# The P- resource, status and opportunities for agriculture

The Phosphorus Challenge

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GABBS, Helsinki, 27 Aug 2013



(Our Nutrient World, 2012)

UNIVERSITY OF COPENHAGEN

### "Peak Phosphorus" – is it valid?

Will P resources be Depleted in 30, 100 or 400 years?

Peak phosphorus curve



## What is at stake?





- P essential for life –plant macro nutrient growth and essential for food production
- Excessive P loads also leads to aquatic **eutrophication**
- But P minerals are a scarce resource and reserves are limited



 The "Peak P" metaphor indicates imminent depletion
– but is it true?

## What is at stake?





- Ethics paradox of inequality:
- Africa is world largest producer of rock P and at the same time the continent with the lowest P use and largest deficit in food security !
  Africa is world largest producer we have A Right To FooD. Not To Phosphoros.



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#### Global drivers Increased and changing demand for food



#### Global drivers Increasing demand for bioenergy



Source: Conway and Waage (2010), sourced from IEA data

#### Global drivers Intensive animal production = N&P surplus



#### Global drivers The worlds soils generally deficient in P...



#### Global drivers: Climate change will affect crop production

Change in yields of 11 major agricultural crops by 2050 given +2° C IPCC scenario



#### Resulting global driver: Increasing consumption of P fertilizer...



(Palliere, 2011; IFA Production and International Trade)

#### Resulting global driver: Increasing consumption of P fertilizer...

World Phoshpate demand in 2010 and 2020 Forecast by region (in MT P<sub>2</sub>O<sub>5</sub>) **North America East Asia** Europe +1.8% +1,4% 17.7 +1,1% 14,7 5,9 5,4 5,2 4,9 2010 2020 2010 2020 **South Asia** World's total 2010 2020 +1,1% +2,0% 10,1 55,6 Latin America Oceania 9,1 +3,2x% 45,7 +3,9% 1,7 1,2 9 6,1 2010 2020 2010 2020 2010 2020

Source: CRU Int. 2010

2010

2020

## Global P reserves and supplies

Phosphate Mining at SNPT (Societe Nouvelle des Phosphates de Togo) Licensed under CC-BY-SA by permission of the author, Alexandra Pugachevsky

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# Global P reserves are also geopolitics

Estimated world rock-phosphate reserves 2005 (USGS) Global total of ca. 16 bio ton



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### **Global P-Rock reserves**



USGS, 2013: Global total reserves 67 Gtons



### So is "Peak P" really valid? Depleted in 30, 100 or 400 years?



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### So is "Peak P" really valid? Depleted in 30, 100 or 400 years?



# Alternative scenarios towards global depletion of rock P reserves



Rosemarin et al 2011 International Fertilizer Society

## Increased rock P supply: potential mine developments



Source: C. Palliere 2011 / IFA Production and International Trade

### Cadmium Content of the Commercial Phosphate Rocks





## So will global P reserves be depleted and supplies stop?

- Yes, eventually 🛞
- But the time horizon is much longer than earlier anticipated (+50-400 y) ☺
- <u>Real</u> threats
  - **Geopolitical** monopoly supply, political destabilisation, food security
  - Environmental impacts pollution from mining, contaminants (cadmium and uranium) and losses from soils to the aquatic environment

#### Global Food Supply Chain: From Mine to Fork – huge P losses!



# No matter what – in the long term P use <u>efficiency</u> and <u>recycling</u> must increase



## **Agricultural P balance in EU**



#### **Recycling opportunities - The Danish example:**

Urban organic waste streams – how much P?



#### **Recycling opportunities - The Danish example:**

Urban vs. agricultural waste – much more P?



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#### Avenues towards change:



Joint declaration for the launch of a European Phosphorus Platform http://phosphorusplatform.eu/

March 2013

Janez Potočnik, European Commissioner for the Environment:

'Dealing with the Phosphorus Challenge today helps us save money tomorrow'

### The 'Nutrient Nexus'

Nutrient cycles represent a key nexus point between global economic, social and environmental challenges



# More triple-helix collaboration on technology and market development



# Conclusions and recommendations

#### Farmers and waste entrepeneurs:

- Balance P inputs, increase P use efficiency
- Improve animal manure and crop P(&N) management
- Increase P(&N) recycling develop new technologies

#### **Policy and decision makers**

 Create incentives for nutrient recycling developments
Remove regulatory barriers for innovation and implementation of new nutrient technologies
Ensure creation of market for recycled P products

## **Final remark**



#### Anything new under the sun?

#### Statesman quote:

"I cannot overemphasize the importance of phosphorus not only to agriculture and soil conservation but also to the physical health and economic security of the people of the Nation. Many of our soil types are deficient in phosphorus, thus causing low yields and poor quality of crops and pastures..."

#### Who said this?



#### FRANKLIN D. ROOSEVELT XXXII President of the United States: 1933-1945

64 - Message to Congress on Phosphates for Soil Fertility. May 20, 1938

#### P challenge related projects in my group at University of Copenhagen

Optimisation of value chains for biogas production in Denmark

#### The Danish Strategic Research Council

Combining the competences of the strongest research groups in Denmark

Integrated Resource Management and Recovery

THE IRMAR PROJECT

Resource Preservation by Application of BIOefFECTORs in European Crop Production



Recovery and Use of Nutrients, Energy and Organic Matter from Animal Waste



chain

**IMPROVE-P:** IMproved Phosphorus Ressource efficiency in Organic agriculture via recycling and Enhanced biological mobilization

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