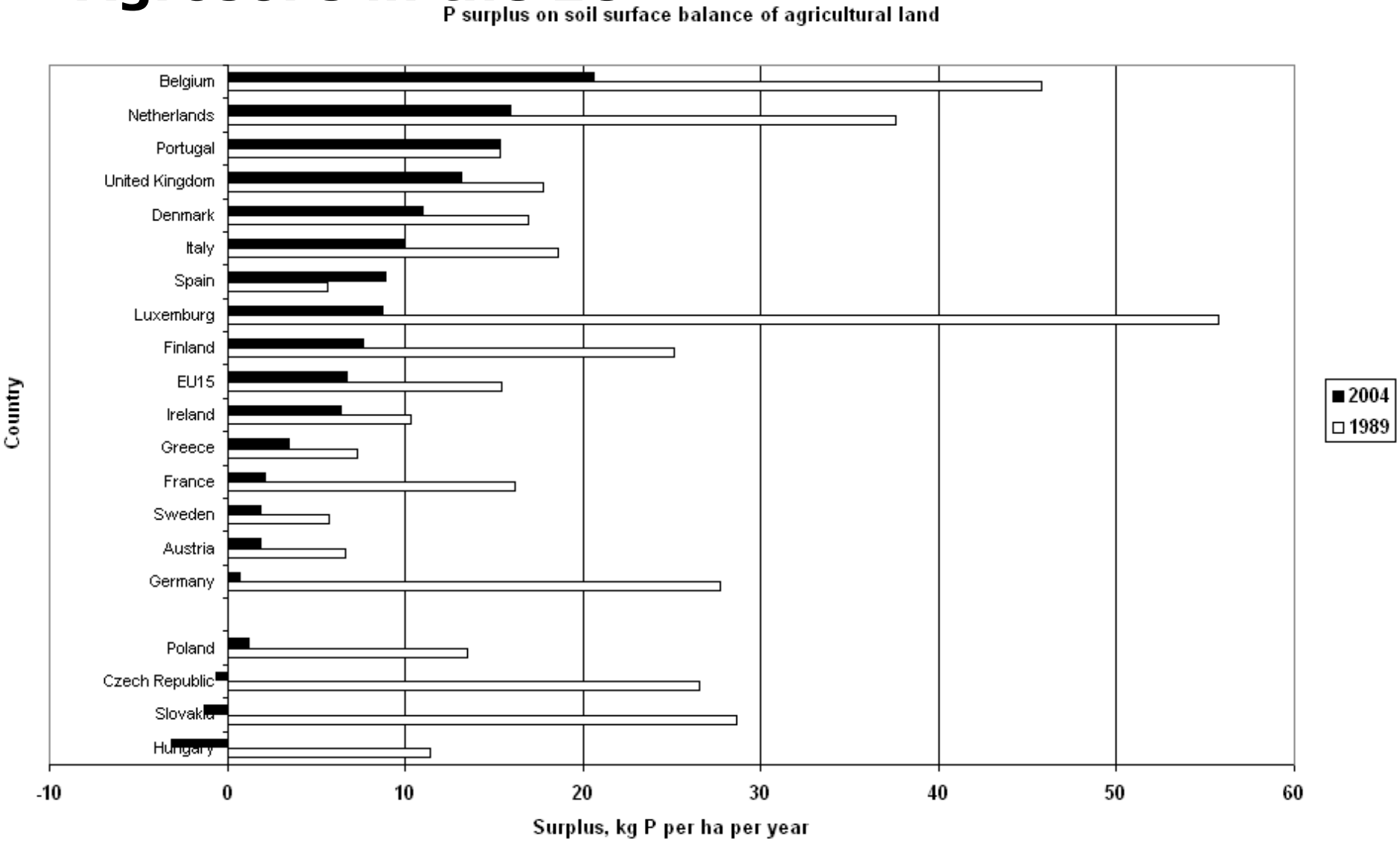
EU: A Net Importer of Phosphorus in Feed, Feedstock and Fertilizer



Schröder and Smit (after Richards & Dawson, 2008)

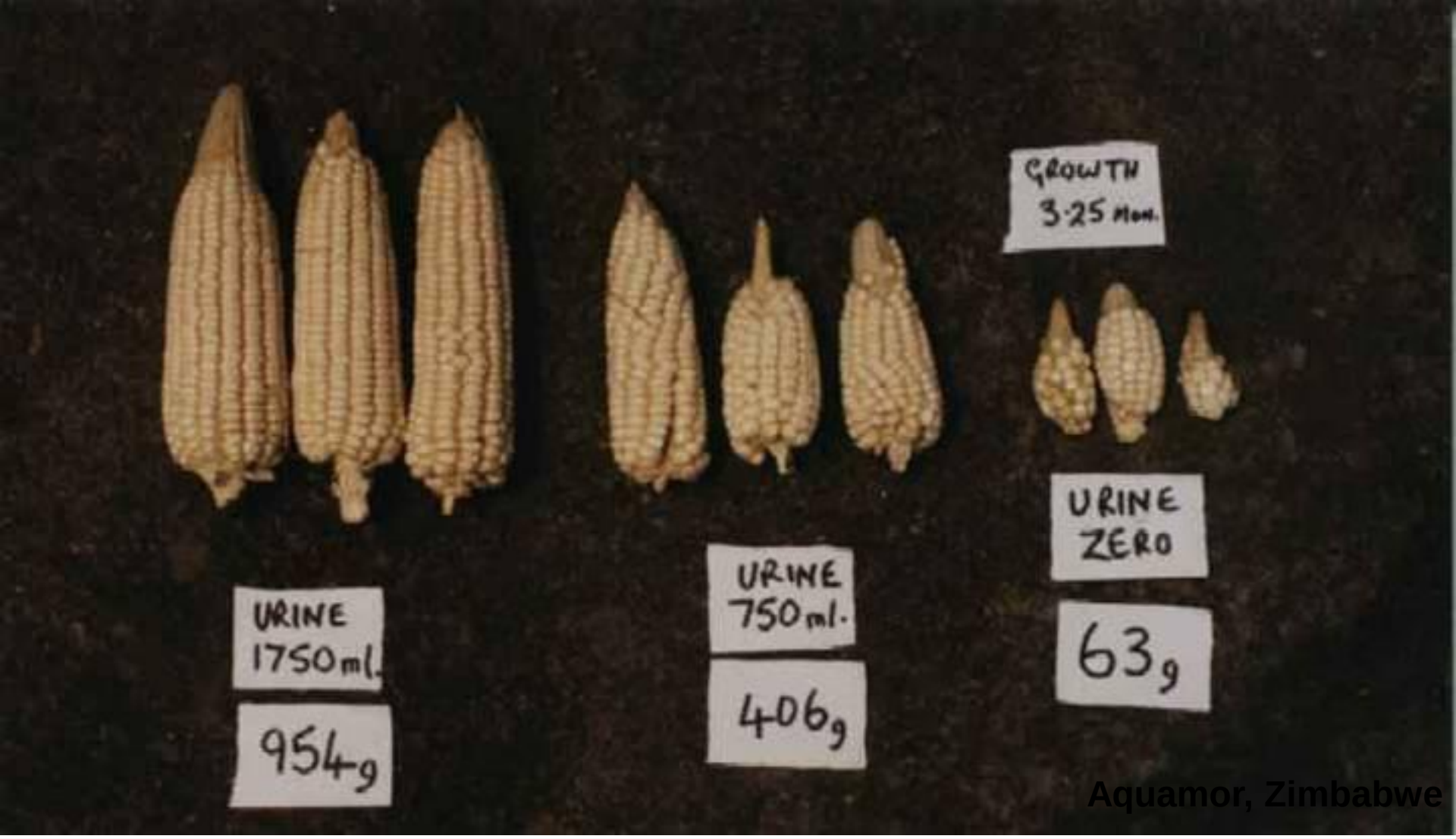
Accumulation Rate of P in Surface Agrosoils in the EU



EU 15 is still accumulating

Schröder and Smit, 2009

Thermal compost chambers (each 6 m^3)
in onsite plant at Erdos – 35 day cycle that reaches 55-60°C.



One day's urine from an adult produces a kilo of food (Aquamor, Harare)

Potential to Recycle P in the EU

- EU uses 1.34 M tonnes of phosphorus each year mainly as fertilisers
- the animal manure produced each year in the EU contains around 1.6 M tonnes of phosphorus
- 2005, the EU produced at least 9.4 M tonnes of dry solids from sewage sludge, from which about 0.3 M tonnes of phosphorus and other nutrients could have been retrieved
- if fully implemented, the EU Urban Wastewater Treatment Directive could probably double the potential P recovery from STPs

- Haarr (2005)

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Recycling Phosphorus from Sludge in the EU

- 10 million tons DS produced by EU26
- 36% (3.7 M tons) is being recycled back to agriculture
  - France 58%
  - Germany 50%
  - Netherlands 0%
  - Denmark 59%
  - Italy 18%
  - Sweden 20%
  - Ireland 63%
  - Portugal 46%
  - Spain 65%
  - UK 68%
- Germany P recycling from sewage treatment plants will increase the running costs only 2-5%

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Cadmium Levels

- Natural contaminant in sedimentary apatite rock
- human urine contains 1 mg Cd/kg P
- chemical fertiliser in EU contains 2-15 mg Cd/kg P
- German regulations legal limit for use of sludge on agrolands 16-17 g Cd/ha/yr
- Morocco phosphate rock contains 60 mg Cd/kg P_2O_5 or 14 mg Cd/kg P
- EU Commission discussing three classes of fertiliser (60, 40 and 20 mg Cd/kg P_2O_5)
- Sweden avg sludge contains 37 mg Cd/kg P (aim is to reduce this to 17 on the avg by 2025

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Recent Developments

- Conferences in 2009 on wastewater and sewage sludge reuse of phosphorus in Vancouver in May and Berlin in September
- Article on peak P in Scientific American by David Viccari - June 2009 (one more coming in 2010)
- EU first project on sustainable use of phosphorus – Wageningen Univ and Stockholm Environment Institute - 2010
- Formation of the GPRI Task Force – researchers from Australia, Sweden, Netherlands, Canada, UK - August 2009
- Article on peak P in Nature by Natasha Gilbert in October 2009

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Recent Developments (cont'd)

- First PhD thesis on peak phosphorus - Cordell (Sydney Univ and Linköpings Univ) Feb 2010
- IFA-IFDC industry study on peak phosphorus announced in January 2010
- Phosphates 2010 industry conference in Brussels March 22-24, 2010 – first public discussion on peak P by industry
- Sustainable Phosphorus Initiative (Arizona State Univ 2010)
- Work of the US committee on peak phosphorus has become classified and not available to the public by the Dept of Trade and Commerce

Suggested Next Steps

- International task force
- White paper laying out the facts
- Communications and awareness
- International commission
- Global convention

- **But there is no established funding yet available for this work**

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www.sei-international.org
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