PEGaSus
P efficiency in pigs & poultry: bridging the gaps in the P value chain

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ERA-NETSUSAN

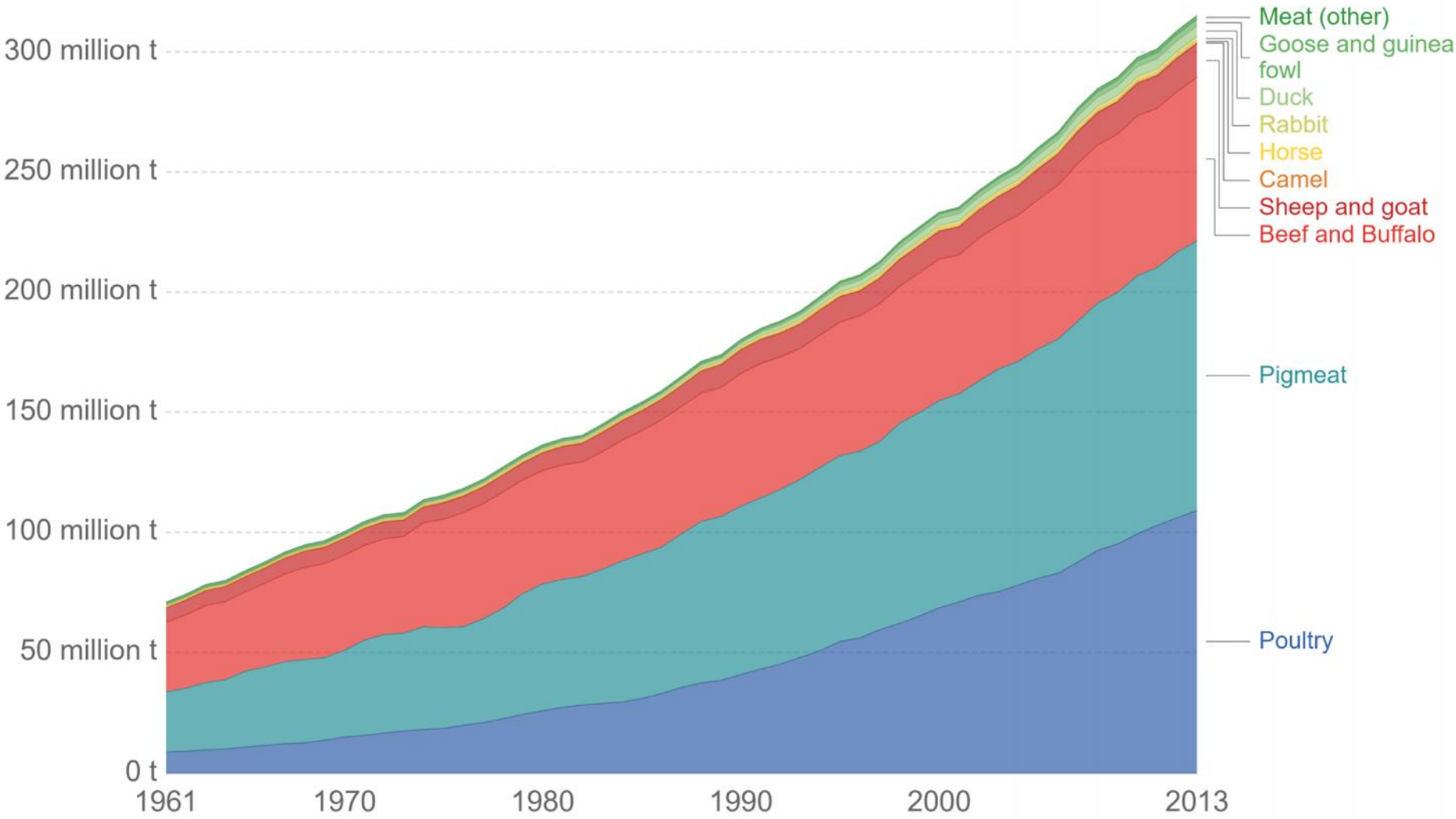
SEI Stockholm Environment Institute

Project aims

- Strategies to increase bioavailability, digestibility & efficiency of plant P in mono-gastric animals to reduce use of inorganic P supplements
- Reduce P losses and emissions from pig & chicken husbandry
- Technical, policy & governance strategies to minimize P discharges from farms, P in runoff from soil and enrichment in aquatic ecosystems

Meat production by livestock type (global data)

Meat production by commodity or product type, measured in tonnes per year. All data shown relate to total meat production, from both commercial and farm slaughter. Data are given in terms of dressed carcass weight, excluding offal and slaughter fats.

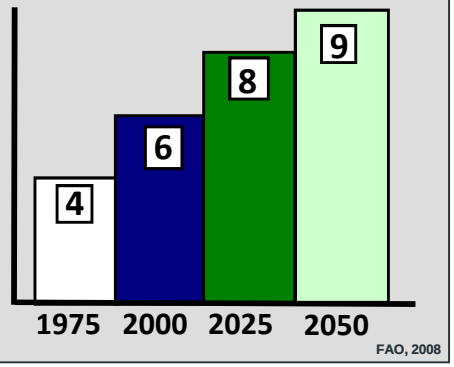


Pig and poultry comprise 70% of the global meat consumption (50-50)

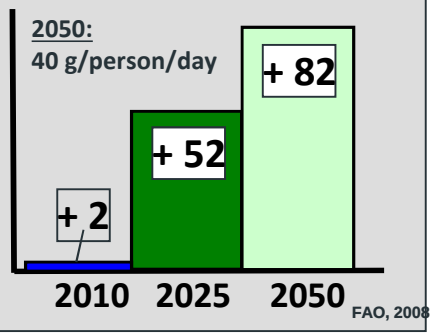
In the EU it is 50% pork and 30% poultry; 22 and 13 Mtons resp. (Eurostat 2014)

Increasing demand for animal protein and efficiency

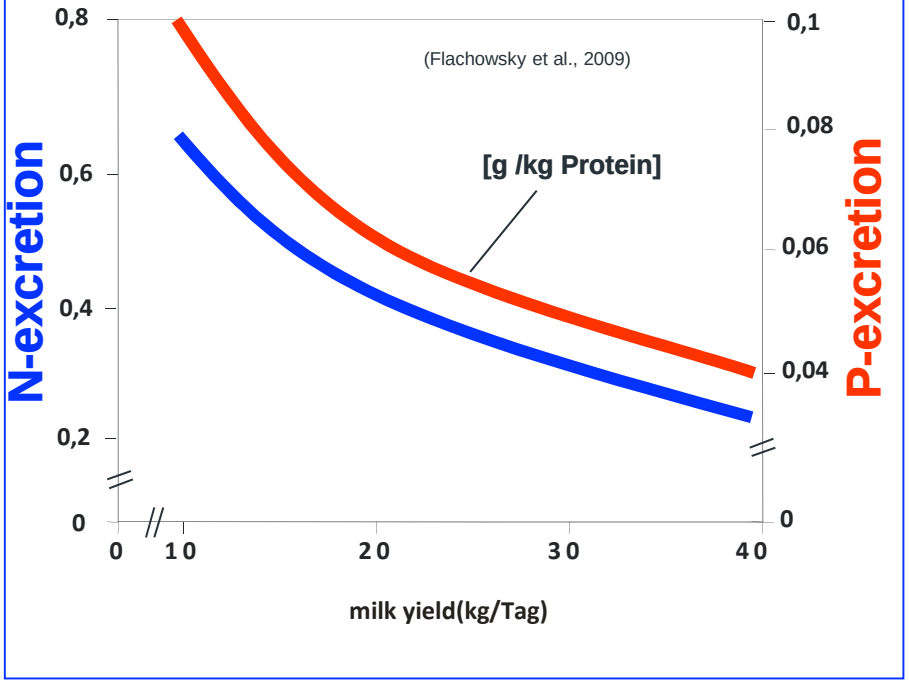
Population growth



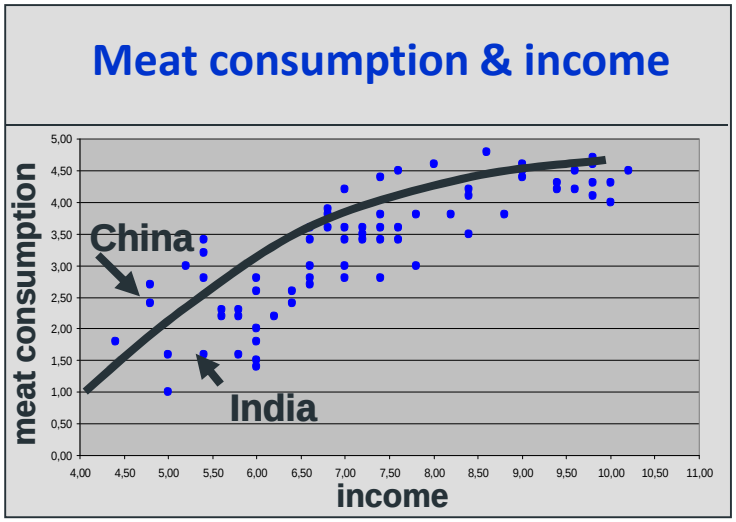
Demand for animal derived protein (% of 2009)



Higher performance➔less N- and P-excretion



Meat consumption & income



CAFOs (concentrated animal feeding operations)

- Pigs and poultry farming has become industrialized ("farmegeddon")
- CAFOs - a minimum of 2500 swine >25 kg, 125 000 broiler chickens, 80 000 laying hens or young hens
- Problems include
  - ammonia emissions
  - nitrate in ground water
  - surplus of manure P in soils
  - eutrophication
  - bacterial contamination
  - antibiotic resistance

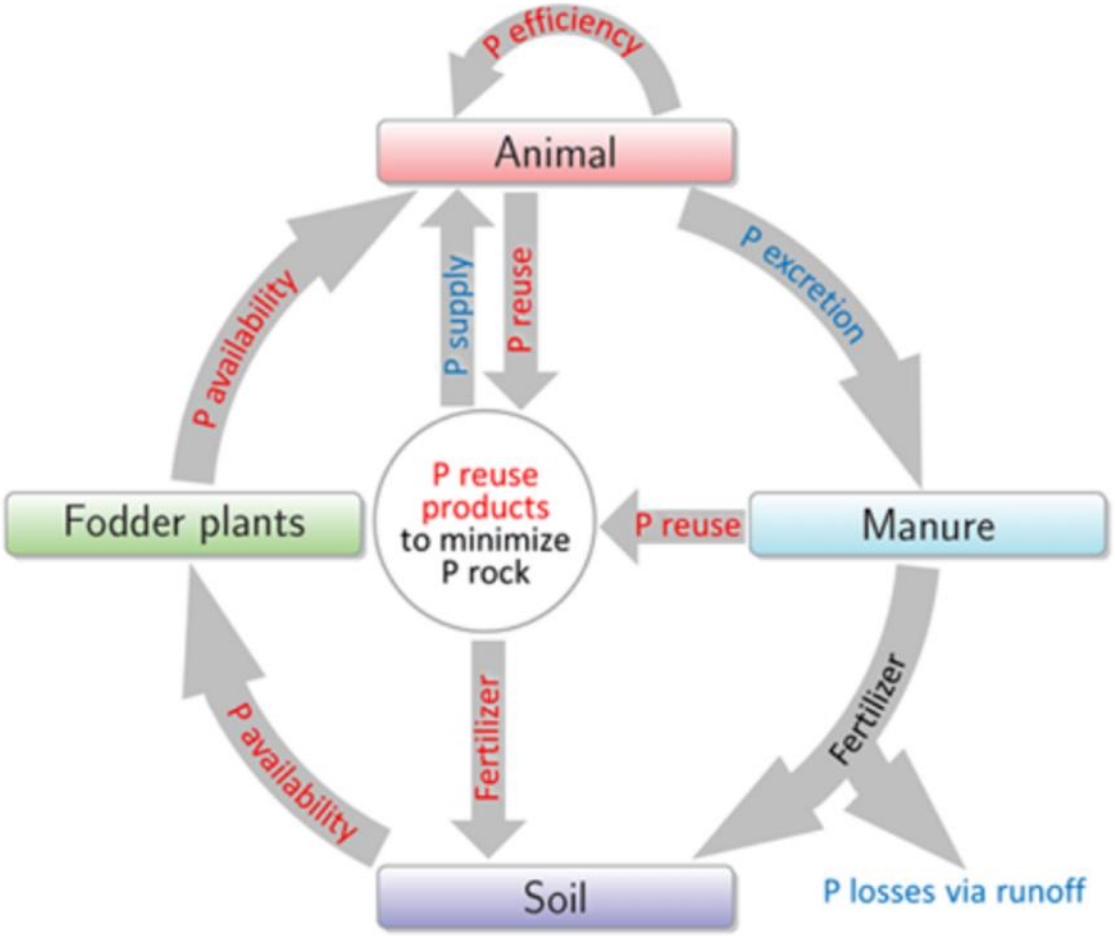
Pigs and poultry have only a limited capacity to extract organic P from feed

- Pigs and poultry are mono-gastrics lacking phytase in their guts
- They can’t break down phytate, the stored form of organic phosphate in plants and seeds
- These animals therefore waste organic phosphorus and excrete most of what they consume – creating a major source of surplus P
- Pigs and poultry excrete 50-80% of organic P intake. Adding microbial phytase results in 50% improvement
- Phase feeding results in a 20% reduction in consumption
- Genotypes can also affect the efficiency of uptake of P

Piggeries as point sources of pollution

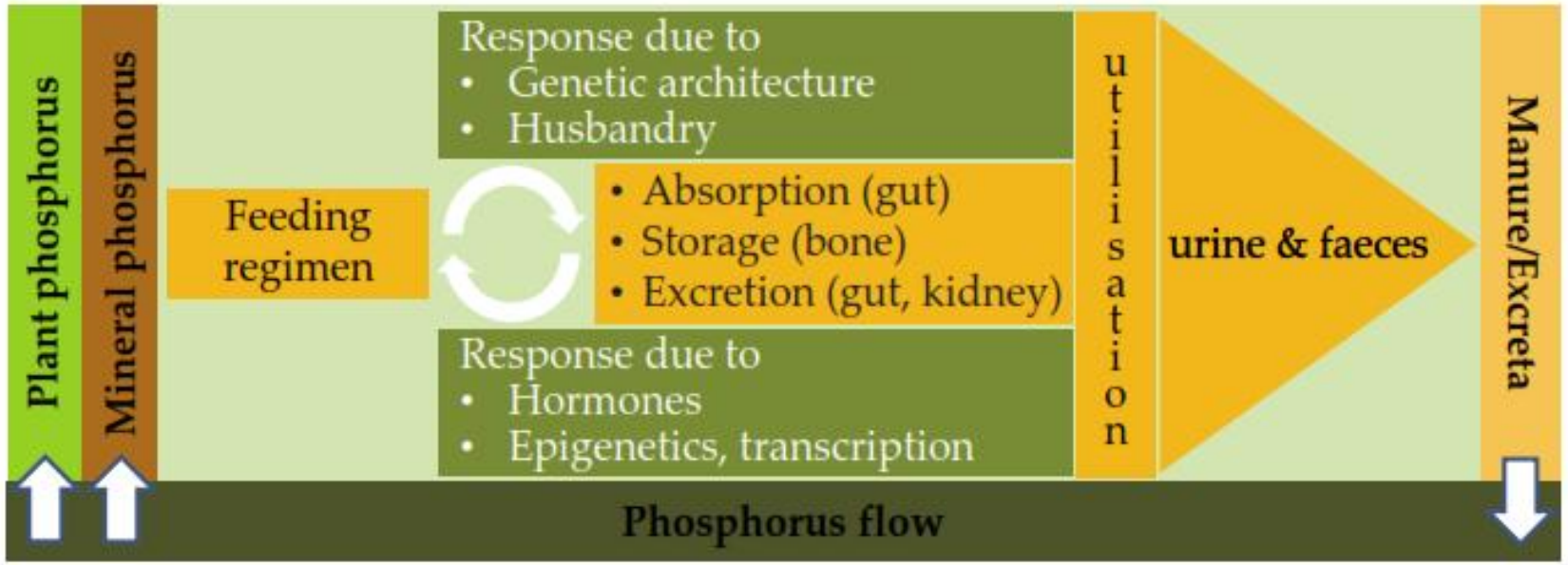
- Large piggeries import most (ca 90%) of their feed thus resulting in surplus production of manure that has to go somewhere
- Pigs use ca 25% of the P in their feed (rest goes to manure)
- Pig manure is often diluted with washwater, rain, etc. resulting in dilute slurry (eg 4-6% suspended solids)
- This creates major handling problems and transport of the slurry is break even only just 15 kms distance
- All the above factors result in making large pig farms major sources of nutrient pollution

P cycle & opportunities for reuse



Reuse involves manure fertilizer, sludge fermentation to biogas, pyrolysis to charcoal, struvite, bone ash and compost

Animal-centered model of the P cycle



To achieve a P balance - the dietary P requirements need to match physiological processes and P excretion based on physiological turn-over (ie the endogenous losses).

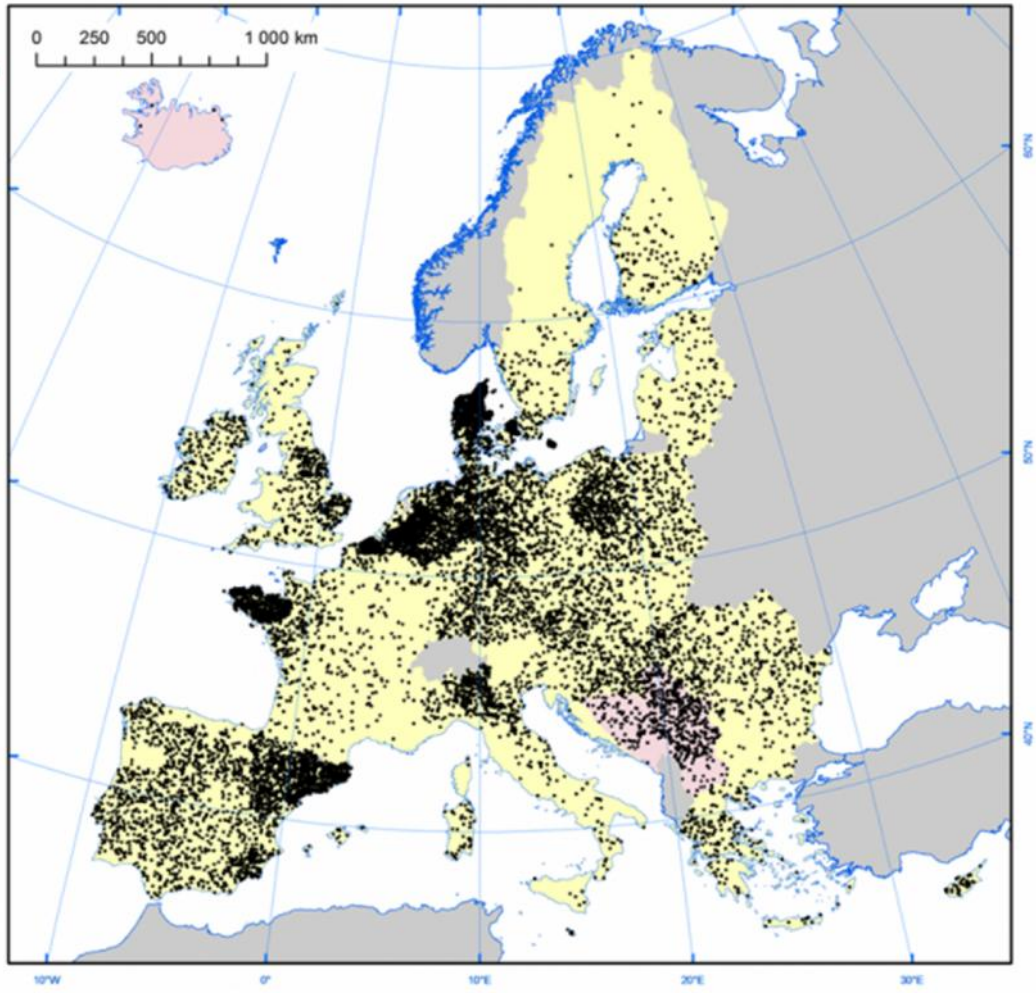
Improvements in P efficiency in animals rely on (epi)genetics, husbandry, P digestibility, hormonal status, and transcription rates.

Map of pig densities in the EU

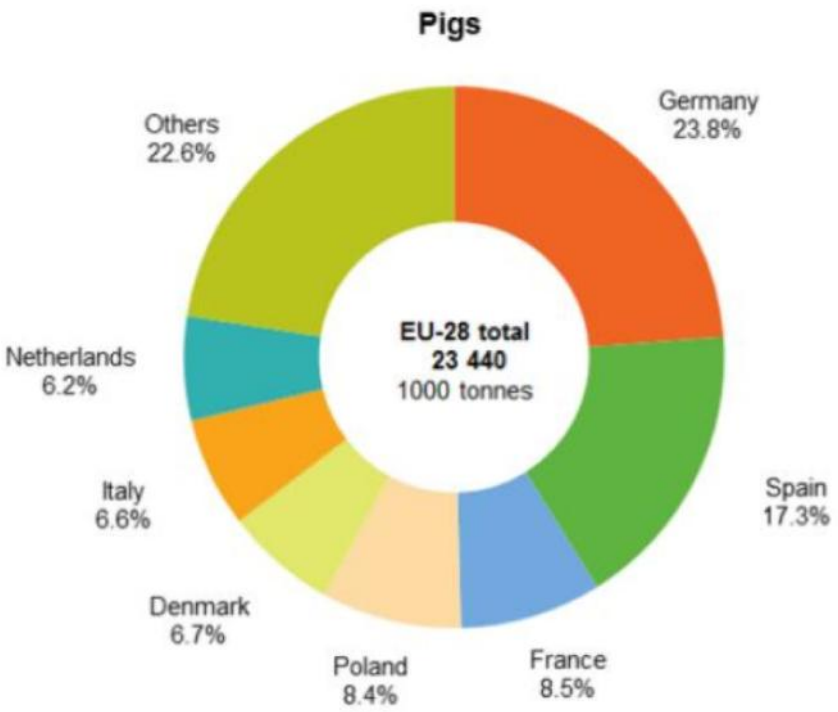
Each black dot represents 1000 heads in the NUTS 2 regions

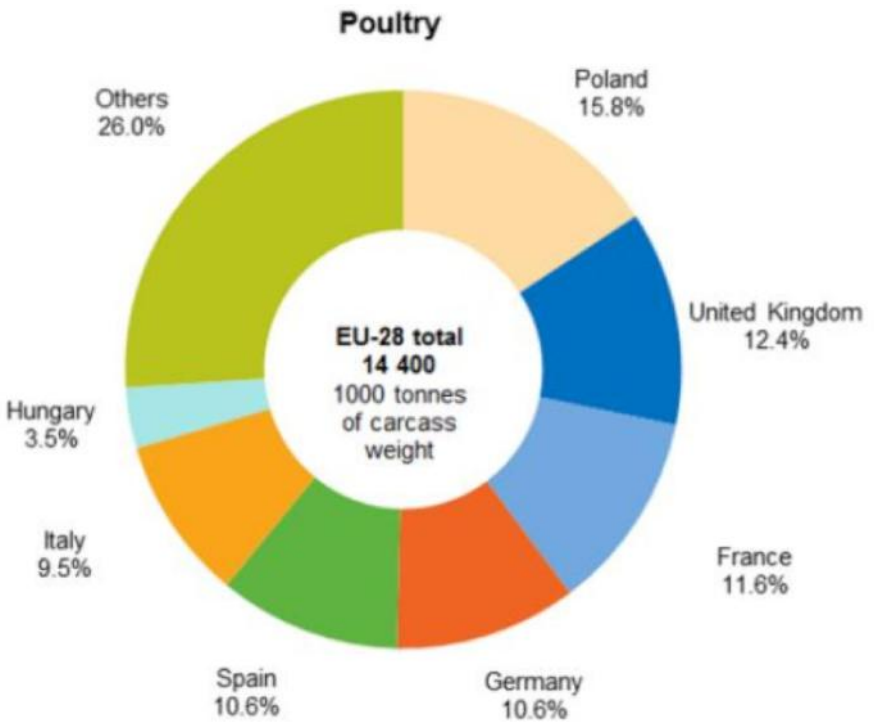
147 million heads in 2016

NUTS: Nomenclature of territorial units for statistics



Dominant pig and poultry producers in the EU



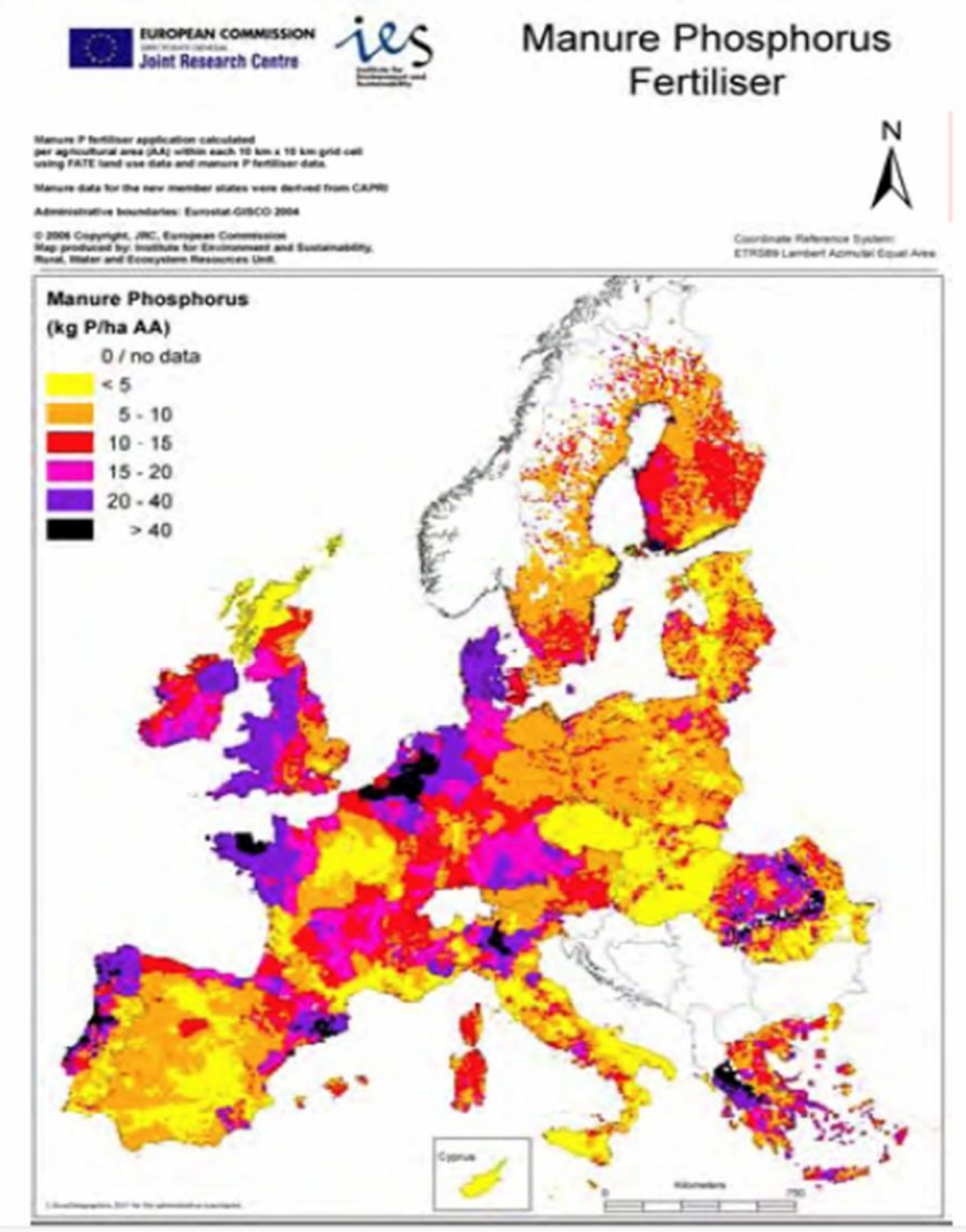


6 billion broilers slaughtered each year in the EU

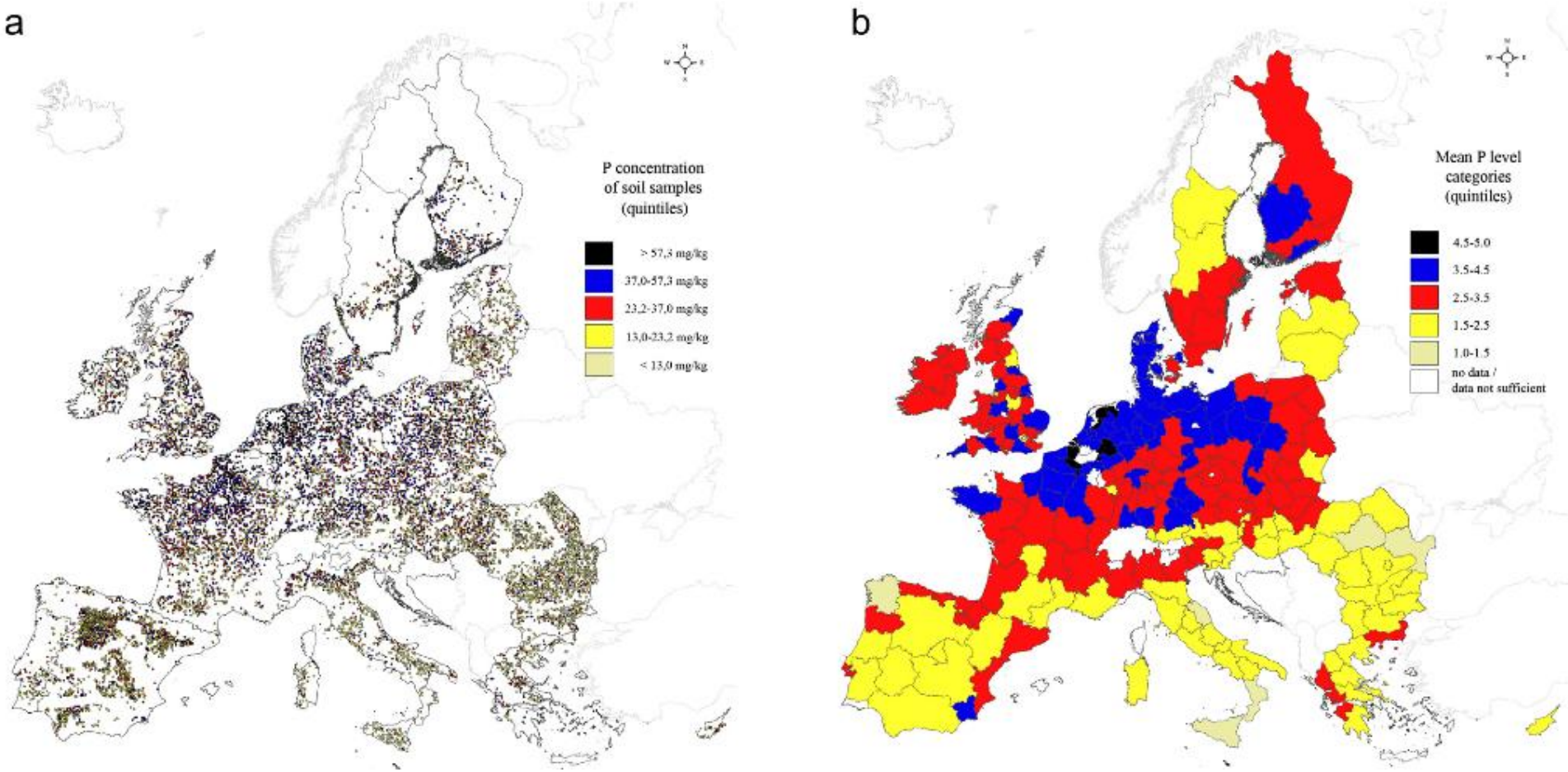
Eurostat 2016. Annual production.

Manure application in phosphorus (kg P/ha/Agricultural Area)

Map from Grizetti and Bouraoui 2006

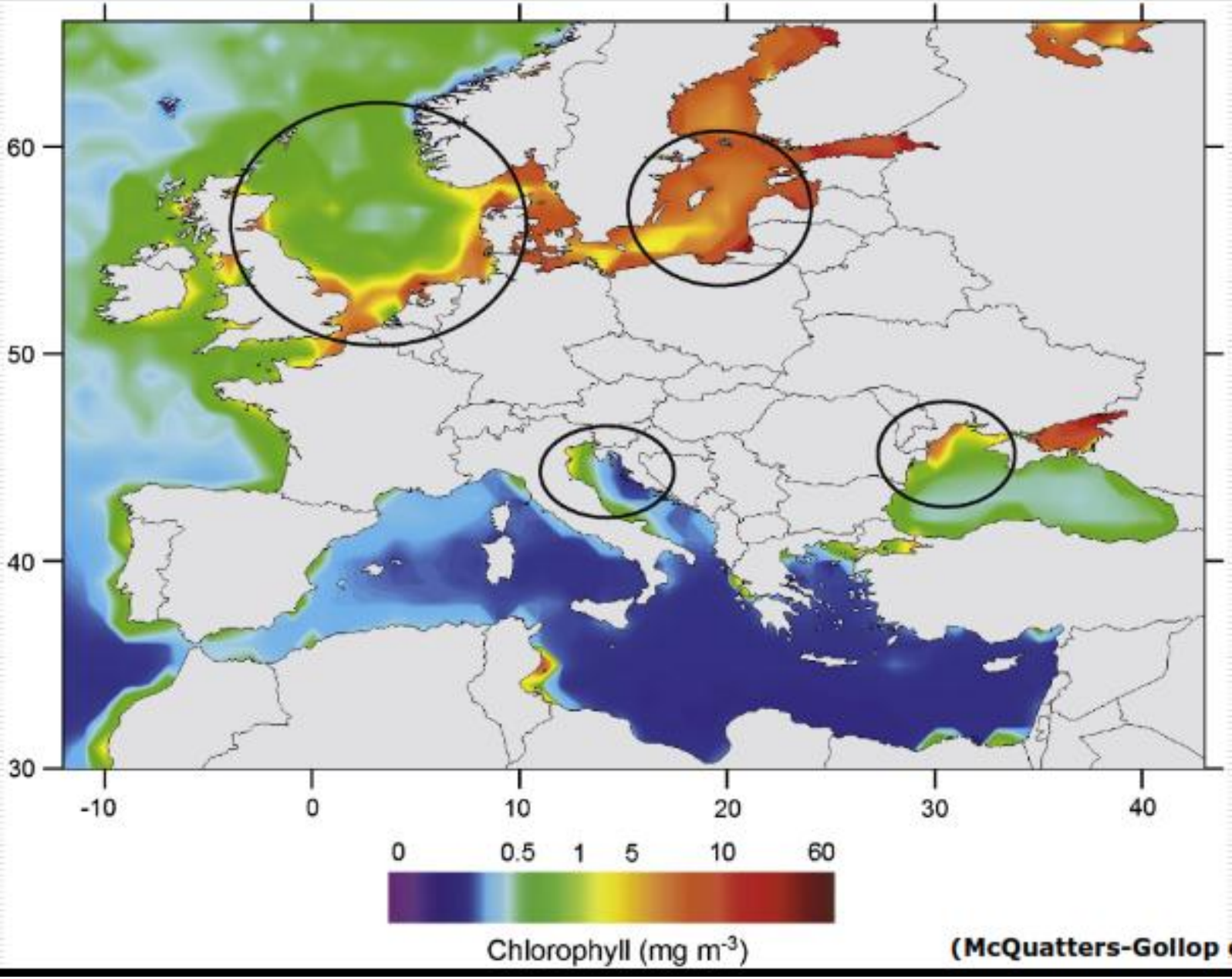


Phosphorus concentration of cropland soils



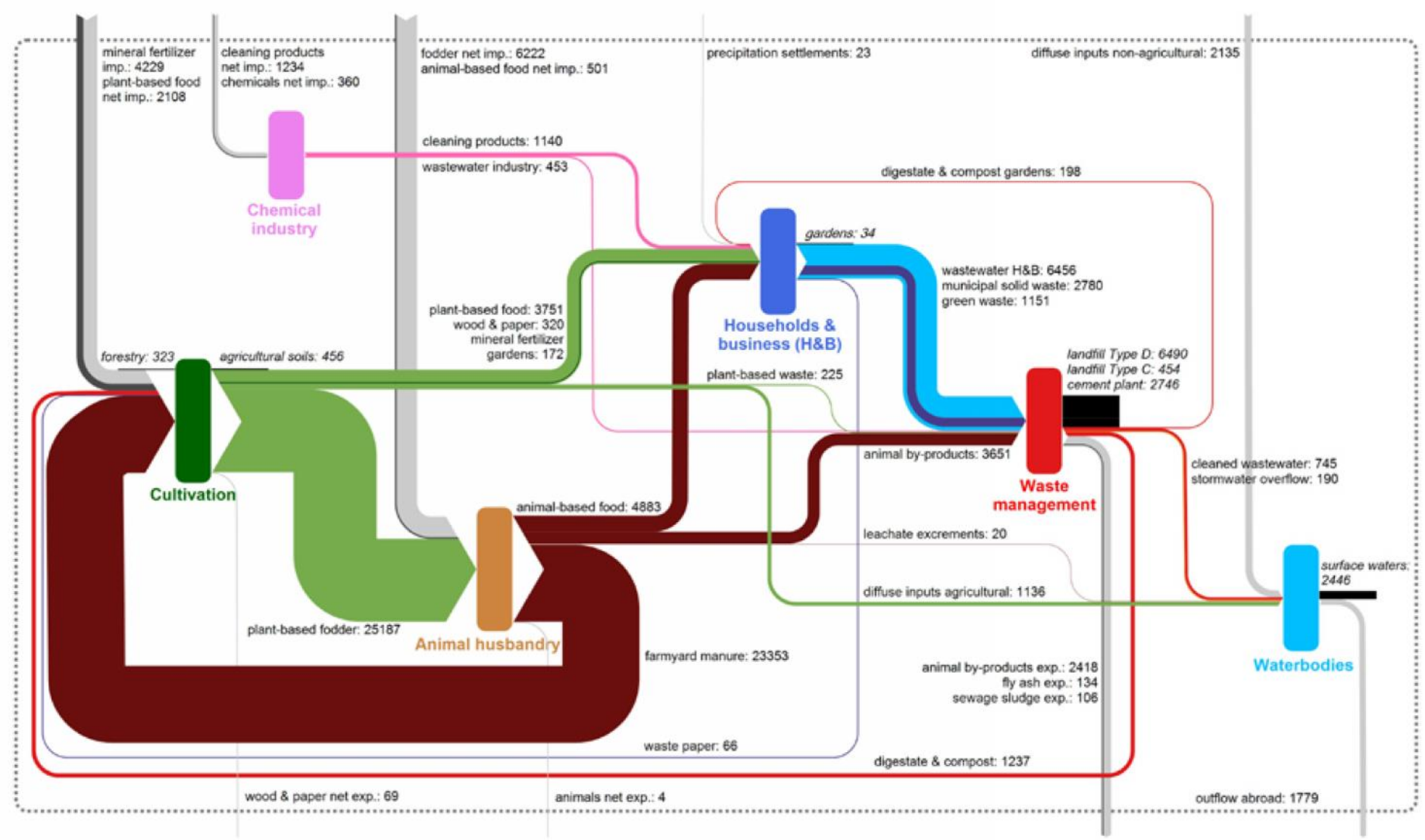
(a) In quintile categories of the LUCAS topsoil samples. (b) Mean topsoil P concentration categories of croplands in NUTS2 regions (based on quintile categories). Tóth et al (2014).

Chlorophyll Concentrations - annual composite for 2007 from remote sensing



(McQuatters-Gollop et al 2009)

P cycle in Switzerland



Data in tons of P per year for 2015. 94% overall efficiency. Was 59% in 1989. P imports reached 24% by 2002. Manure drives the production of food. (Mehr et al 2018)

PEGASUS Research components in summary

Animal husbandry

- Feed strategies and use of microbial phytase
- Alternative feed supplements – eg comfrey instead of soybean
- Methods of manure handling
- Genetics and gut microbiology affecting the efficiency of P digestion

Bioeconomy model – looking at the financial losses and gains

Reuse options – providing incentives to close the loop

Losses to nature and measures to reduce these

Governance and policy

Project runs to end of 2020

Partners

LEIBNIZ-INSTITUT FÜR NUTZTIERBIOLOGIE

afbi Agri-Food and Biosciences Institute

AARHUS UNIVERSITY

SEI Stockholm Environment Institute

UNIVERSITÀ CATTOLICA del Sacro Cuore

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Ministry of Environment and Food of Denmark
The Danish Agrifish Agency

mipaaf ministero delle politiche agricole alimentari e forestali

defra Department for Environment Food and Rural Affairs

http://pegasus.fbn-dummerstorf.de/

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