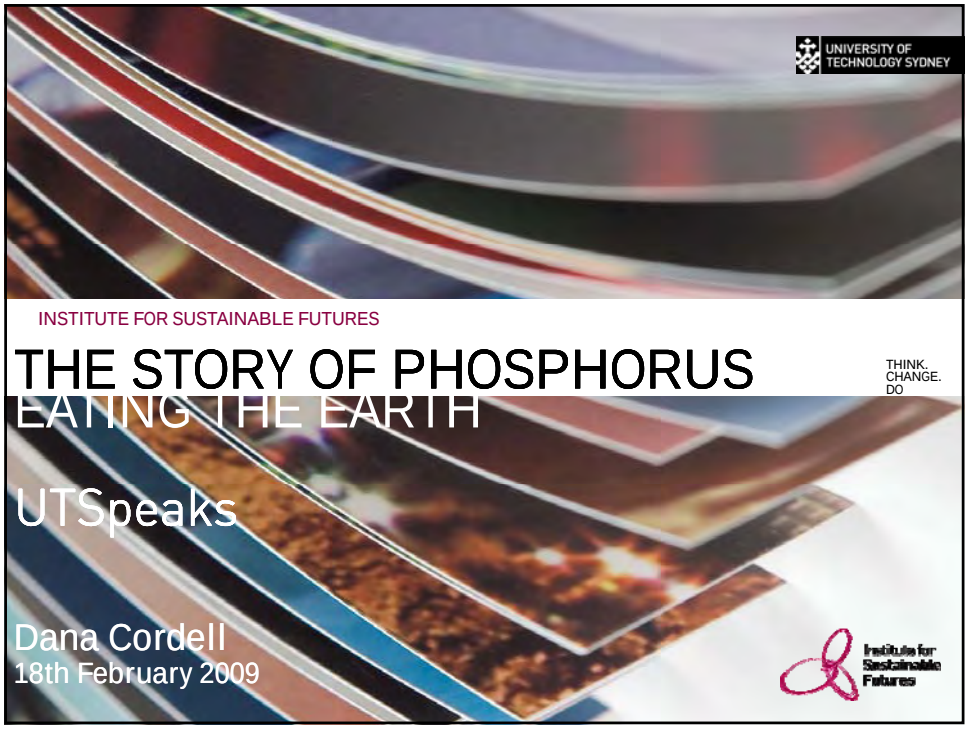
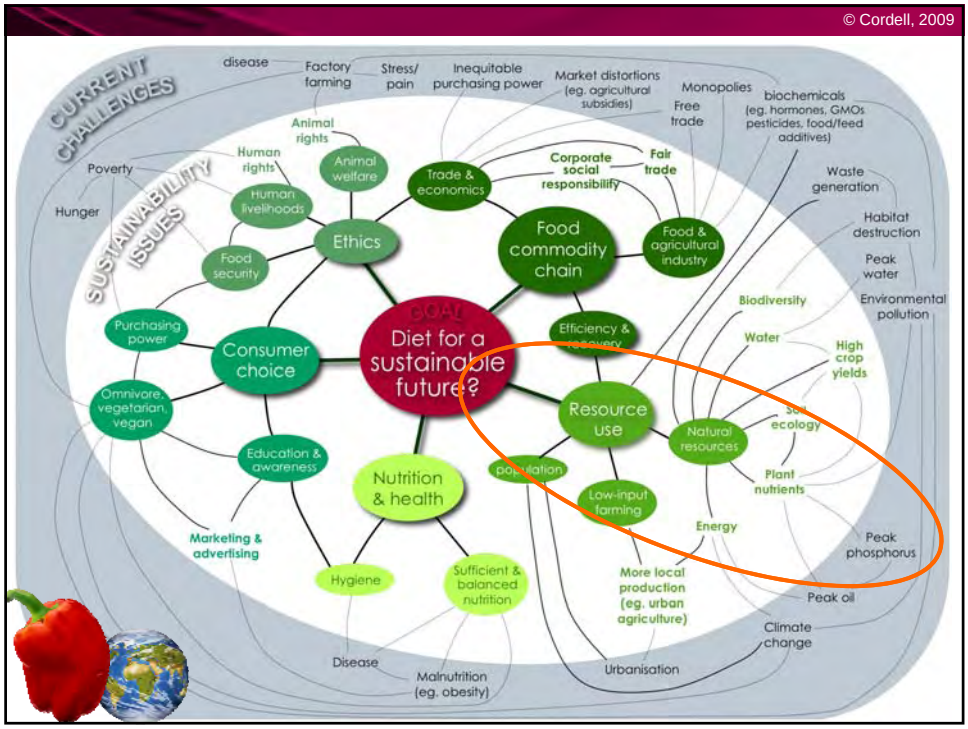

UNIVERSITY OF TECHNOLOGY SYDNEY
INSTITUTE FOR SUSTAINABLE FUTURES
THE STORY OF PHOSPHORUS
THINK. CHANGE. DO
EATING THE EARTH
UTSpeaks
Dana Cordell
18th February 2009
Institute for Sustainable Futures


© Cordell, 2009
CURRENT CHALLENGES
SUSTAINABILITY ISSUES
disease
Factory farming
Stress/ pain
Inequitable purchasing power
Market distortions (eg. agricultural subsidies)
Monopolies
Free trade
biochemicals (eg. hormones, GMOs pesticides, food/feed additives)
Animal rights
Human rights
Poverty
Hunger
Animal welfare
Human livelihoods
Food security
Ethics
Trade & economics
Corporate social responsibility
Fair trade
Food commodity chain
Food & agricultural industry
Waste generation
Habitat destruction
Peak water
Environmental pollution
Biodiversity
Water
High crop yields
Soil ecology
Natural resources
Plant nutrients
Energy
Peak phosphorus
Peak oil
Climate change
Urbanisation
More local production (eg. urban agriculture)
Low-input farming
Resource use
Efficiency & recovery
GOAL
Diet for a sustainable future?
Purchasing power
Consumer choice
Omnivore, vegetarian, vegan
Education & awareness
Marketing & advertising
Nutrition & health
Hygiene
Sufficient & balanced nutrition
Disease
Malnutrition (eg. obesity)

THE STORY OF PHOSPHORUS

All living things require phosphorus to grow

energy?

ethical ?

chemicals?

geopolitical?

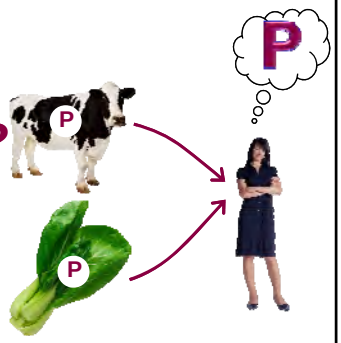
pollution?

future availability?

waste?

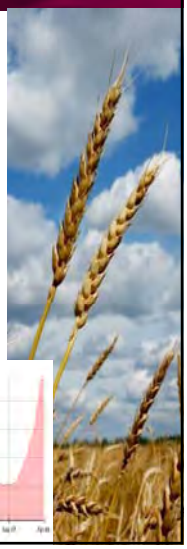
cost-effective?

sustainable?

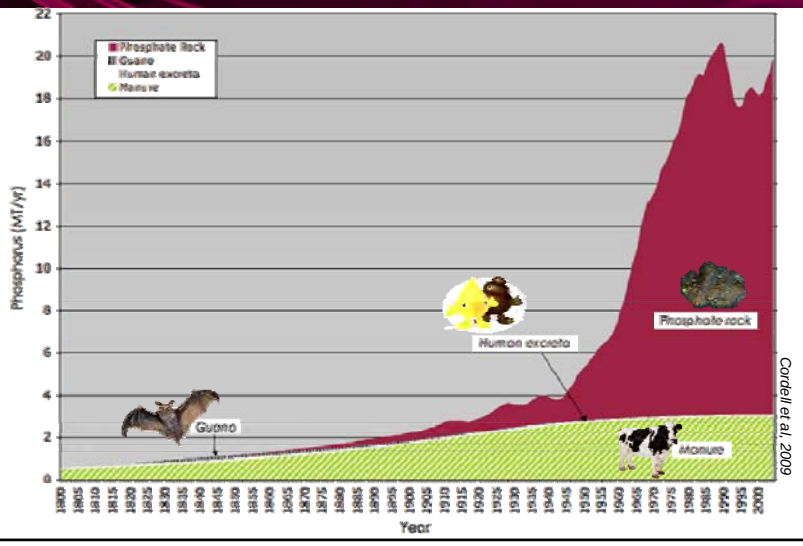


BACKGROUND: THE CURRENT SITUATION

- > Chemical fertilizers (N,P,K) have contributed to feeding billions by boosting crop yields
- > Today, modern agriculture is dependent on continual inputs of phosphate rock as fertilizer to sustain high yields
- > Phosphate rock is a non-renewable resource and current global reserves depleted in 50-100 years
- > 90% of mined phosphate rock for food production
- > long-term: increased P demand because:
  - increased population & demand for f
  - Increased meat-based diets (eg. Chi
  - Increased biofuel demand
- > short term price rise in 2007-08: US$50/tonne to US$400/tonne

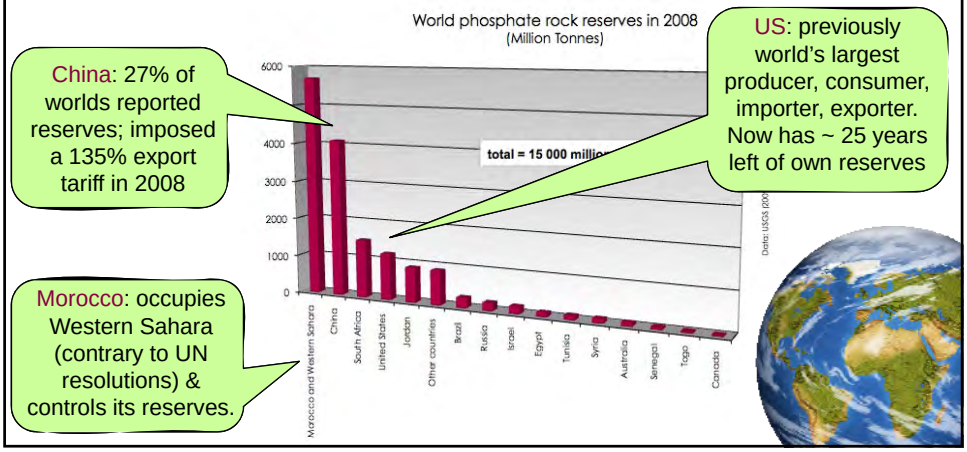


HISTORICAL GLOBAL SOURCES OF P FERTILIZERS



PHOSPHATE ROCK: REMAINING RESERVES

> All farmers need phosphorus, yet just 5 countries control around 90% of the worlds remaining phosphate rock reserves



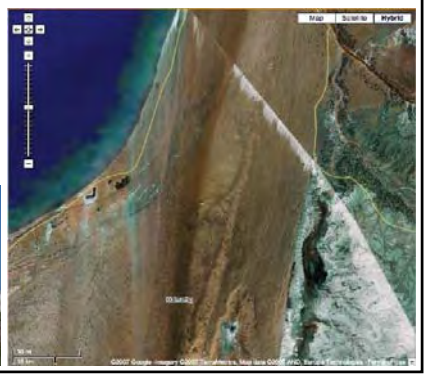
PHOSPHATE ROCK: ENVIRONMENTAL COSTS

> Mining, processing and transport (ocean freight) is energy intensive - 30 million tonnes transported each year

> every tonne of phosphate generates 5 tonnes of radioactive phosphogypsum waste (stockpiled)

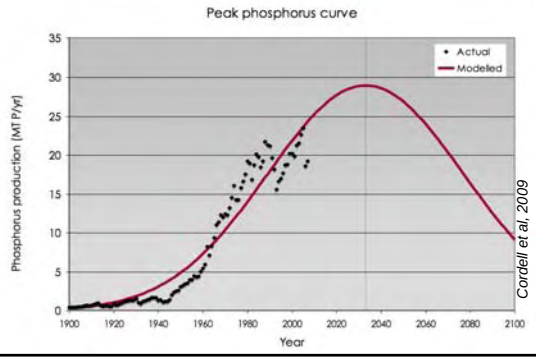
> Phosphate rock is naturally radioactive, yet accepted in organic agriculture

www.epa.gov

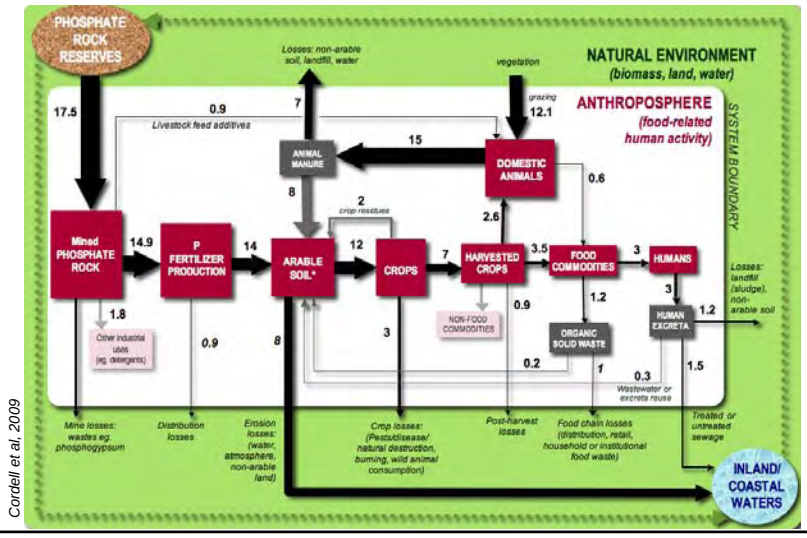


PEAK PHOSPHORUS

- Like oil, P rock is finite resource and will reach a production peak - estimated peak P around 2030
- No alternatives on market today could replace demand for P rock: significant institutional and physical infrastructure will be required
- Timing of peak uncertain, but industry recognises:
  - quality is declining;
  - costs increasing;
  - environmental impacts (eg energy, Cadmium, phosphogypsum)



PHOSPHORUS FLOWS THROUGH GLOBAL FOOD PRODUCTION & CONSUMPTION SYSTEM



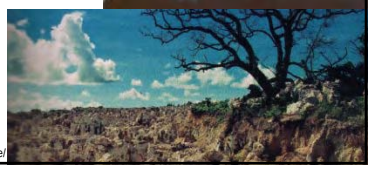
Cordell et al, 2009

THE AUSTRALIAN STORY OF PHOSPHORUS

> Naturally phosphorus-deficient soils

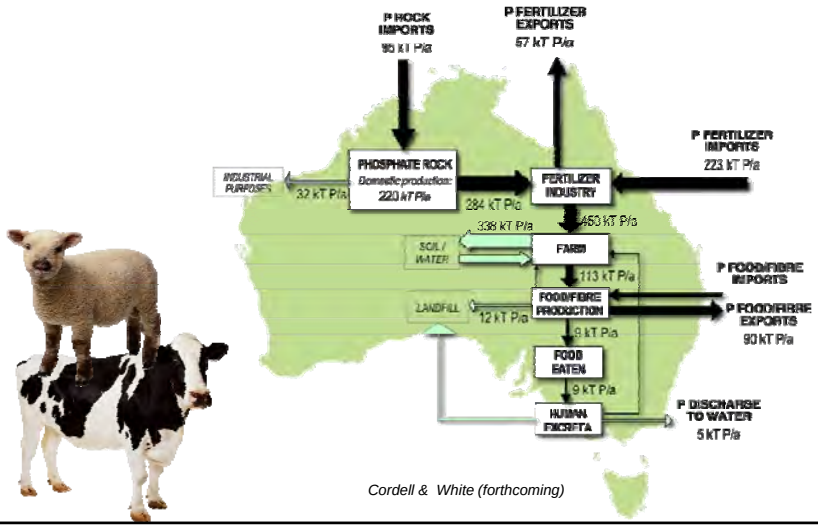
> Simultaneously invested heavily in ‘phosphorus intensive’ agricultural export industries like beef, wheat, wool

- High crop yields the past century made possible by mining phosphate-rich guano on Nauru



www.janeresture.com/nauru_home/

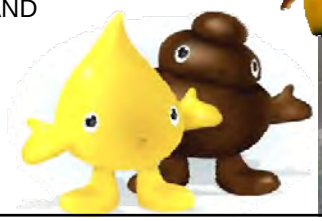
PHOSPHORUS FLOWS THROUGH THE AUSTRALIAN FOOD PRODUCTION AND CONSUMPTION SYSTEM



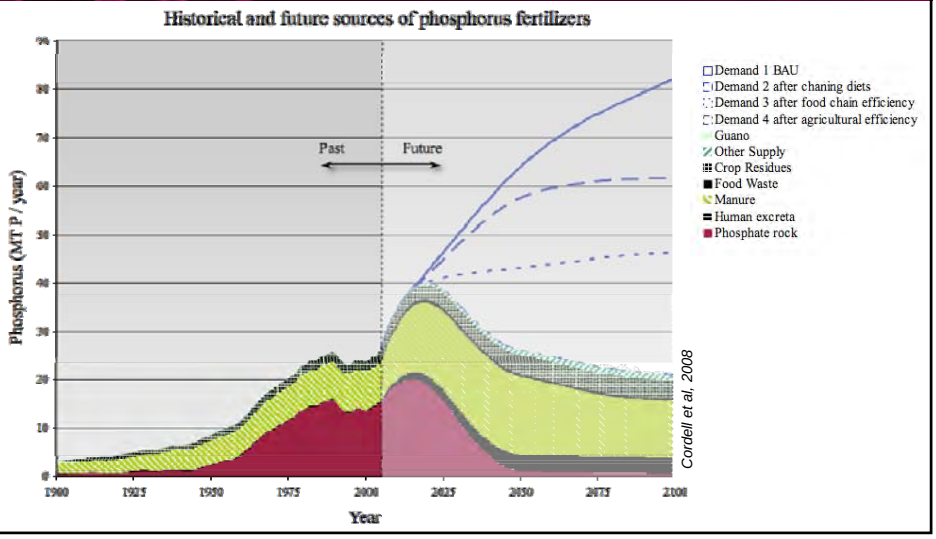
Cordell & White (forthcoming)

WHAT CAN WE DO?

- The good news is, unlike oil, phosphorus can be recovered once used:
  - Reuse crop residues, food waste (eg. supermarkets & household bins), excreta (pee and poo)
- Reduce the demand for phosphorus:
  - Efficiency in agriculture, food production, less 'phosphorus-demanding' diets
- Look for synergies – eg. from raw sewage we can get biogas energy AND use sludge as fertilizer
- Create healthy soils and 'unlock' phosphorus in agricultural soil?



PREFERRED FUTURE PHOSPHORUS SCENARIOS



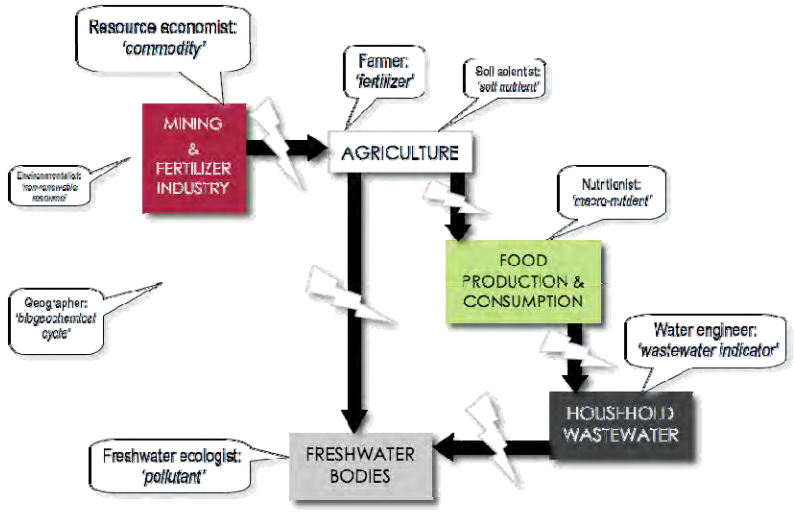
PHOSPHORUS SCARCITY: WHO'S RESPONSIBILITY?

> Unlike water and energy, phosphorus scarcity is not on priority agenda within key discussions on global food security (eg. UN FAO)

> Currently no intentional and coordinated global governance of phosphorus:

eg. no international policies, regimes, guidelines or organisations responsible for securing long-term availability of phosphorus for food production

PHOSPHORUS SCARCITY: WHO'S RESPONSIBILITY?

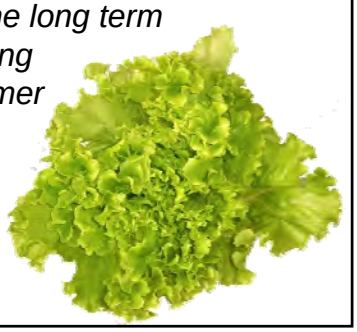


PHOSPHORUS SECURITY: A NEW GLOBAL GOAL?

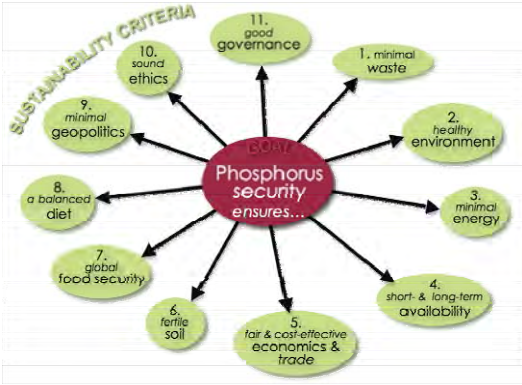
> We talk about global food security, water security, energy security, why not phosphorus security?

Phosphorus security:

How can we ensure all the world's farmers have access to sufficient phosphorus in the long term to grow enough food to feed a growing world population, while ensuring farmer livelihoods and minimising environmental and ethical impacts?



FROM PHOSPHATE SCARCITY TO PHOSPHORUS SECURITY



SUMMARY: THE TAKE HOME MESSAGES (1)

- Phosphorus is vital for all life on earth – no substitute!
- Chemical phosphorus fertilizers have been responsible for feeding the world
- Today, substantial environmental, economic and ethical concerns means we need to reconsider how we source and use phosphorus for food production.
- Peak phosphorus within decades, remaining phosphate rock low quality and high cost
- Substantial phosphorus losses => increase efficiency & recovery, consider changing diets
- Consider local and renewable sources of phosphorus too – including pee and poo!

SUMMARY: THE TAKE HOME MESSAGES (2)

- No coordinated, equitable and timely governance of global phosphorus resources for food security ∴ international market by default
- Need to integrate phosphorus security into international discussion on global food security
- Continue a national discussion on implications for Australia, and what policy, infrastructure and social changes would need to occur?
- Look for synergies that can simultaneously address phosphorus scarcity, pollution, climate change, water scarcity, peak oil etc.

GLOBAL PHOSPHORUS RESEARCH INITIATIVE

For more information visit:

www.phosphorusfutures.net
or
www.isf.uts.edu.au

or email: Dana.Cordell@uts.edu.au

THANK YOU!

GPRI PUBLICATIONS

Most publications available for download on the Global phosphorus Research Initiative website: www.phosphorusfutures.net:

Cordell, D., Drangert, J-O. and White, S., *The story of phosphorus: Global food security and food for thought.* Global Environmental Change (2009), doi:10.1016/j.gloenvcha.2008.10.009

Cordell, D., Neset, T. S. S., Drangert, J.-O. & White, S. (in press), *Preferred future phosphorus scenarios: A framework for meeting long-term phosphorus needs for global food demand,* International Conference on Nutrient Recovery from Wastewater Streams Vancouver, 2009. Edited by Don Mavinic, Ken Ashley and Fred Koch. ISBN: 9781843392323. Published by IWA Publishing, London, UK.

Cordell, D. and White, S. (2008), *The Story of Phosphorus: Sustainability implications of global fertilizer scarcity for Australia.* Discussion paper prepared for the National Workshop on the Future of Phosphorus, Sydney, 14th November 2008, Institute for Sustainable Futures, University of Technology, Sydney.

Cordell, D. (2006), *Urine Diversion and Reuse in Australia: A homeless paradigm or sustainable solution for the future?,* Masters Thesis, Department of Water and Environmental Studies, Linköping University, Sweden.

Drangert, J-O. (1998) *Fighting the urine blindness to provide more sanitation options.* Water SA Vol 24, No 2.

Neset, T-S S, Bader H-P, Scheidegger R, Lohm U (2008), T*he Flow of Phosphorus in Food Production and -Consumption 1870-2000.* Science of the Total Environment. Vol. 396:1-2. p.111-120

Neset, T-S S. and Andersson, A. (2008), *Environmental impact of food production and consumption – from phosphorus leakage and resource depletion to recycling, i*n Water for Food, p.99-108, Editor: Jonas Förare, The Swedish Research Council Formas

OTHER RESOURCES

European Fertilizer Manufacturers Association, (2000), *Phosphorus: Essential Element for Food Production. European Fertilizer Manufacturers Association (EFMA), Brussels.*

Jasinski, S.M.,(2008), Phosphate Rock, Statistics and Information. US Geological Survey.

Jönsson, H (2001), *Urine separation - Swedish experiences, SLU, Swedish University of Agricultural Sciences, EcoEng Newsletter 1, October 2001*

Pfeiffer, D.A.,(2006), *Eating Fossil Fuels: Oil, Food and the Coming Crisis in Agriculture,* Canada: New Society Publishers.

Rosmarin, A.,(2004), The Precarious Geopolitics of Phosphorous Down to Earth (Science and Environment Fortnightly), (June 30, 2004): p. 27-31

SIWI-IMWI (2004), *Water - More Nutrition Per Drop, Towards Sustainable Food Production and Consumption Patterns in a Rapidly Changing World. Stockholm International Water Institute, Stockholm.*

SEI (2005), *SustainablePathways to Attain the Millennium Development Goals - Assessing the Role ofWater, Energy and Sanitation, For the UN World Summit September2005, Stockholm Environment Institute (September 2005)*

Smil, V.,(2000), *Phosphorus in the Environment: Natural Flows and Human InterferencesAnnualReview of Energy and the Environment, 25: p. 53-88.*

WHO, (2006),Guidelines for the safe use of wastewater, excreta and greywater, Volume 4:Excreta and greywater use in agriculture. World Health Organisation. Available from: http://www.who.int/water_sanitation_health/wastewater/gsuww/en/index.html