

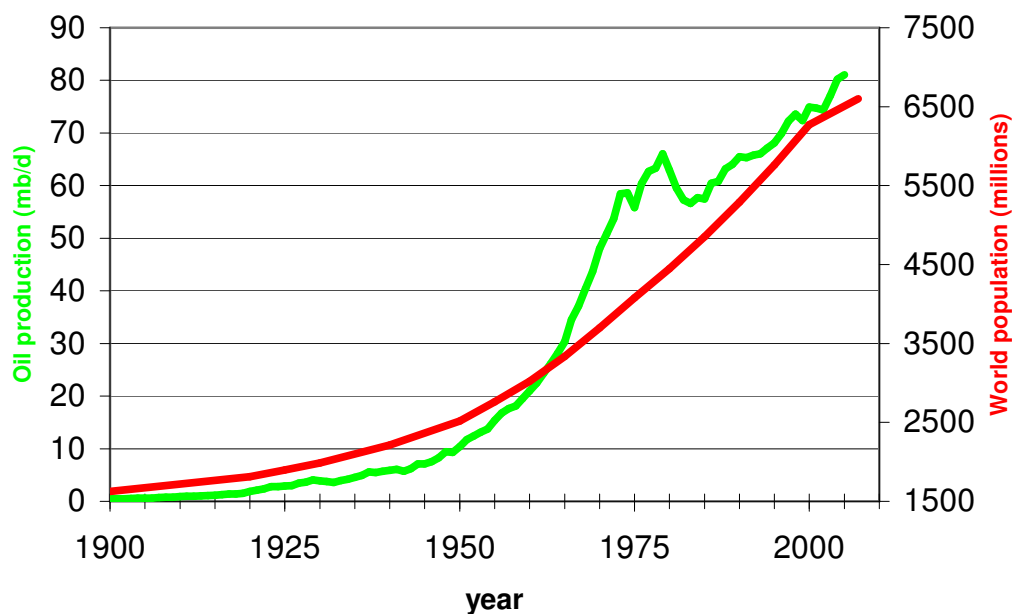
Phosphorus and population

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There is a widespread idea that oil is turned indirectly to food in our society (1). It's true that agriculture uses a lot of oil and gas to produce food with heavy yield. We just have to plot data of world population versus world oil production to see that there is a strong correlation between both.

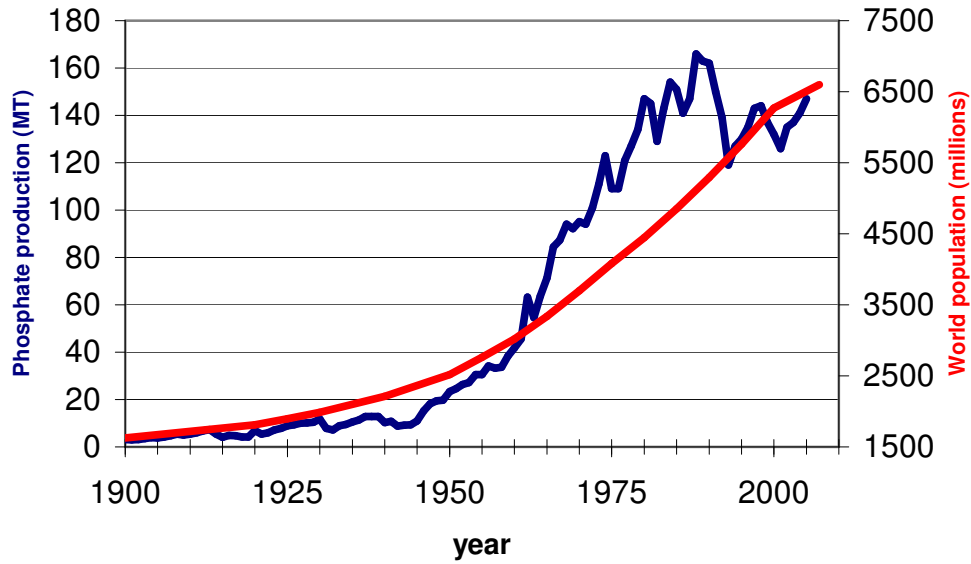
World oil production vs world population



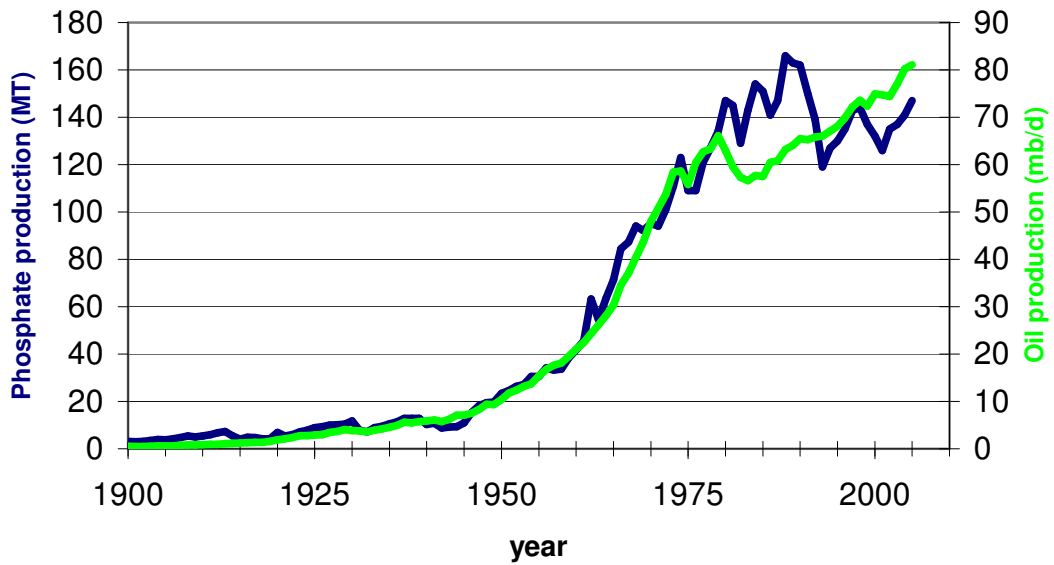
But, I think that population growth is not directly related with oil production. There is something between oil and population growth: this is mined phosphorus. Without phosphate deposits, it was almost impossible to have a “green revolution”. Nitrogen was also a big part of that but it is present in large quantity in the atmosphere: 78% of it's composition. Nitrogen production is an energy intensive process (Haber-Bosch) which uses one percent of all energy consumed by human (2), but it can be fixed in the soil using micro-organisms like rhizobium and azotobacters. Phosphorus is the real bottleneck of agriculture.(3)

So population growth was only possible because we found phosphorus deposits **and** we also found cheap energy to extract, transform and transport it to farms. When we plot data of world population versus world phosphate production, we find the same correlation as in the previous plot with oil production because world phosphate production is closely related with world oil production as you can see in the third graph.

World rock phosphate production vs world population



World rock phosphate production vs world oil production



What that mean?

Even if we find a real substitute for fossil fuels, it will be impossible to maintain population growth because fossil phosphate deposits are probably in decline.⁽⁴⁾ It

will also be impossible to maintain an agriculture without a cycle of nutrients.

Phosphorus can be “recycled”, contrary to fossil fuels, however if we waste it, we cannot replace it by an other source.

(1) D.A. Pfeiffer, “Eating fossil fuels, oil, food and the coming crisis in agriculture”, New Society Publisher, 2006.

(2) Barry E. Smith, “Nitrogenase Reveals Its Inner Secrets”, Science, 6 September 2002: Vol. 297. no. 5587, pp. 1654 – 1655, www.sciencemag.org/cgi/content/full/297/5587/1654

(3) Conrad, Jim, “A bottleneck in nature”, Backyard Nature, www.backyardnature.net/phosphor.htm

(4) Déry, Patrick, “The phosphorus peak”, www.energybulletin.net ; Déry, Patrick, « Pérenniser l’agriculture » Mémoire pour la Commission sur l’avenir de l’agriculture du Québec, avril 2007, [www.caaq.gouv.qc.ca/userfiles/File/MEMOIRE\(1\)/02-07-Saguenay-Dery.Patrick.pdf](http://www.caaq.gouv.qc.ca/userfiles/File/MEMOIRE(1)/02-07-Saguenay-Dery.Patrick.pdf) (in french only)