ETH
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Been there, done that:
A short history of phosphorus scarcity

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This presentation is dedicated to the memory of Jean-Claude Fardeau

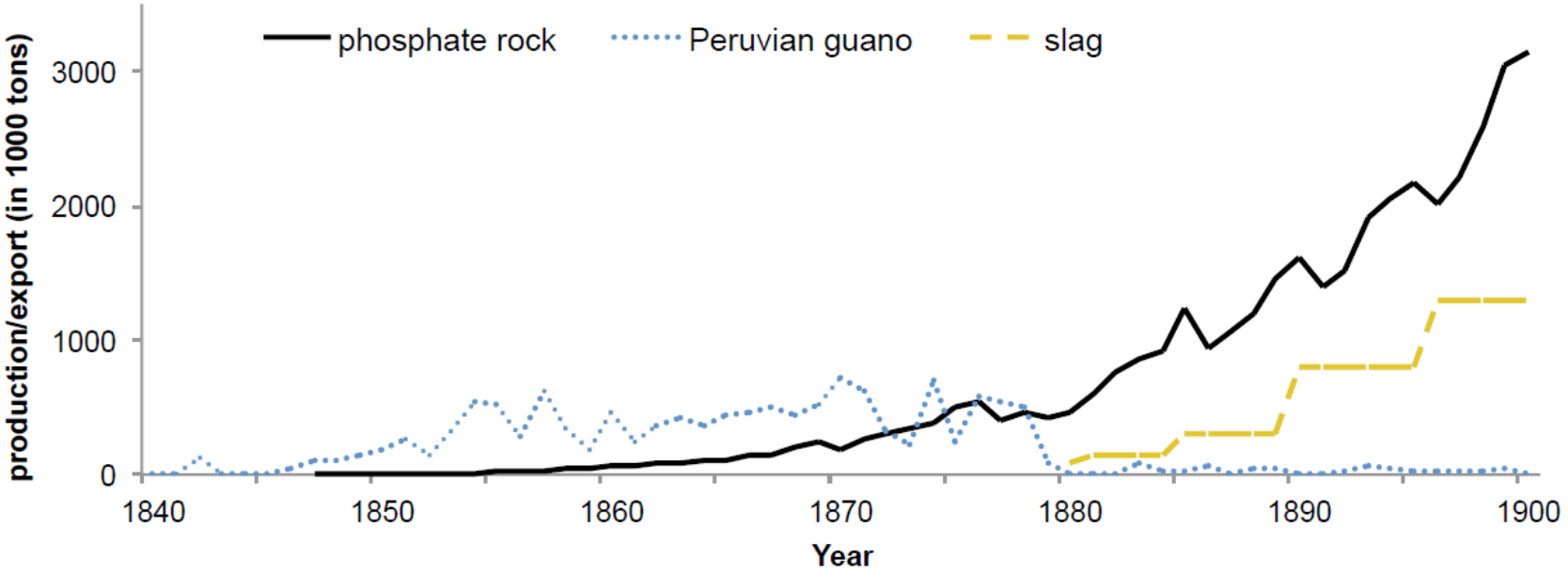
Why an historical look?

- Improving P management to sustainably meet of future needs is a key topic; the debate on P scarcity is therefore of utmost importance
- Few papers on P scarcity provide any historical insight
  → Is P scarcity a new topic?
- No it is not! → Anxieties on P scarcity started as soon as the essentiality of P for agricultural production was understood and then "peaked" several times
- Have we learnt something from these previous P crises ? That must be assessed as ignoring the past would pose the risks of:
  - using time/resources in a non-effective manner due to not considering the findings of the past
  - undermining our scientific credibility by supporting the misleading proclamation that "peak P" is a new scientific and policy issue

A discourse on guano/bone scarcity (Liebig, 1876)

- **The stock issue (amount/data quality):** 8.5 millions of tons of guano in Peru; there is no other guano deposit known; however this number is probably not very credible
- **The coming catastrophe:** This stock does not allow to feed the population (Europe/North America) for more than a few decades, so either new nutrient sources are found or we face a hunger catastrophe
- **The trade issue:** Great Britain is kidnapping a large fraction of the global bone and guano resources for its own agriculture
- **The efficiency issue:** With all these imports Great Britain should actually produce much more food, but large amounts of nutrients disappear in the newly installed water closets and are transferred to the rivers and the seas
- **The recommendation:** Recycling urine and feces from cities

Liebig's anxieties were relieved by the development of phosphate rock deposits and the apparition of Thomas slags from the steel industry



The rise of new phosphoric materials for fertilizer use: Peruvian guano exports, initial world phosphate rock, and world basic slag production (1840-1900)

(Ulrich and Frossard, 2014)

A discourse on phosphate rock scarcity in the U.S.: The Institute of Ecology/Emigh case (1972)

- **Concerns**
  - Known world supplies of phosphate rock will be exhausted before the end of the XXIst century; 200% increase in rock phosphate price between 1973 and 1975
- **Findings**
  - Man doubled the global flow of elements essential to life; It led to increased production and to excess loading in aquatic systems; Need for an institutional setting of “adequate prestige” so that world P use can be managed and P conserved
- **Recommendations**
  - Establish an international agency to advise regarding the prudent production, distribution, and use of the phosphorus resources of the world; Increase the recovery of P from mining activities

A discourse on phosphate rock scarcity: The Institute of Ecology/Emigh case (1972)

- **Recommendations** (continued)
  - Curtail the use of P for purposes other than fertilizer; Intensify the search for additional phosphate raw materials; Retrieve contaminants in phosphate rock as by-products; Decrease the overall use of phosphatic fertilizers; Develop methods of recovering phosphate released into the environment
- **Points of contention**
  - Use of incorrect figures for P reserves; P prospecting remained small; Lack of knowledge on the geology of phosphate; Low grade phosphate rock deposits not taken into account

Beside this case, two other were analyzed in the USA (in 1938/39, and in 1979)

Common trends emerging from scarcity discourses

1. P scarcity concerns can be attributed to presumed phosphate rock (PR) supply bottlenecks

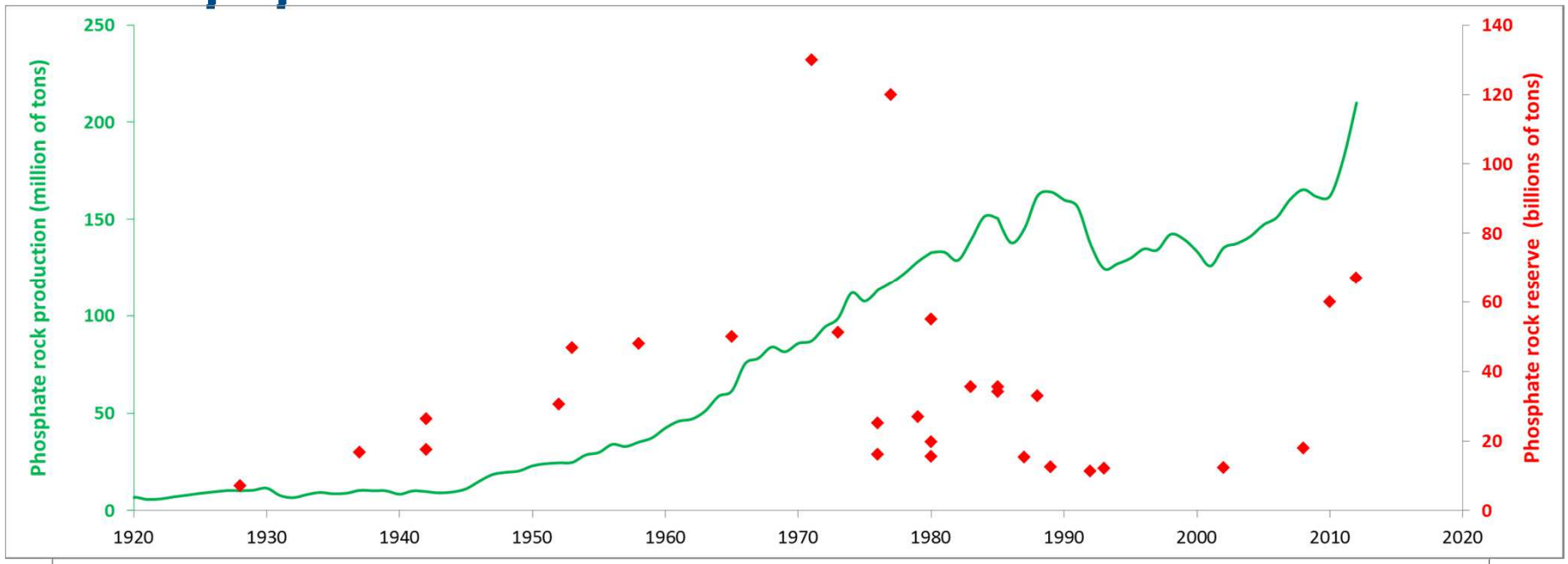
2. Concerns result in controversial/heated debates about the extent of global PR reserves, potential measures to secure availability and reduce externalities, and calls for policy intervention

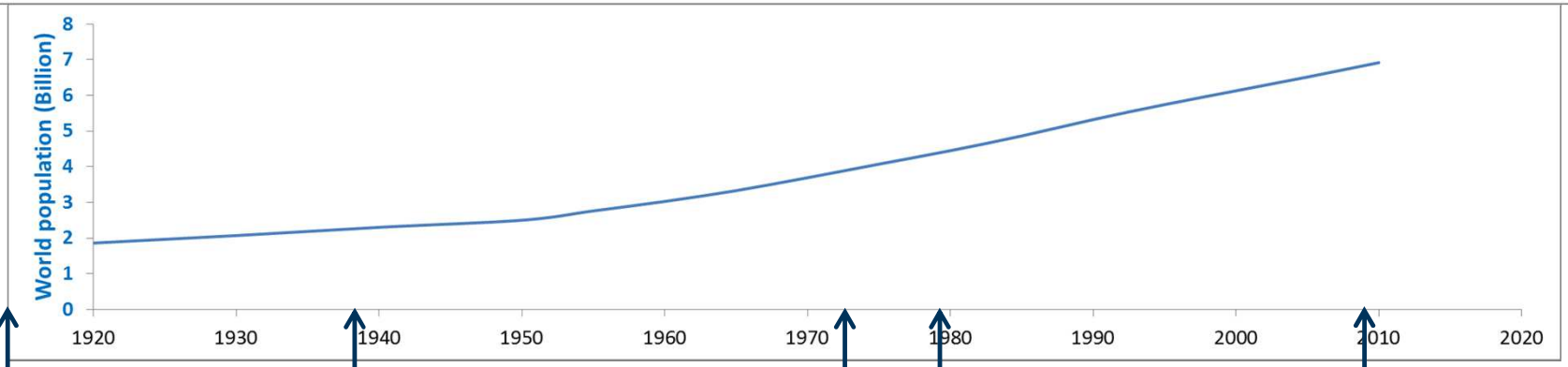
3. New data become available that prove reserves and resources to be larger than formerly anticipated

4. These new resource appraisals dispel depletion concerns

5. Because the danger of imminent PR shortage had been dispelled, additional suggested measures do not resonate further

World phosphate rock production, reserve estimates, world population and the P crises





Liebig P crisis

P crisis

P crises

P crisis

Conclusive statements

- This study is largely incomplete as it focused on U.S. debates
- But it shows that
  - P scarcity has been discussed regularly since 1850; this is not a new issue
  - Similar trends were observed in each case (including the dramatic tone and the focus on phosphate deposit)
  - What will be our next big deposits? Our wastes? (Liebig 1876)
  - In any case we must now address the problem in a global manner, and address beside the phosphate deposit also the issues of use efficiency, trade, distribution…

Ulrich A E, E Frossard, 2014. Science of the Total Environment, 490: 694–707

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Invitation for contributions – Call for papers

Science of the Total Environment - Special Issue on Sustainable Phosphorus

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