

# Food production as a driver for Earth system changes in the Baltic Sea region



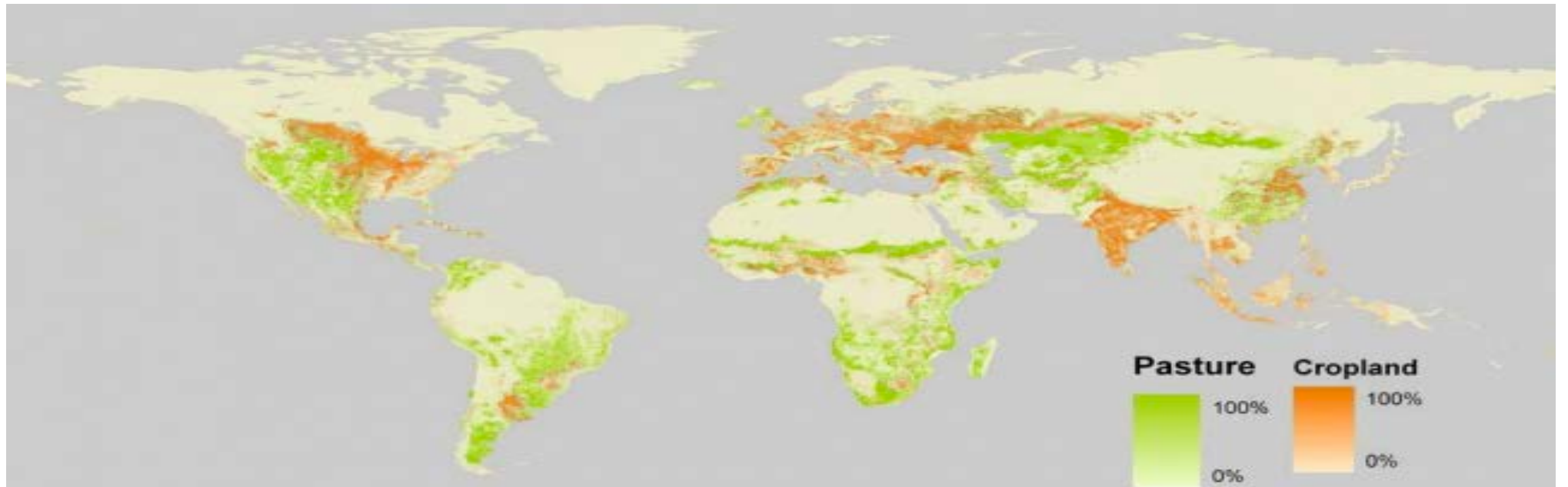
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Baltic Sea Centre, Stockholm University

# Agriculture – a global player

- 40% of global area
- 30% of greenhouse gas emissions
- 70% water withdrawal
- 2 x N and P fluxes

*(Foley et al. Nature 2011)*



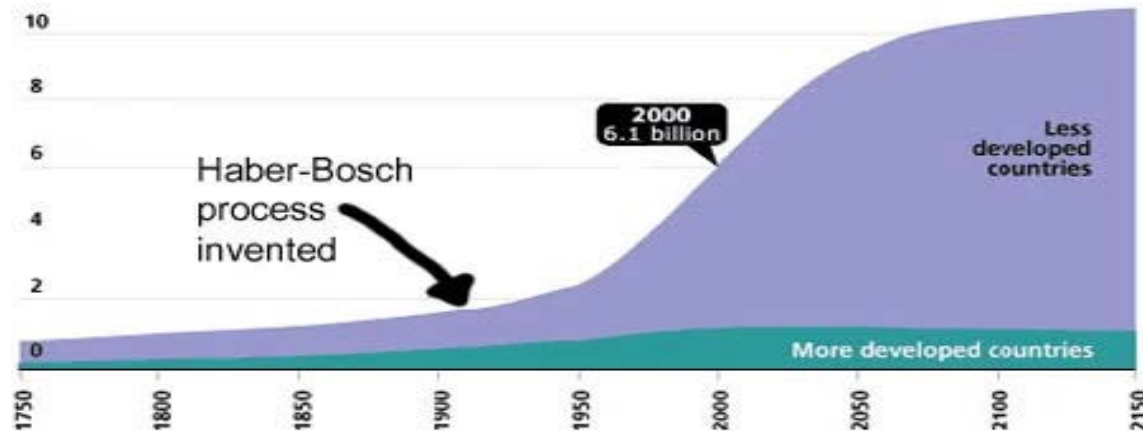
# Detonator of the population explosion

**Without ammonia, there would be no inorganic fertilizers, and nearly half the world would go hungry. Of all the century's technological marvels, the Haber–Bosch process has made the most difference to our survival.**



Haber (right) invented the process while Bosch brought the necessary engineering skills.

Population (in billions)

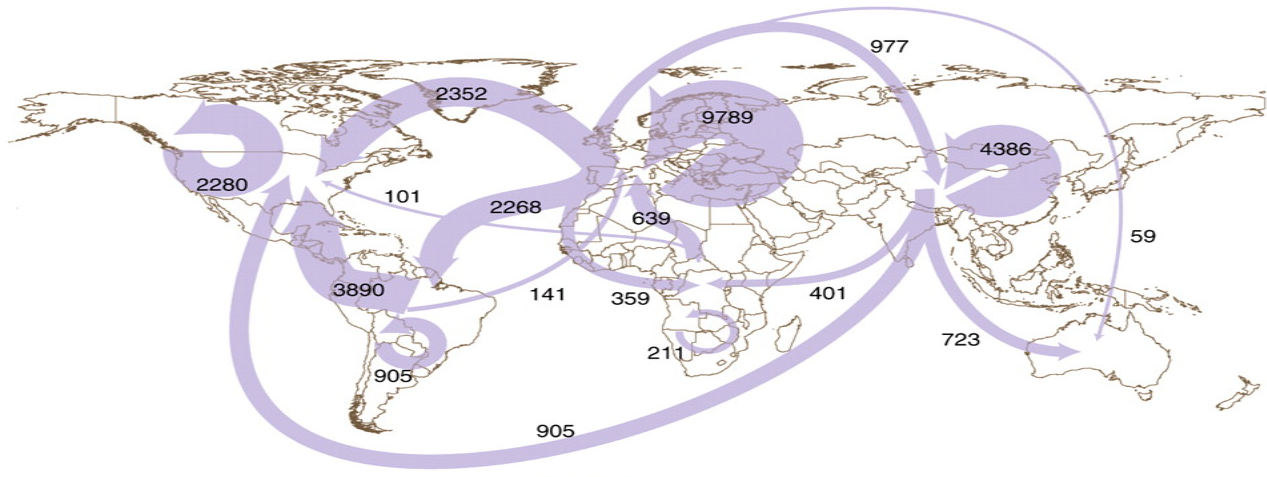


Nitrogen + Hydrogen  $\rightleftharpoons$  Ammonia

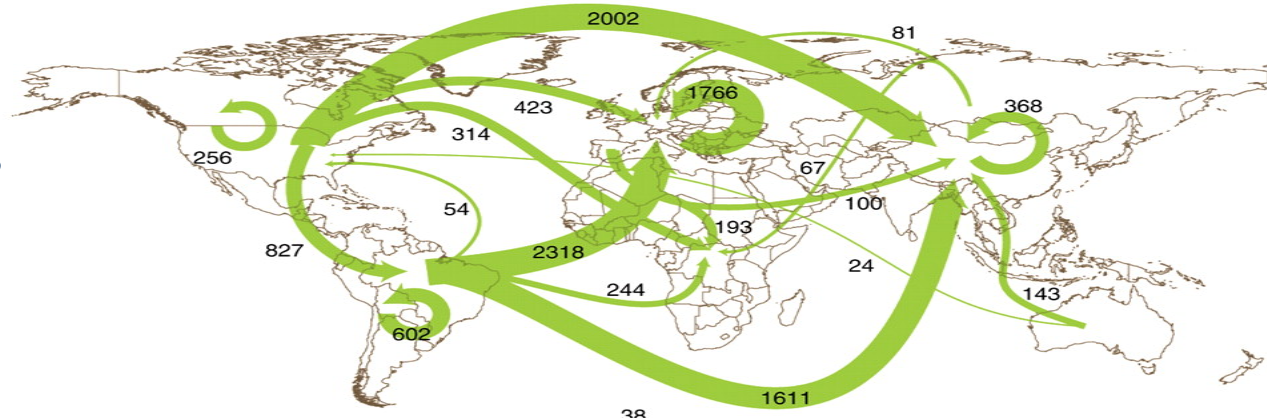


**Global nitrogen transport  
50 million tonnes per year  
equal to:  
1/3 of all industrially  
produced N**

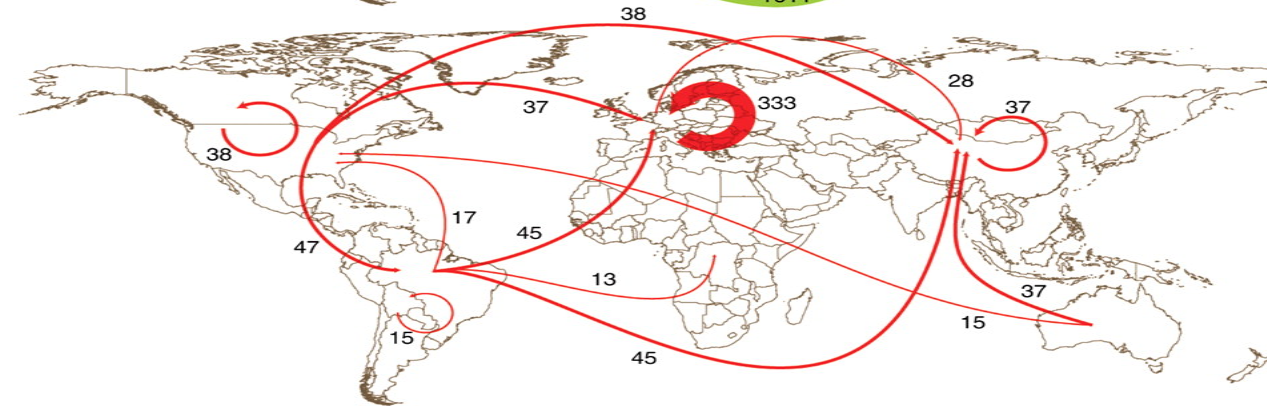
**A**  
fertilizer



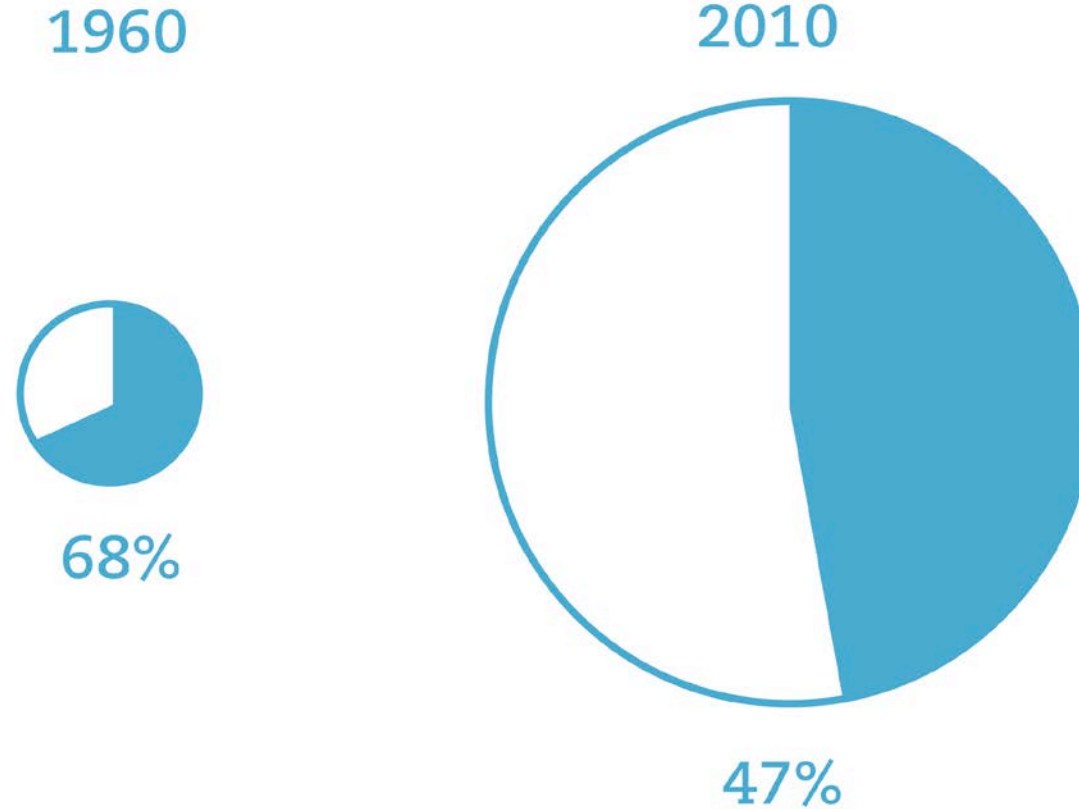
**B**  
cereals



**C**  
meat



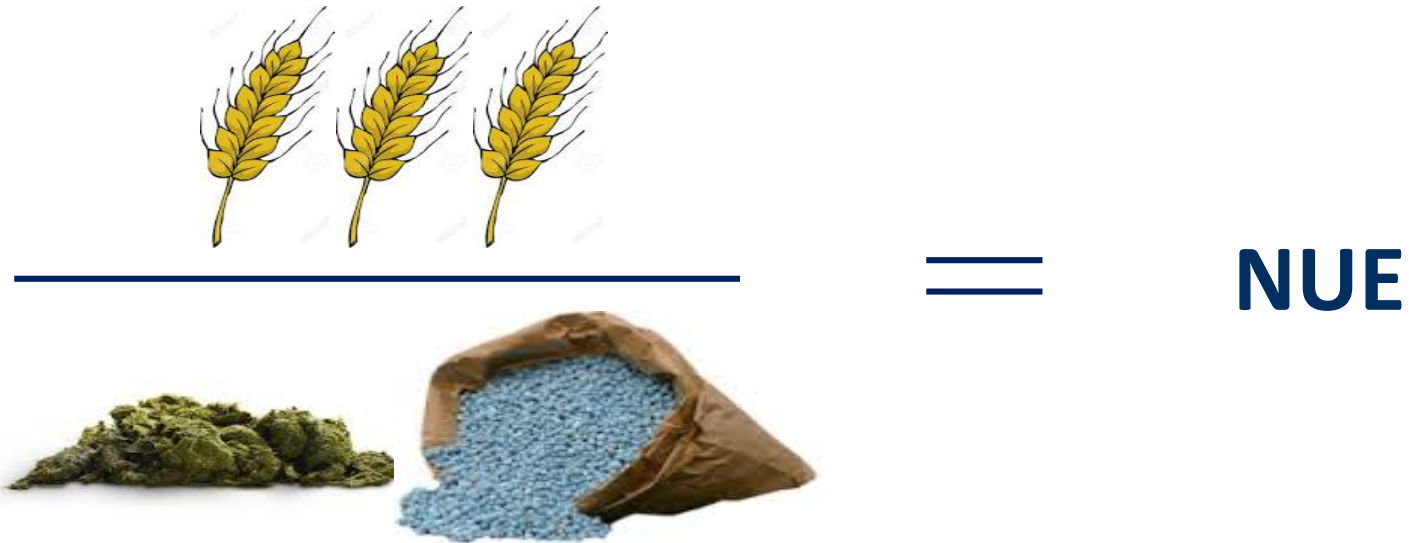
Galloway et al, Science 2008



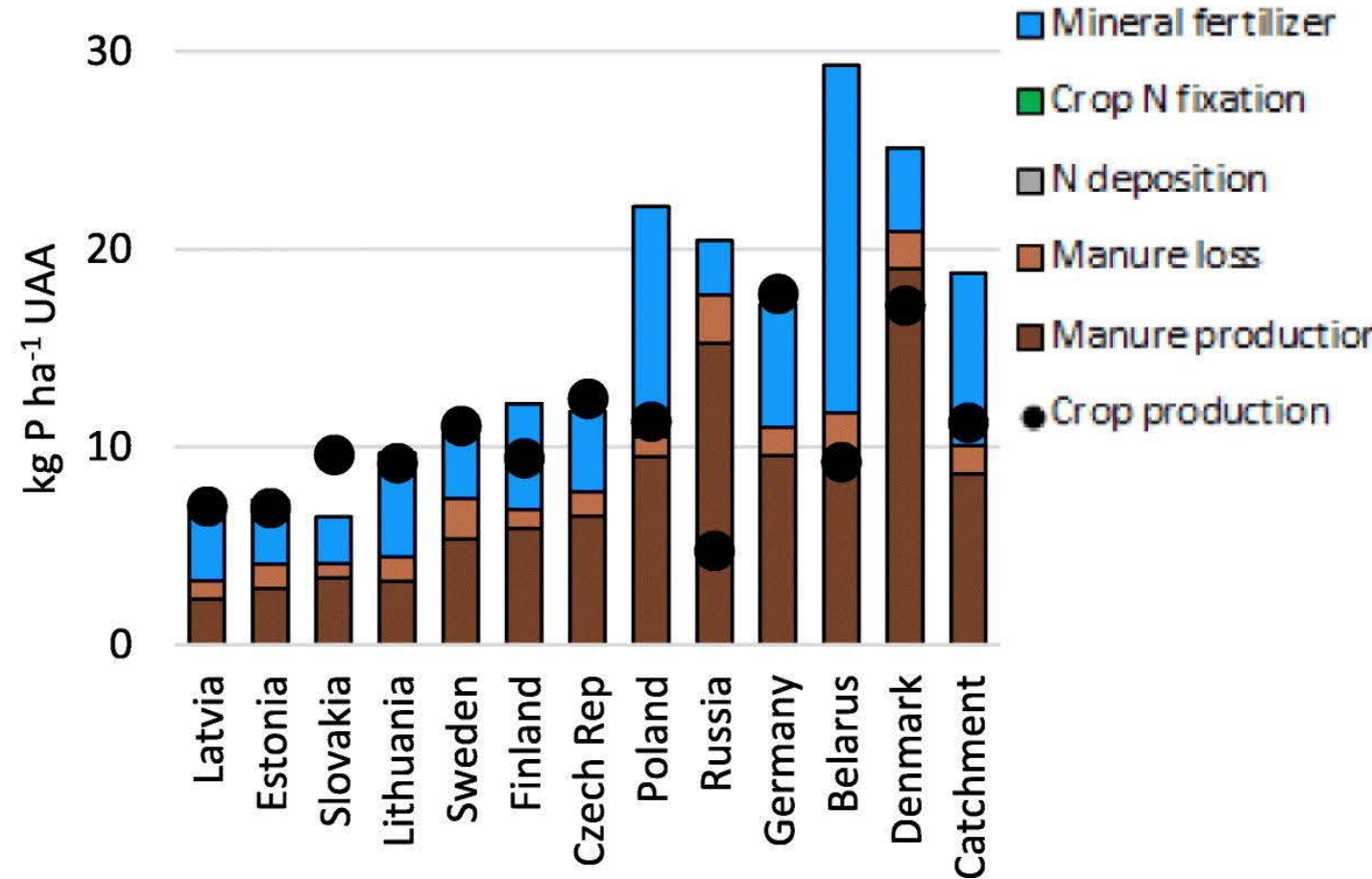
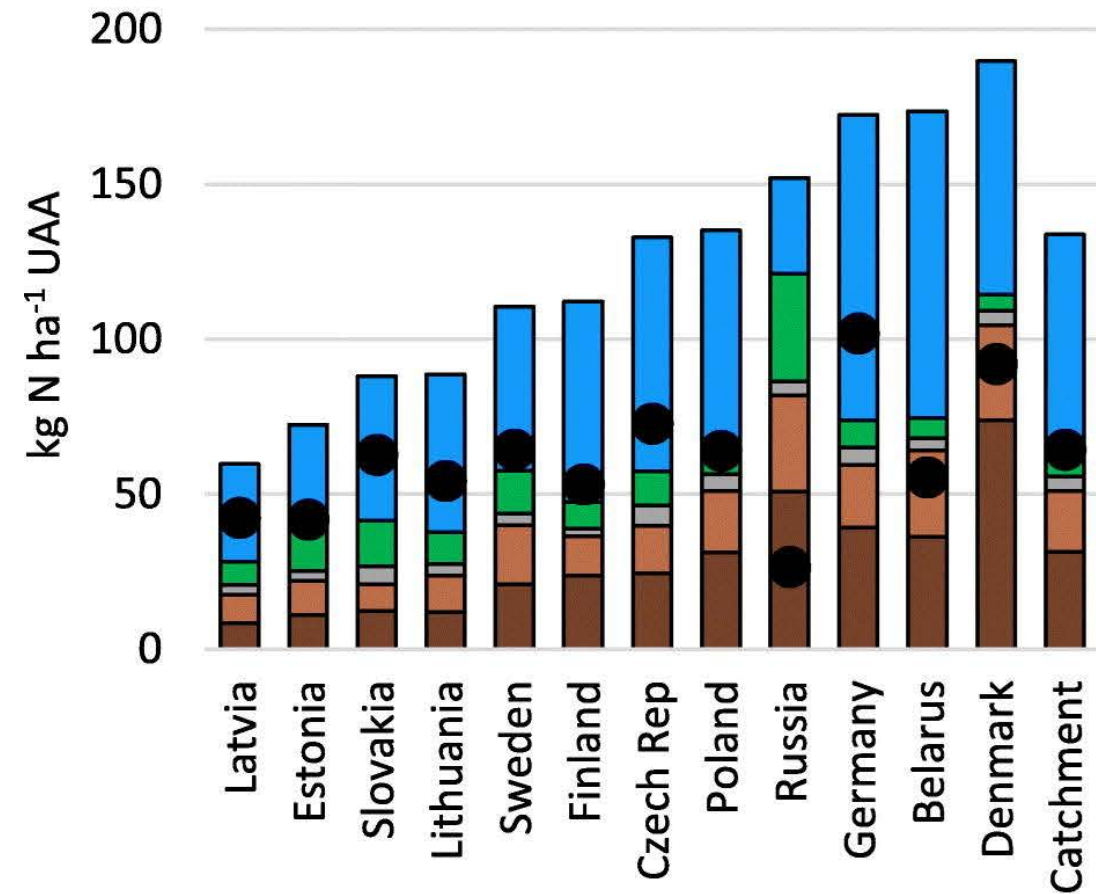
↗ Inorganic fertilizer applications have increased 10 times

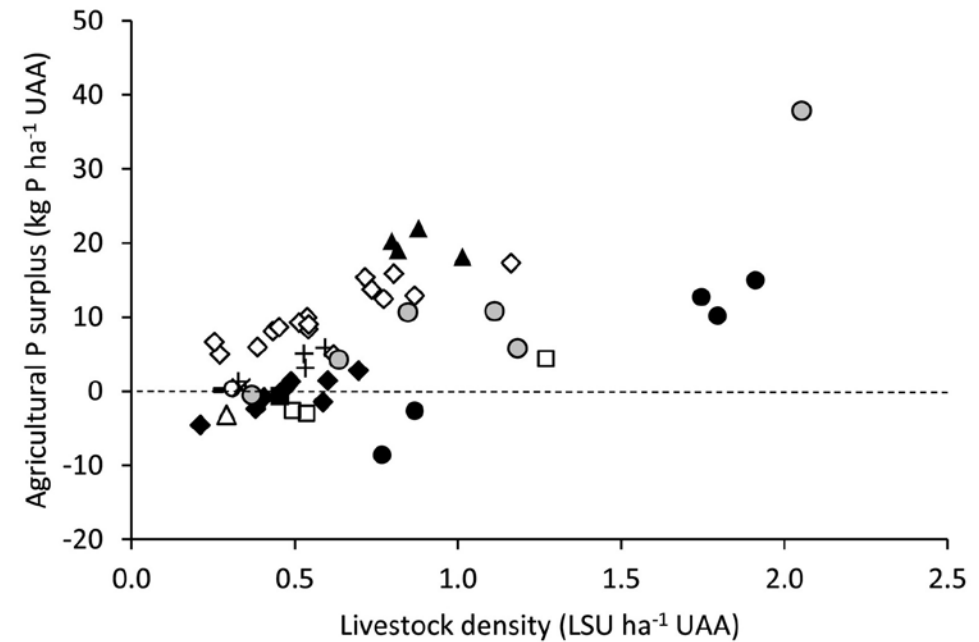
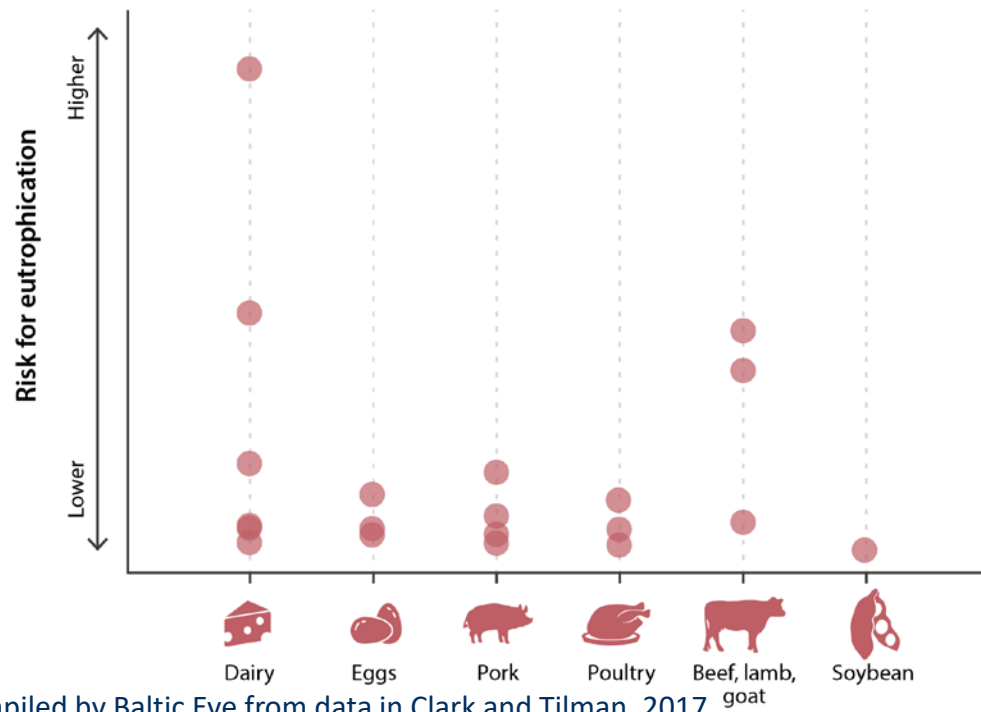
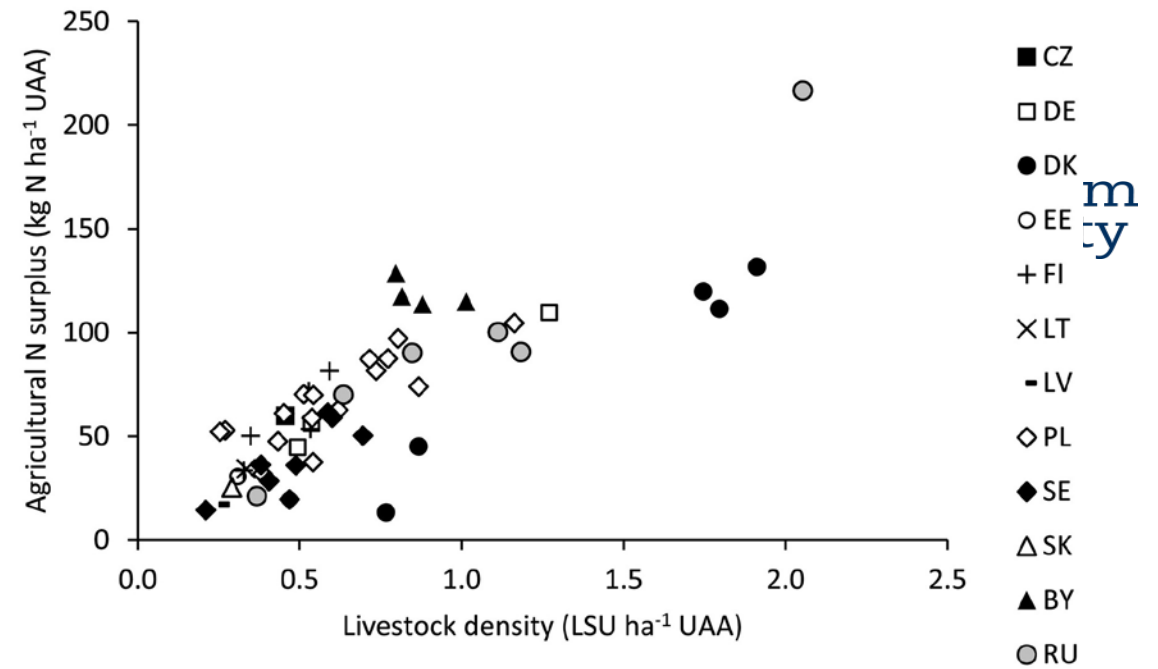
↘ Share of harvested products have decreased

# Nutrient Use Efficiency

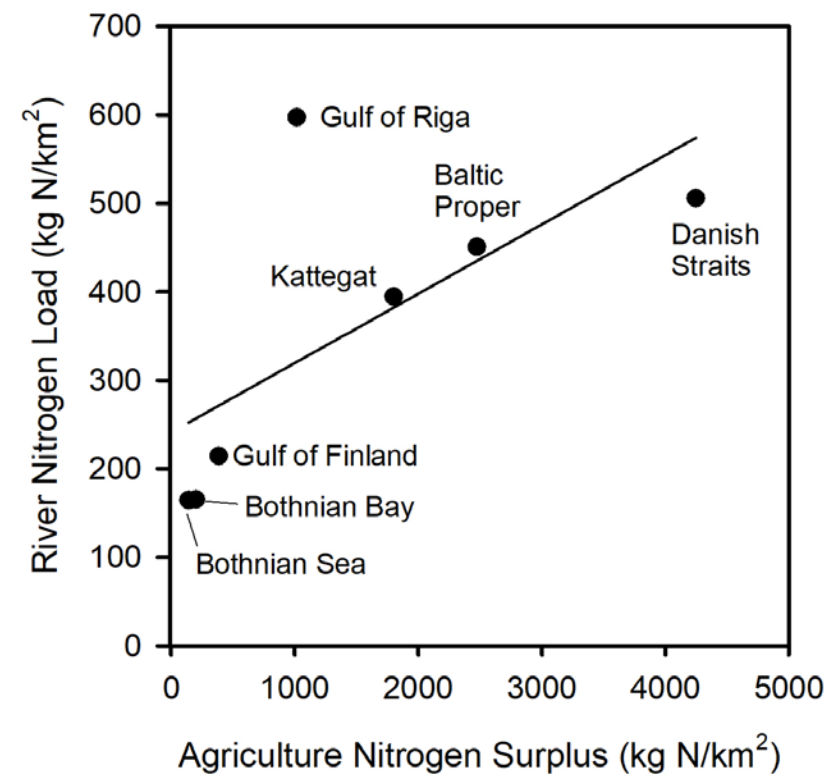
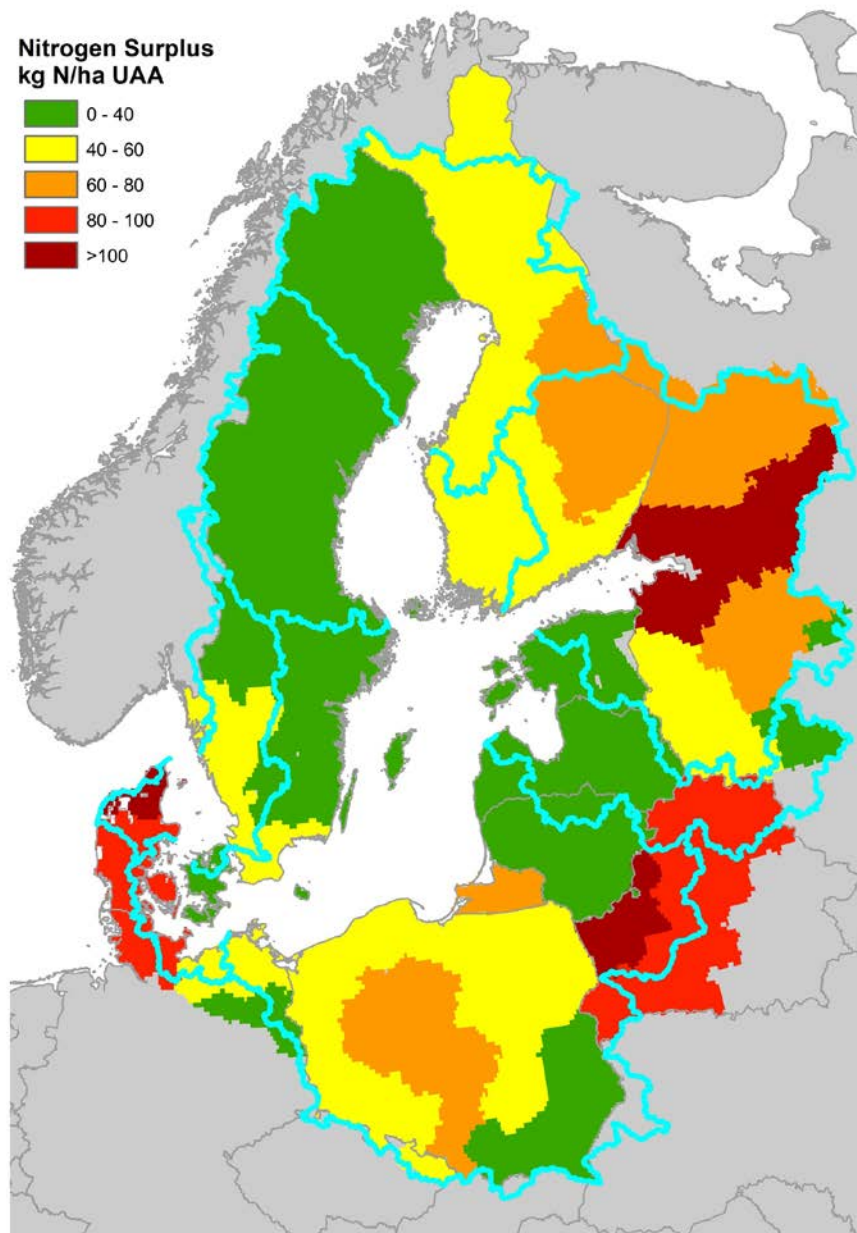


# Inputs vs outputs of N and P as harvested crops

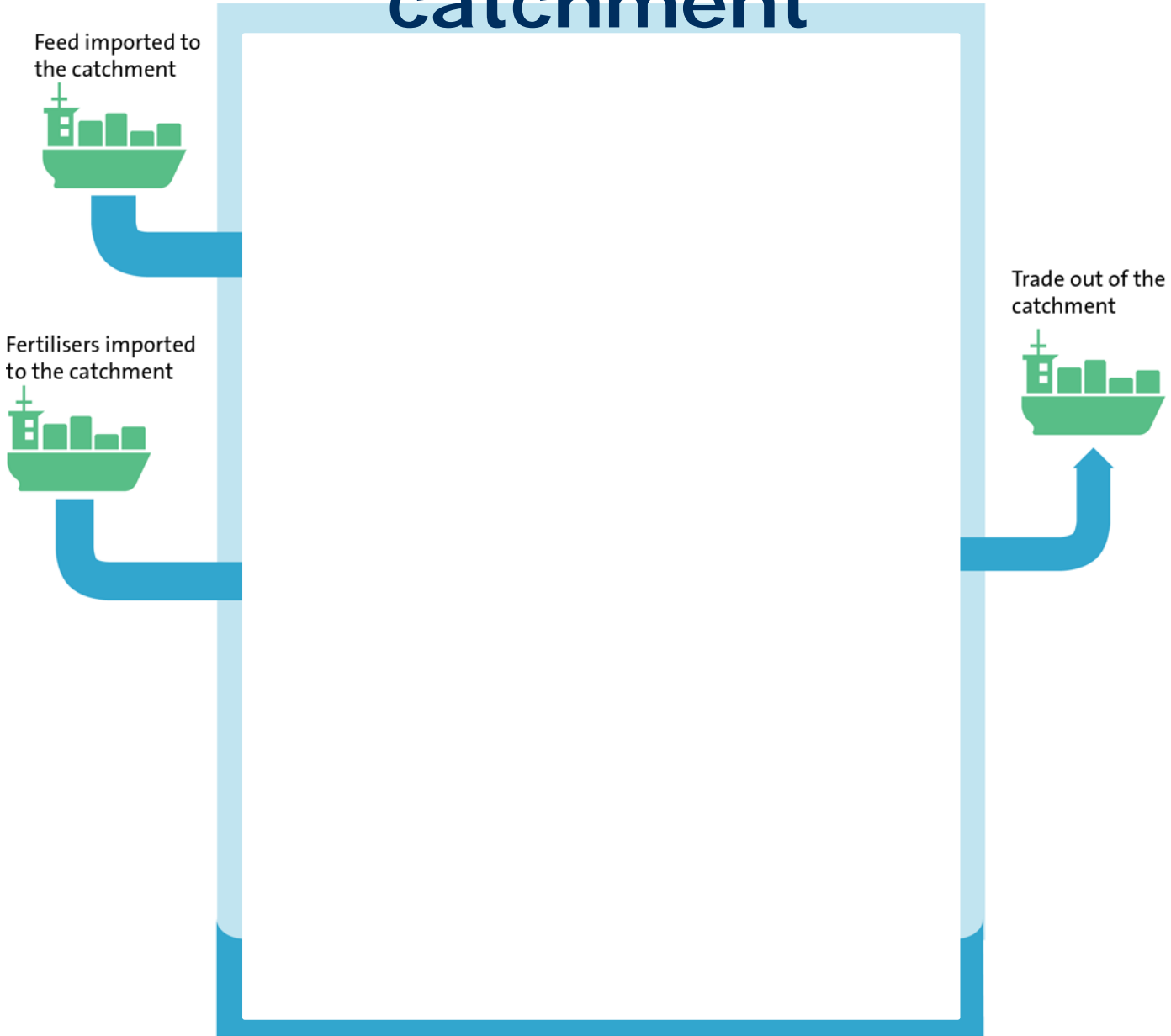




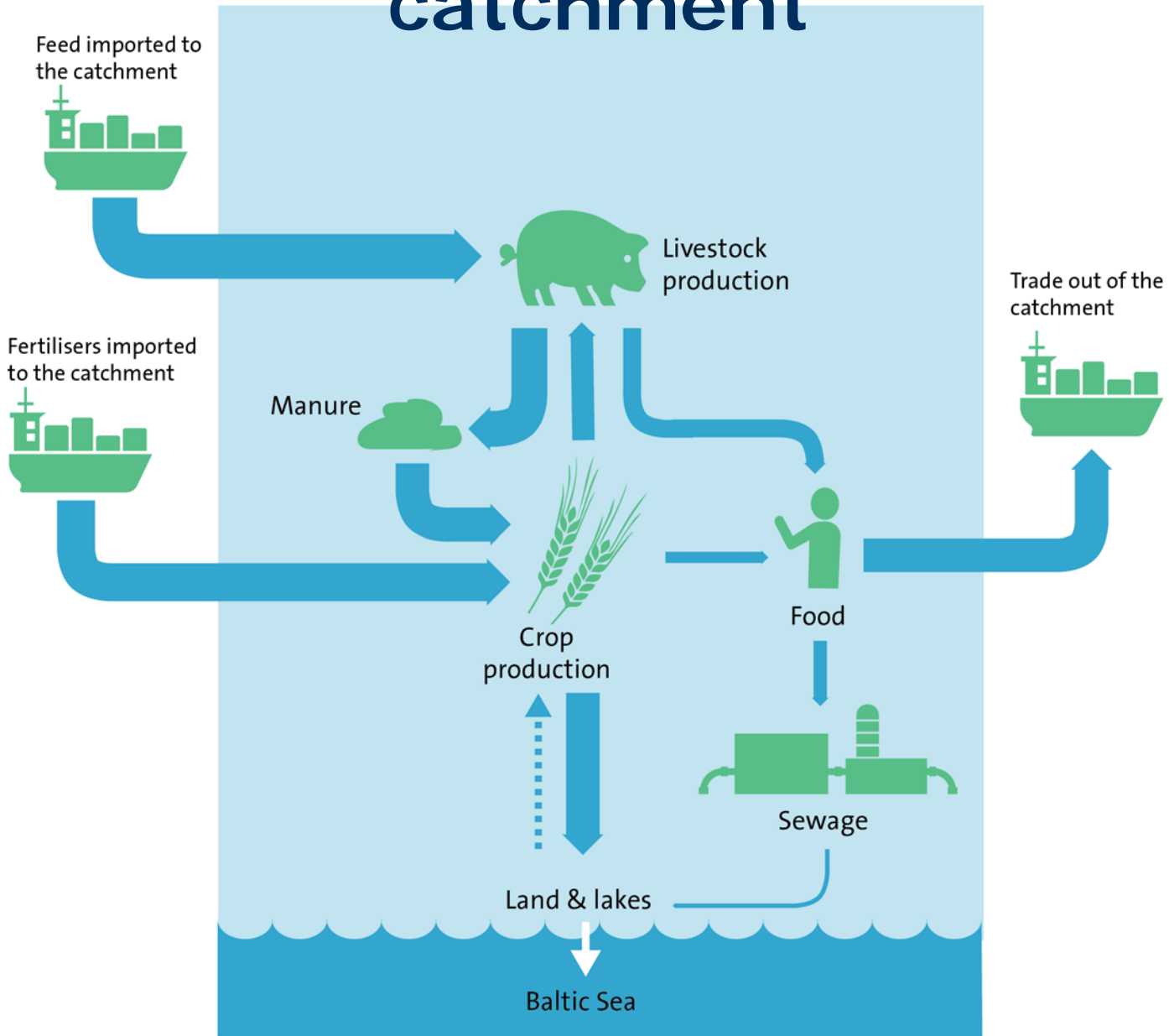




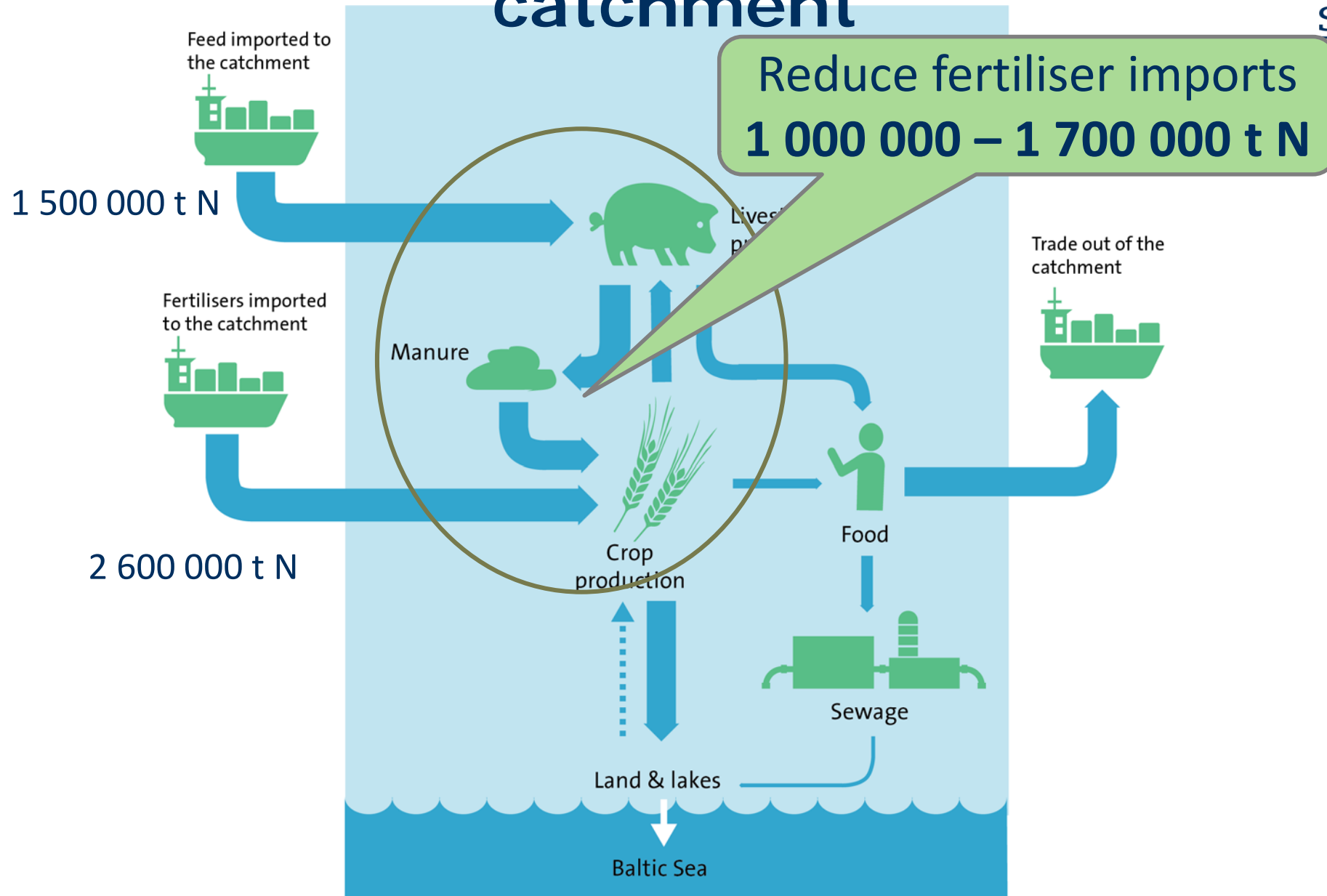
# Nitrogen flows in the Baltic Sea catchment



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## Components of NUE (2010, tons)

Crop production 2,373,509

### Inputs

Manure excretion 1,878,242

Fertilizer 2,593,710

Atmospheric deposition 116,360

Crop N-fixation 292,777

subtotal 4,881,089

NUE 49%

Manure excretion 1,878,242

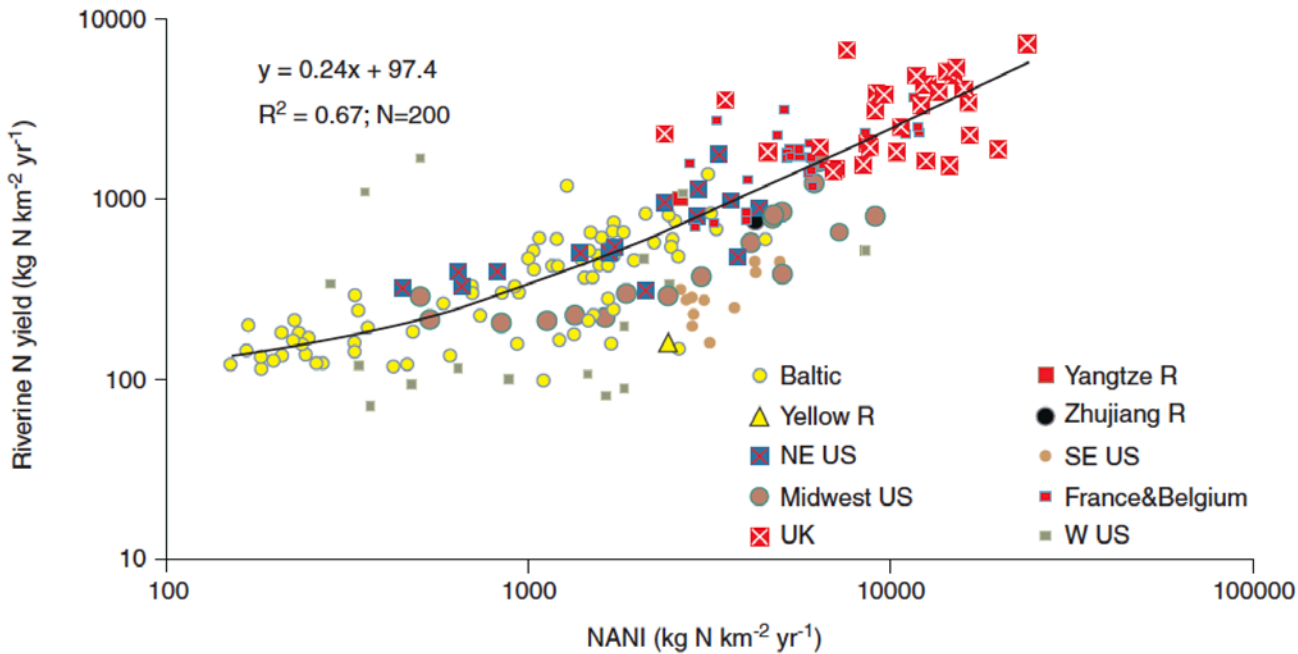
Losses 724,534

Manure produced 1,153,708

NUE with manure losses 57%

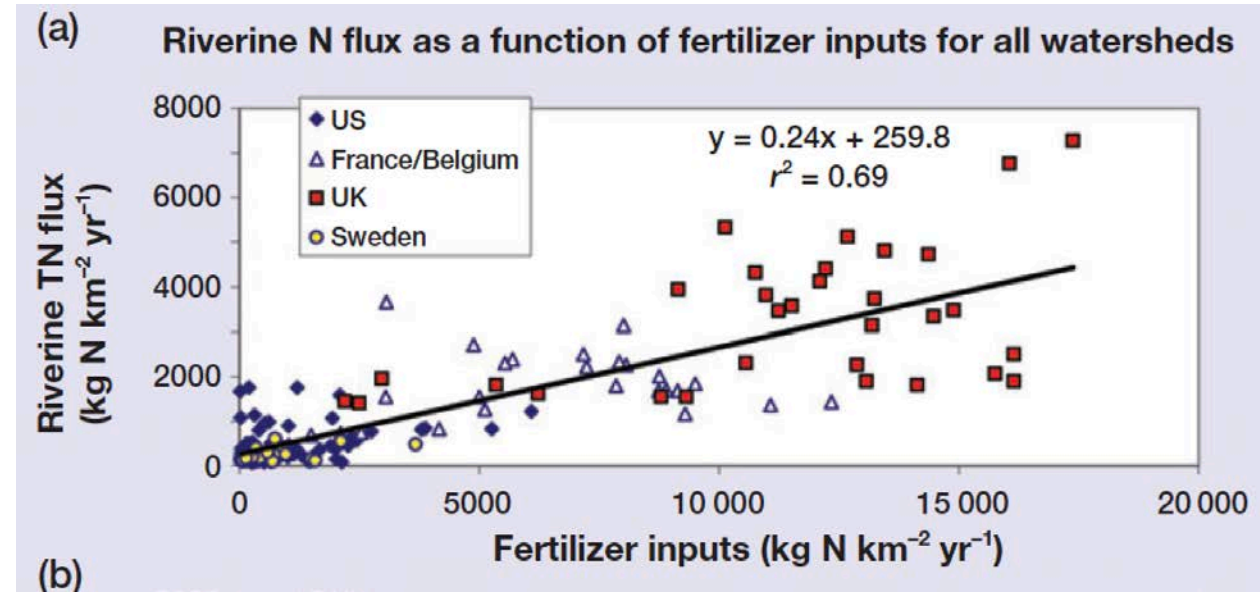
## Details

# Fertilizer vs riverine loads



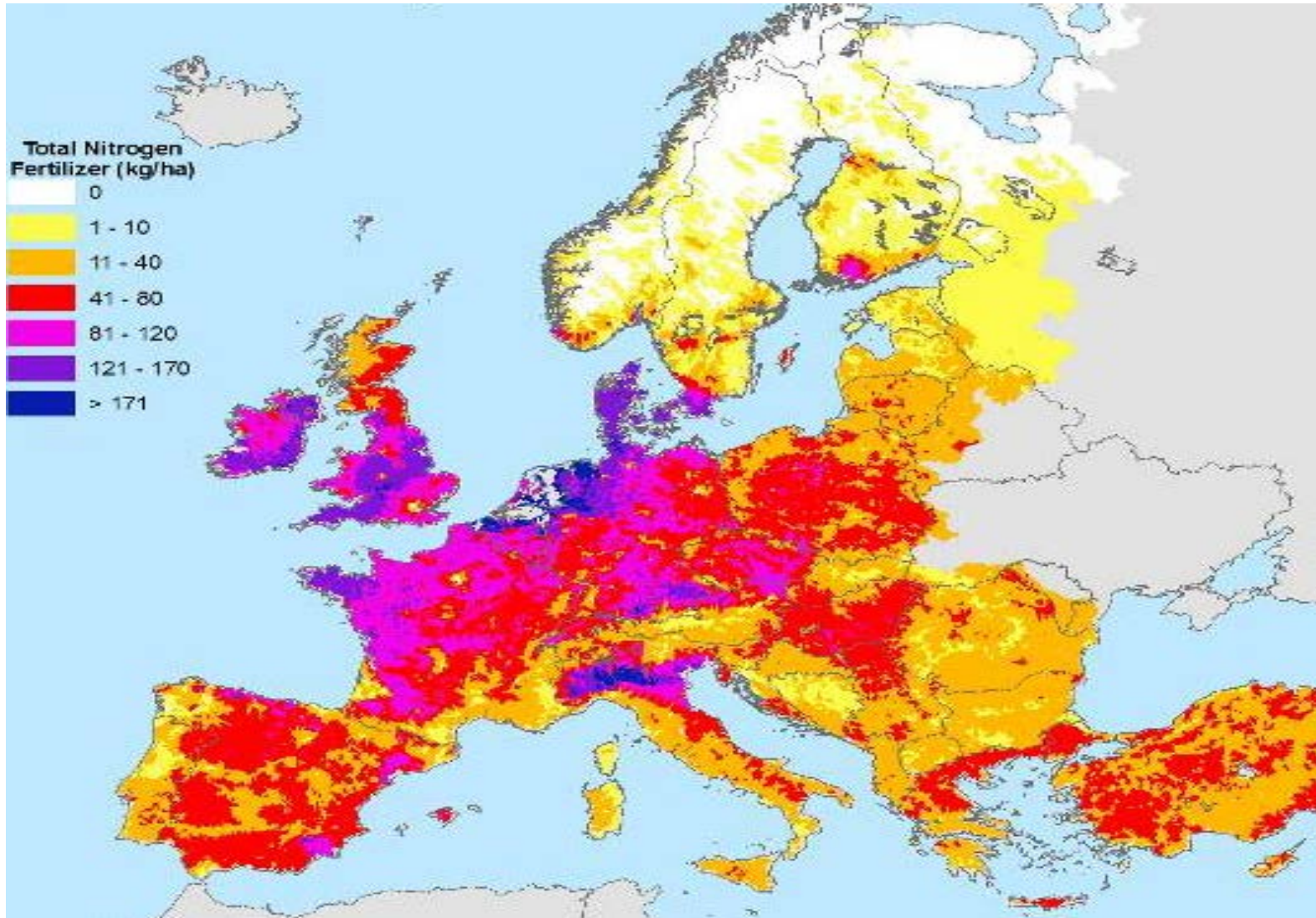
Current Opinion in Environmental Sustainability

Swaney et al. 2014

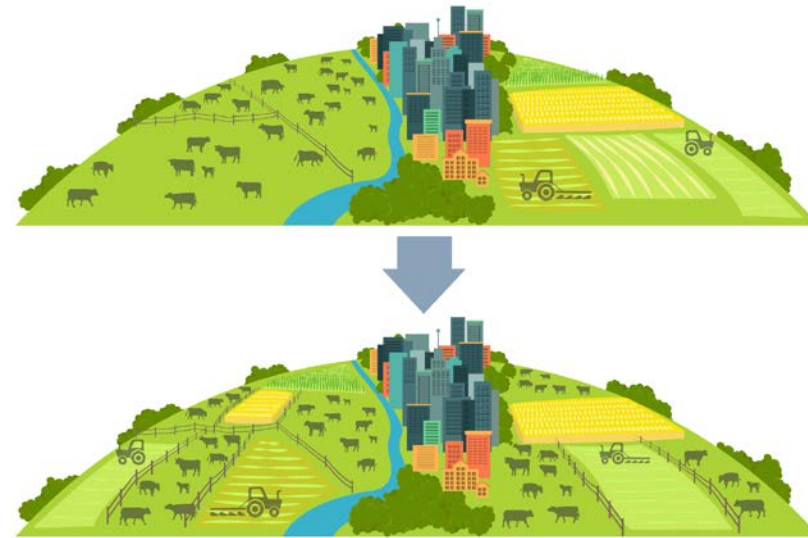


Howarth et al., 2012

# Fertilizer use EU perspective



# Solutions



## Barriers

Trade deals encourage the export of livestock products.

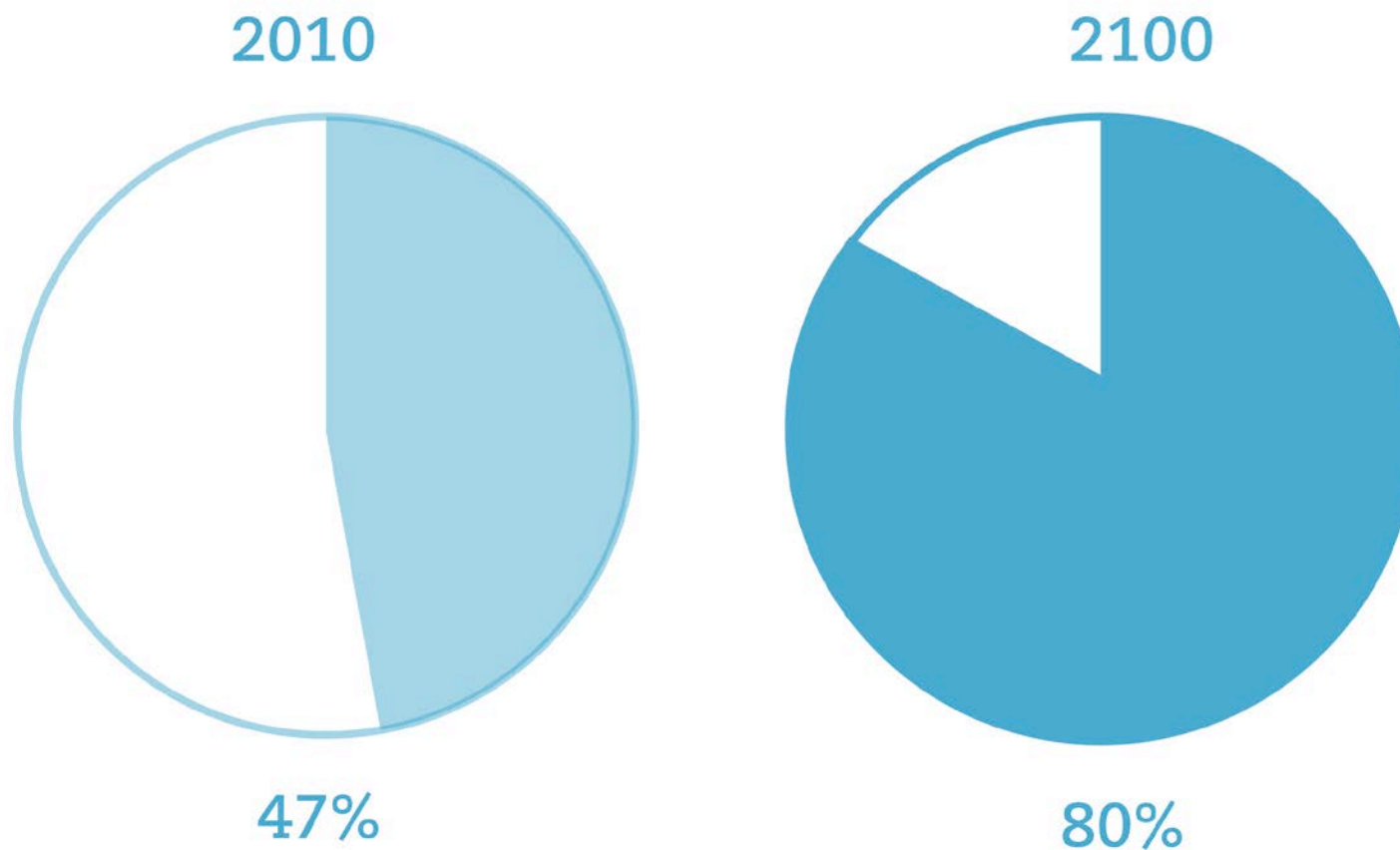
Strong and growing global demand for livestock products.

Low awareness of environmental and health issues.

EU scale: Baltic Sea catchment no hot spot.



# The Challenge.....for the Globe and the Baltic





## Baltic Sea Science Congress, Stockholm 19-23 Aug 2019

Welcome to Stockholm and the 12th Baltic Sea Science Congress 2019. In the Royal National Park, neighbouring the archipelago, Stockholm University will gather the marine research community for discussions on the last 10 years of Baltic Sea research and how it has adopted new interdisciplinary approaches and scientific disciplines. Policy aspects of the latest research will also be discussed.

This time we seek to provide new insights from the interlinked processes in the catchment and the coastal zone as growing research foci. The congress will present advances in our understanding of biogeochemical cycles in the open Baltic Sea as well as new approaches addressing genomics, population structure and function, evolutionary changes and how climate change and human impact changes the system.

**See you in Stockholm 19-23 Aug 2019!**

### UP-COMING BSSC2019 EVENTS

- 31 JAN** Early bird registration deadline
- 28 FEB** Abstract submission deadline
- 30 MAY** Registration deadline
- 19 AUG** **Baltic Sea Science Congress 2019**

[Show all events](#)



- 1** **Change and Impacts of External Forcing**  
Climate, Catchment and Anthropogenic drivers and pressures. [Read more](#)
- 2** **Coastal Seascapes and Dynamics**  
Coastal processes, Biogeochemical processes and Ecosystem goods and services. [Read more](#)
- 3** **Causes and consequences of Baltic Sea ecosystem dynamics**  
Fluxes and transports and Baltic Sea Ecosystem structure and functioning. [Read more](#)
- 4** **Monitoring, Observations and Assessment systems**  
Session includes BONUS workshop *Technology for Science*. [Read more](#)
- 5** **Policy and management/assessment strategies**  
How to make policy-makers better informed by scientific developments.

