How to Achieve A Good Nutrient Balance in Our Environment

The Key to a Healthy Planet, Healthy Living!

Brought to you by your good friends from the

Global Nutrient Cycle Project (GNC)

and

Toward an International Nitrogen Management System Project (INMS)

9th GEF International Waters Conference
Marrakesh, Morocco

Global foundations for reducing nutrient enrichment and oxygen depletion from land based pollution in support of the Global Nutrient Cycle

gef UN environment GPA GPNM

IWC9

INMS

gef UN environment CEH Centre for Ecology & Hydrology INI

Meet your **Nutrient Medics**

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Nutrients…a pain in the **Environmental Neck?**

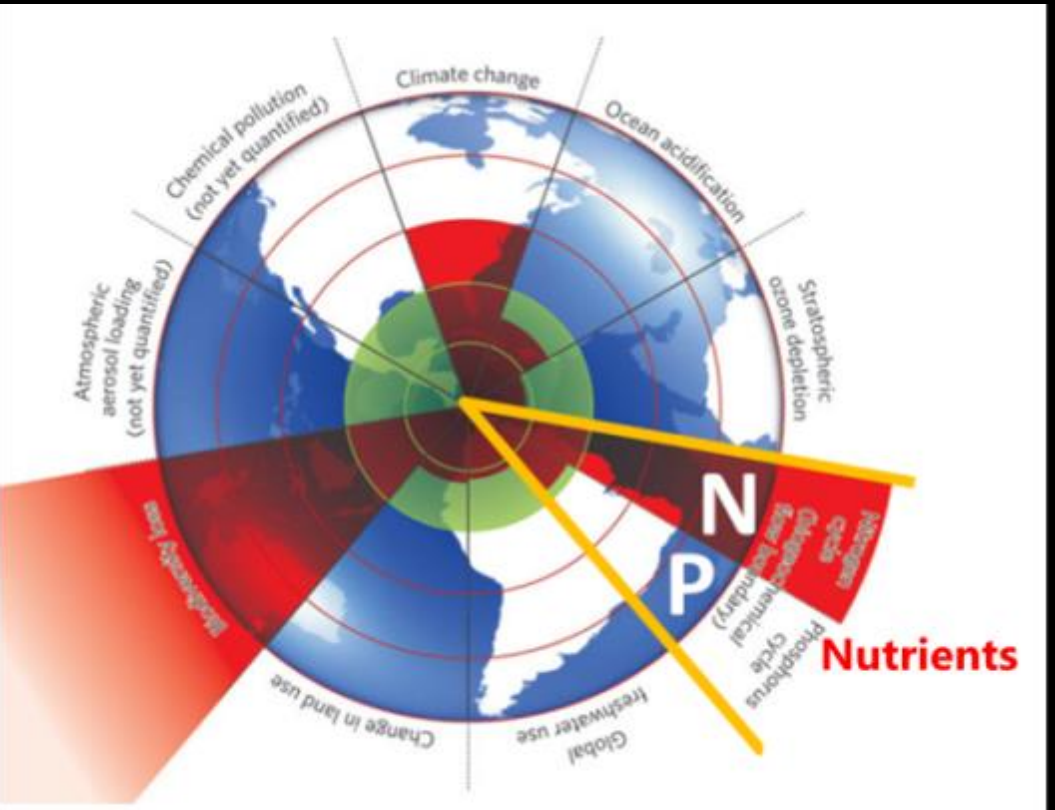
How can we help?

Nutrients…a challenge?

Nutrients…a good thing!

But too much or too little…not so good!

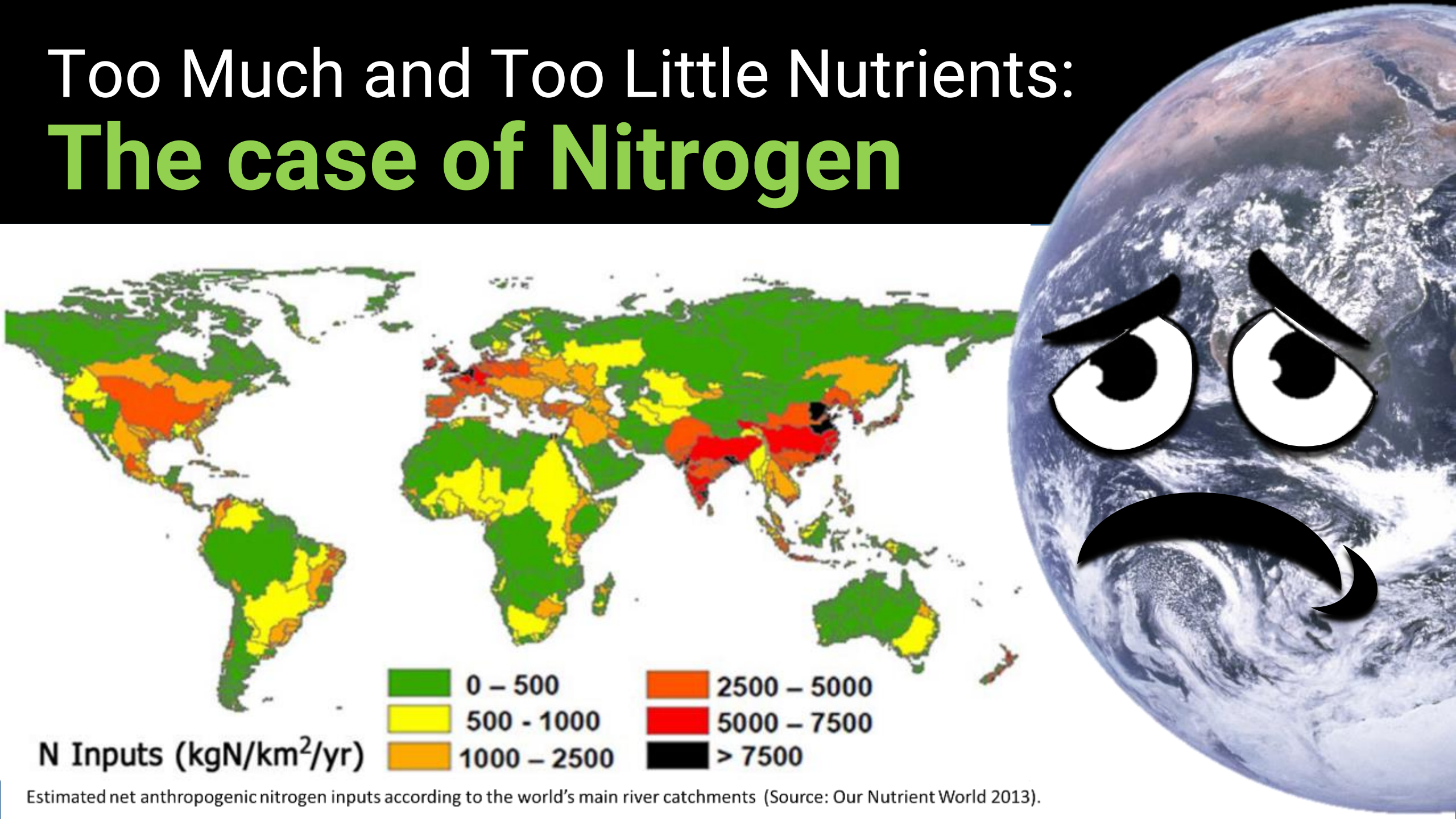
Planetary Boundary for Nitrogen is greatly exceeded; boundary for Phosphorus is being approached



Source: Johan Rockström et al., Nature 461, 472-475 (24 September 2009)

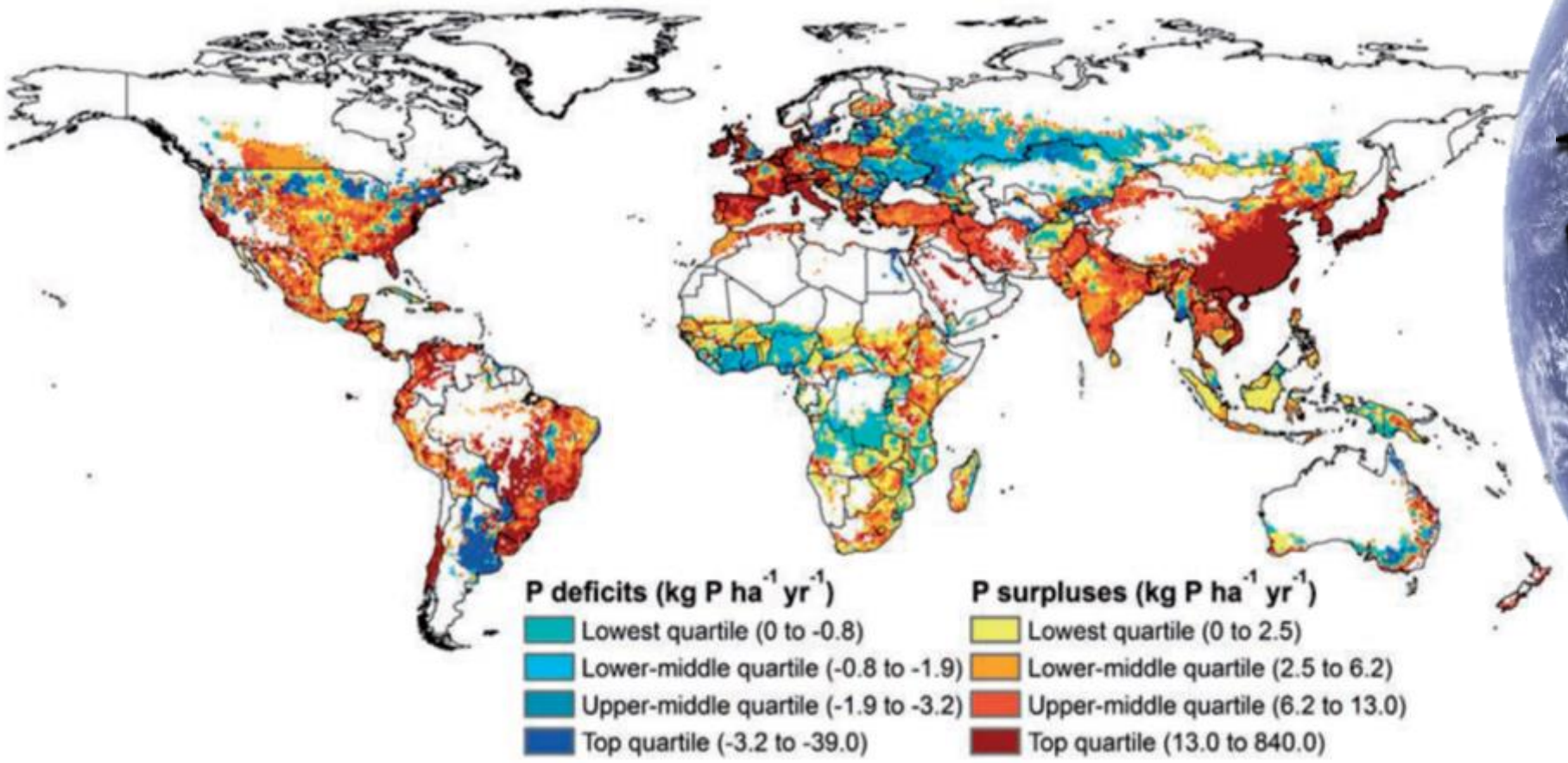
Planetary boundaries define safe operating space for humanity with respect to the Earth system

Too Much and Too Little Nutrients:
The case of Nitrogen



Estimated net anthropogenic nitrogen inputs according to the world's main river catchments (Source: Our Nutrient World 2013).

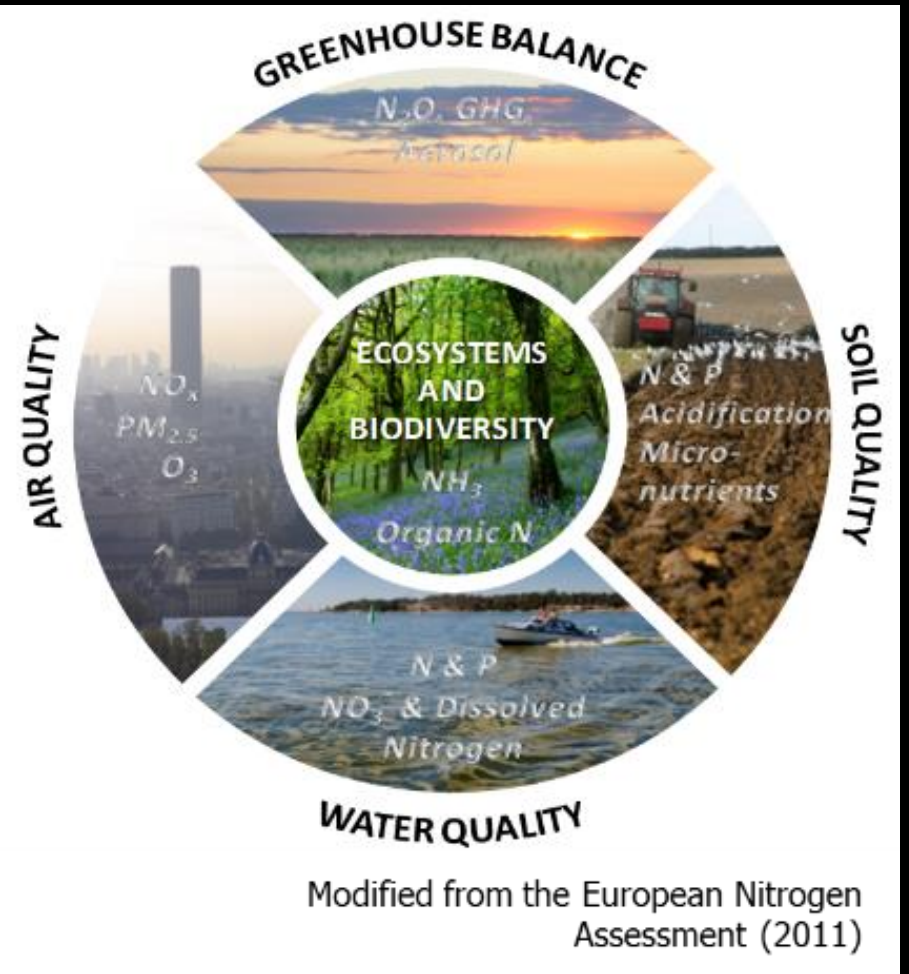
Too Much and Too Little Nutrients:
The case of Phosphorous



Estimated global phosphorus surplus and deficit. Source: Our Nutrient World, 2013, citing (MacDonald et al., 2011)

Nutrients….a good thing!

But too much or too little… not so good!



Modified from the European Nitrogen Assessment (2011)

- The **WAGES** of too much or too little Nitrogen and Phosphorus
- Multiple impacts across several environmental areas
  - **W**ater quality
  - **A**ir quality
  - **G**reenhouse balance
  - **E**cosystems
  - **S**oil quality

Too much nutrients….
Sources

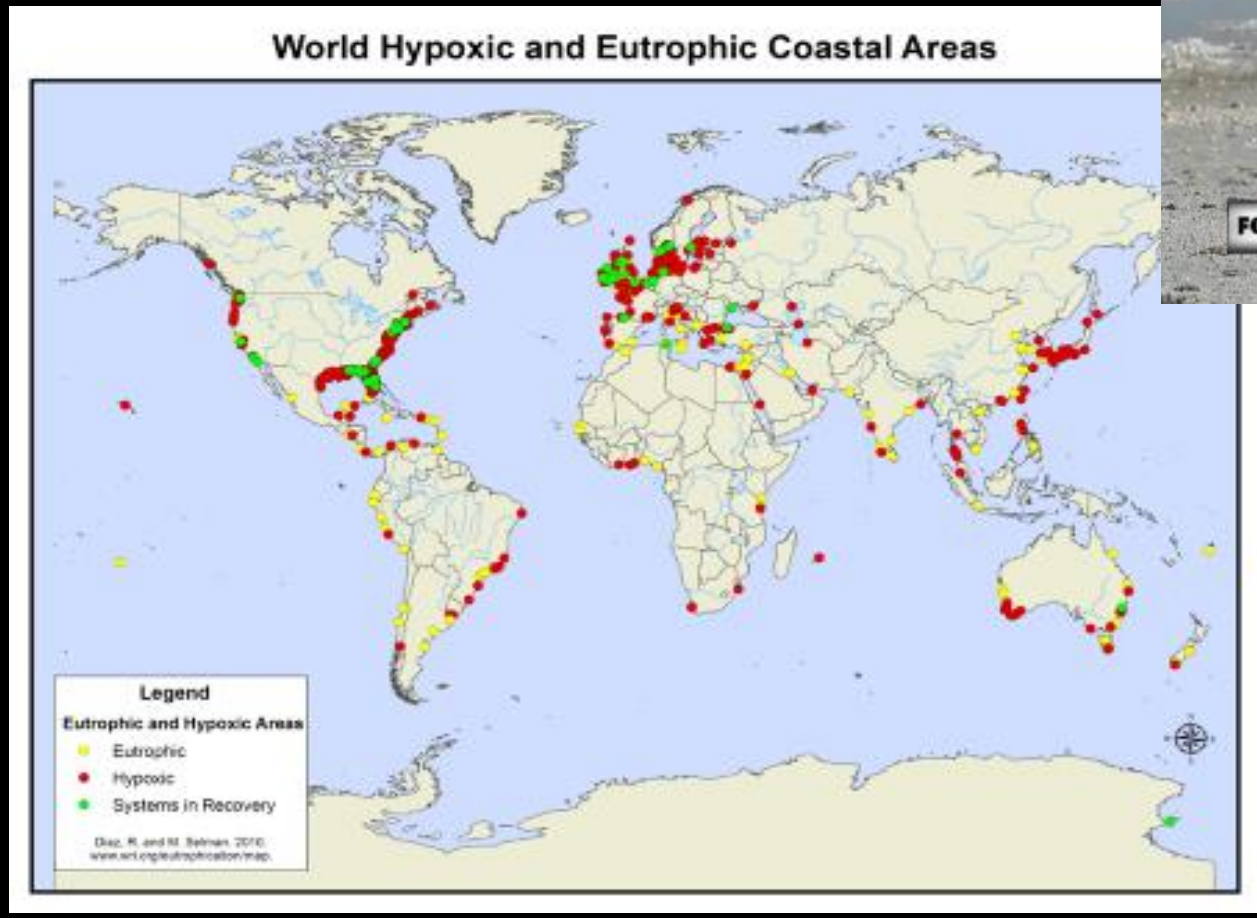
Untreated wastewater

Fertilizer excess runoff

Livestock waste runoff

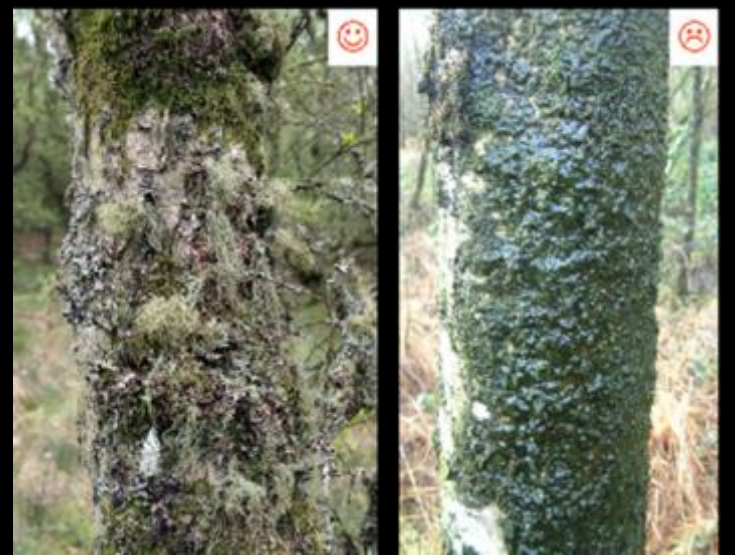
Air pollution

Too much nutrients….
Impacts




3 kids died, 64 taken ill due to red tide poisoning

Article from the *Philippine Daily Inquirer* on May 19, 1995, reporting victims who ate green mussels collected from Manila Bay. Used with permission.



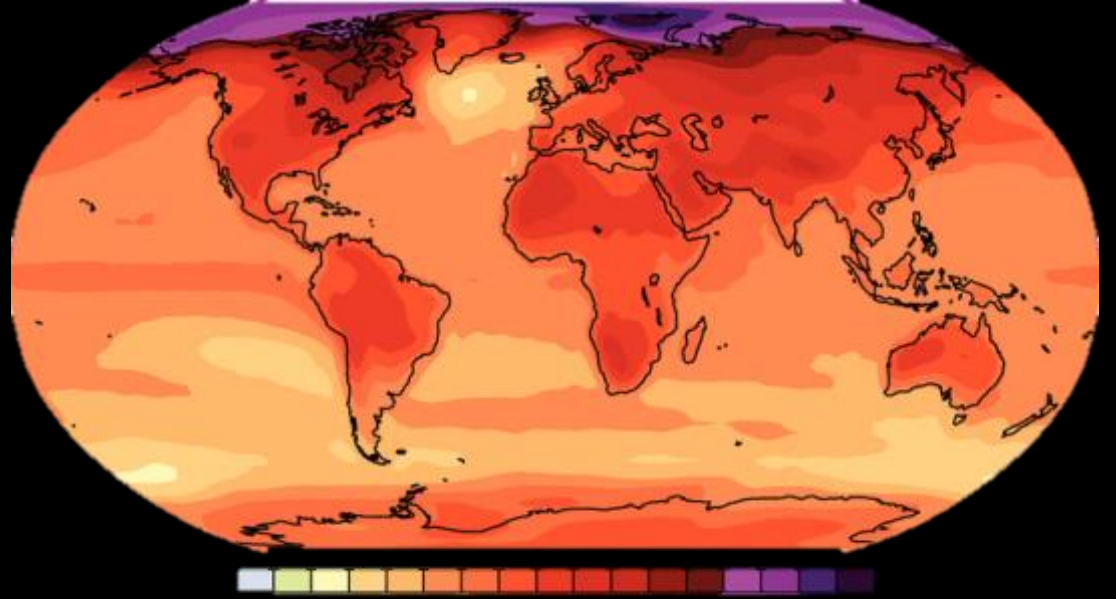
Too little nutrients…

Harvest more than is replaced by nutrients - **nutrient mining**, reduced crop yield and failure

Land degradation

Poor nourishment, social conflict

And on top of all that….
Climate change

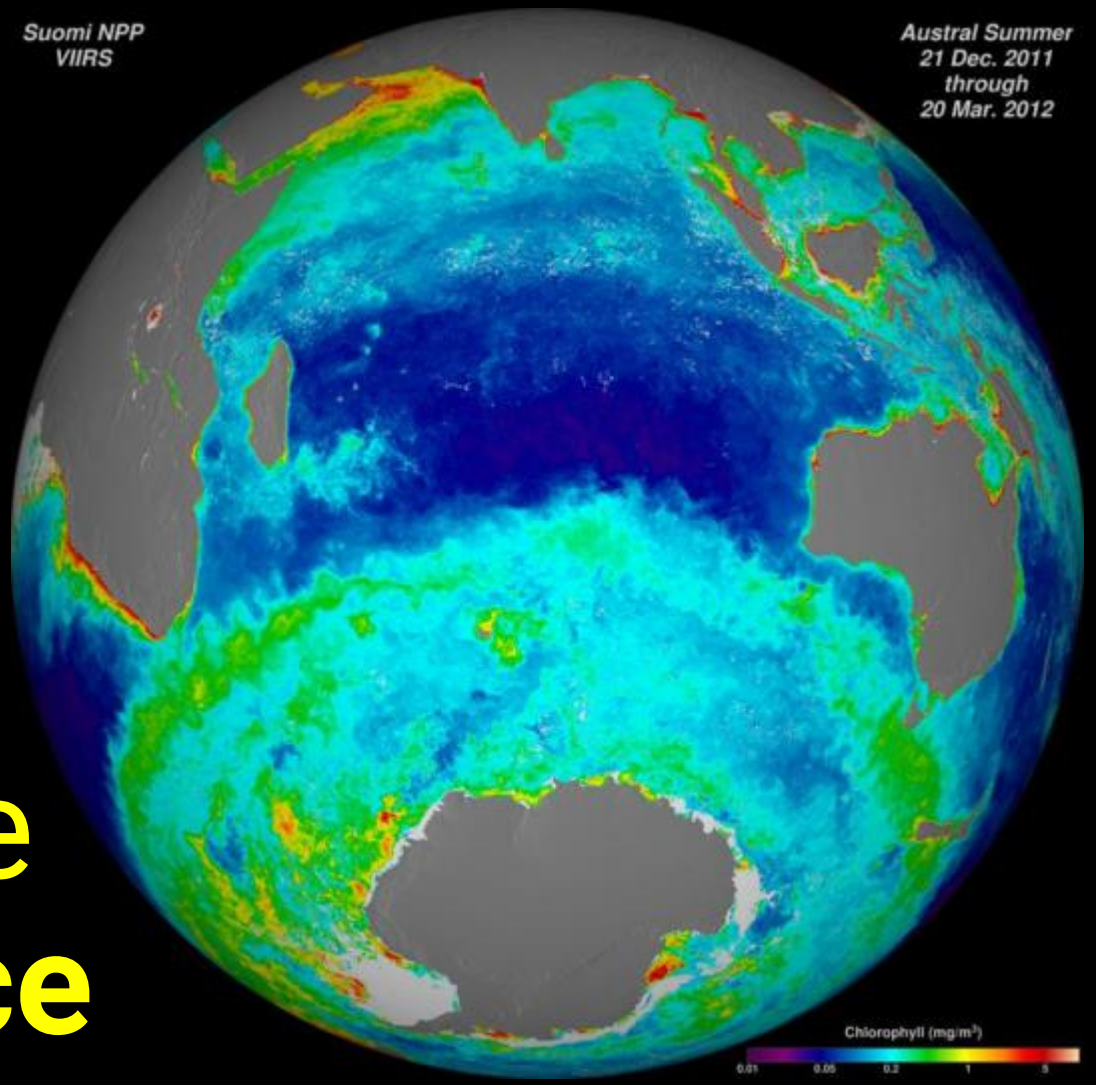


Bleached corals…further weakened due to nutrient pollution

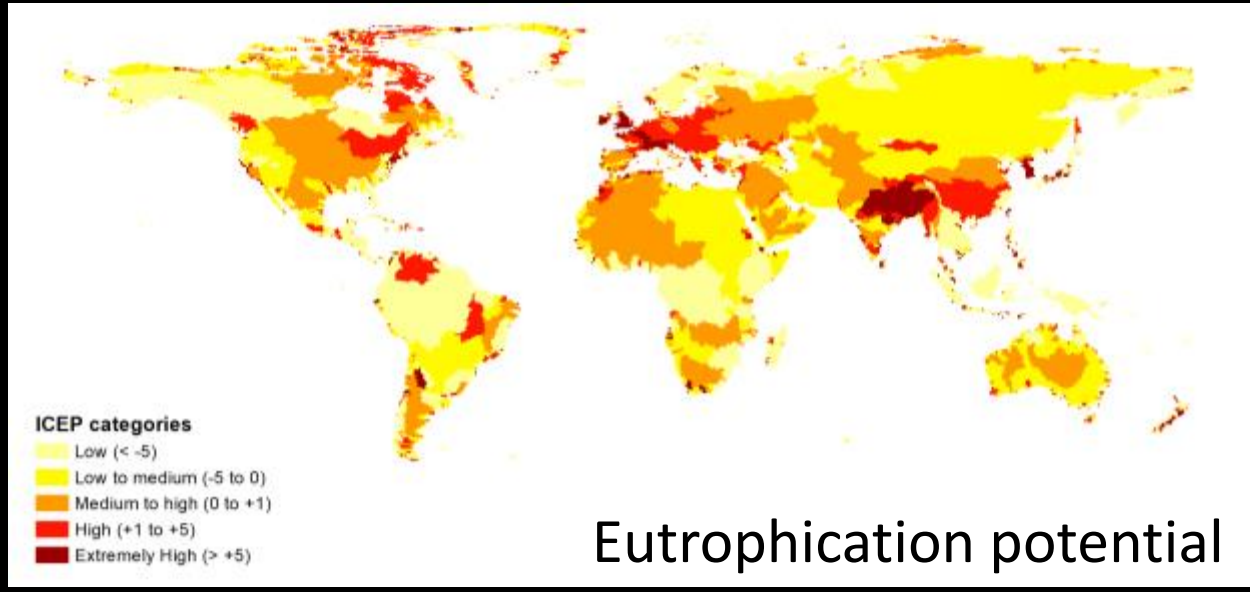
Deoxygenation of marine waters

Releases of nitrous oxide

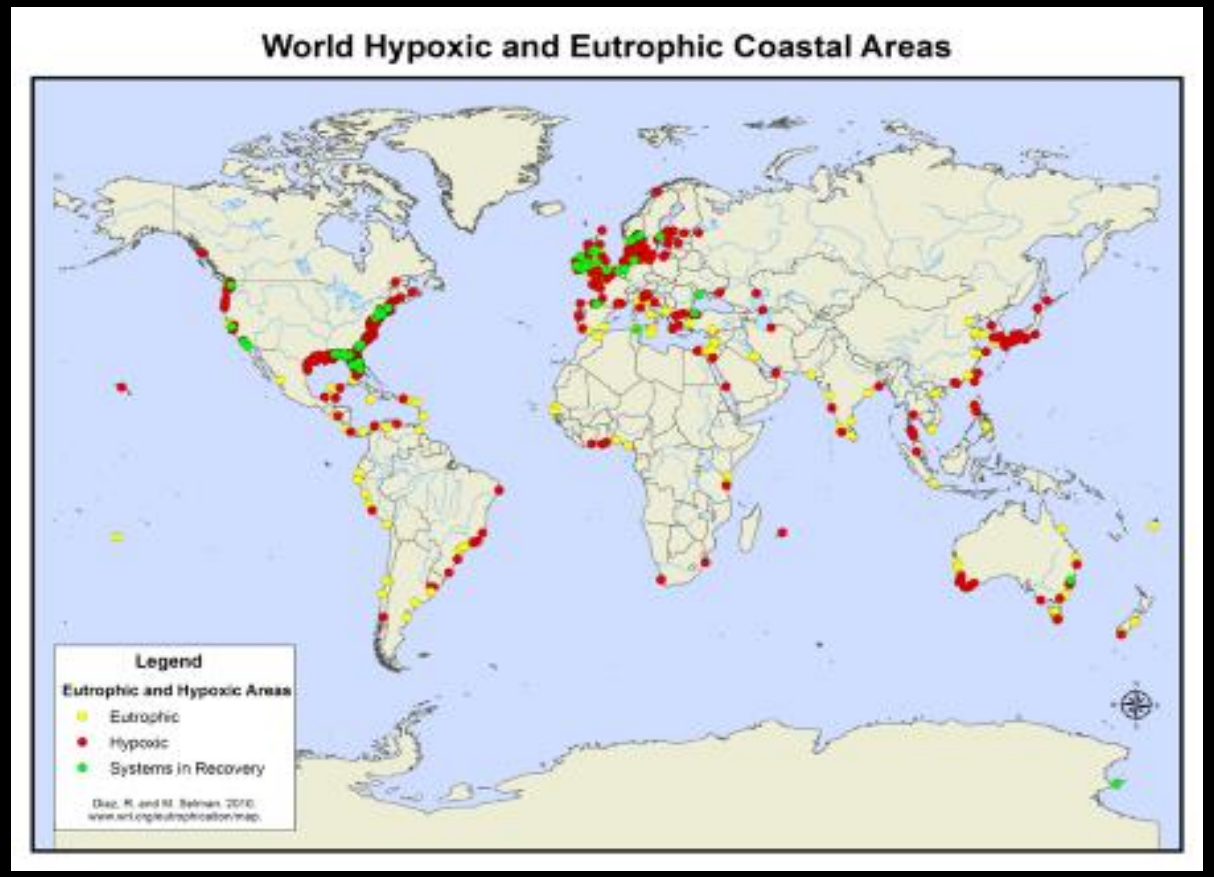
How big is big?
Measuring up the **Nutrient Nuisance**



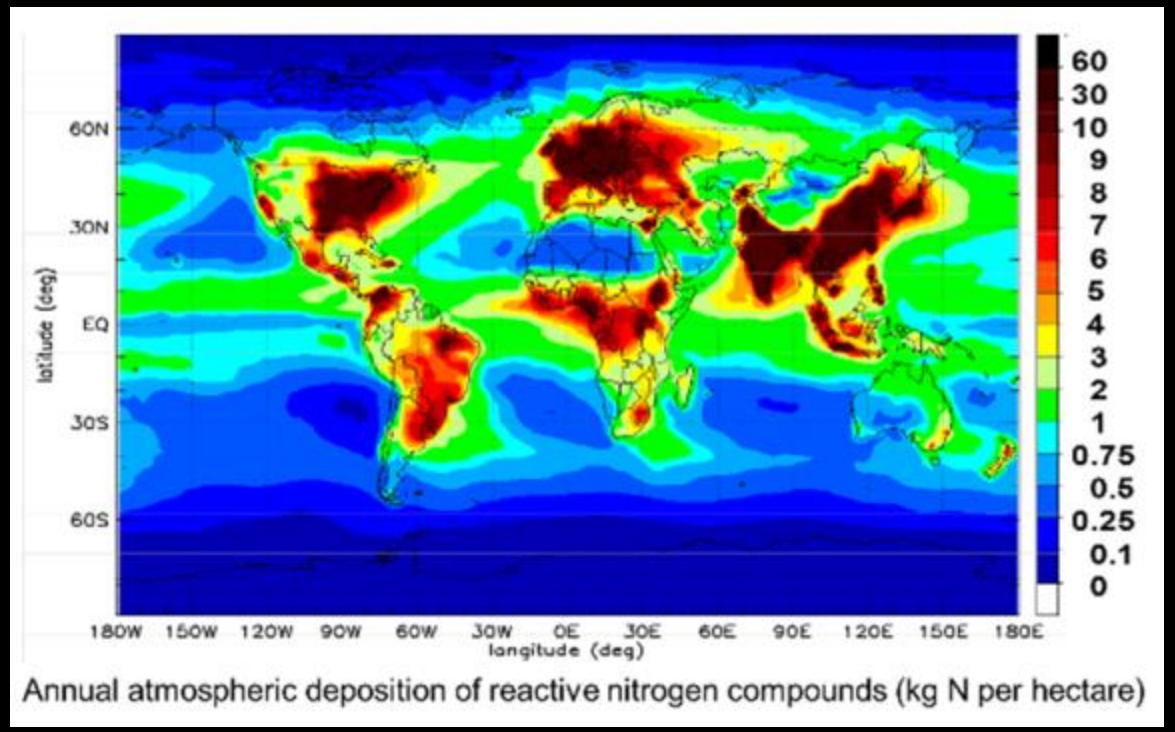
Measuring up the **Nutrient Nuisance**



Eutrophication potential



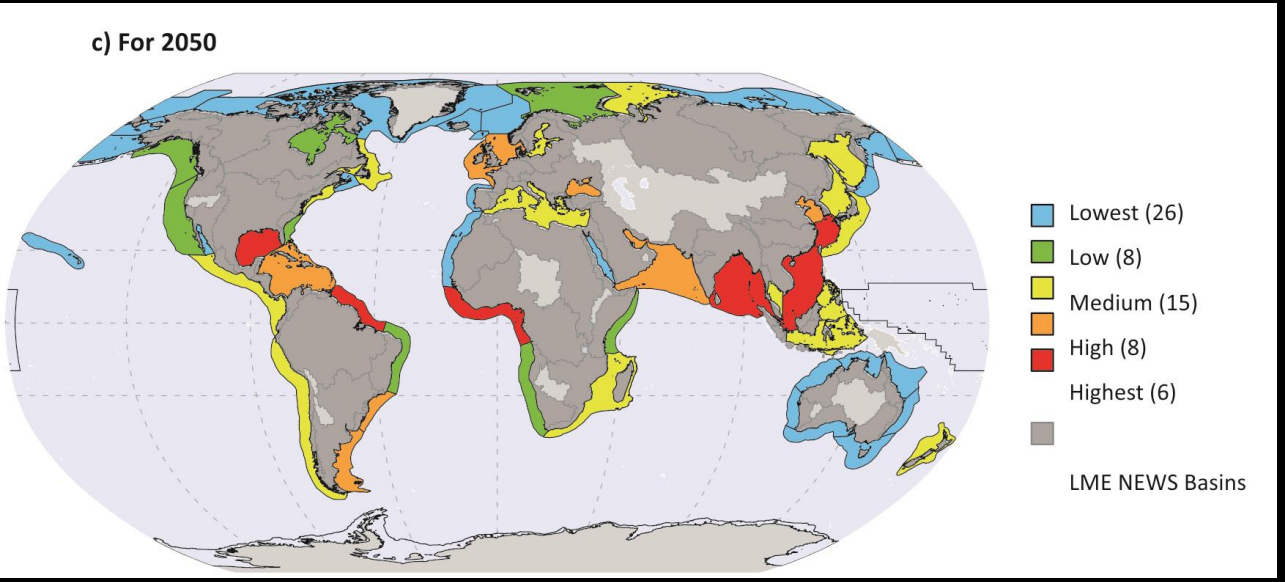
Deadzone occurrence



Atmospheric deposition of N

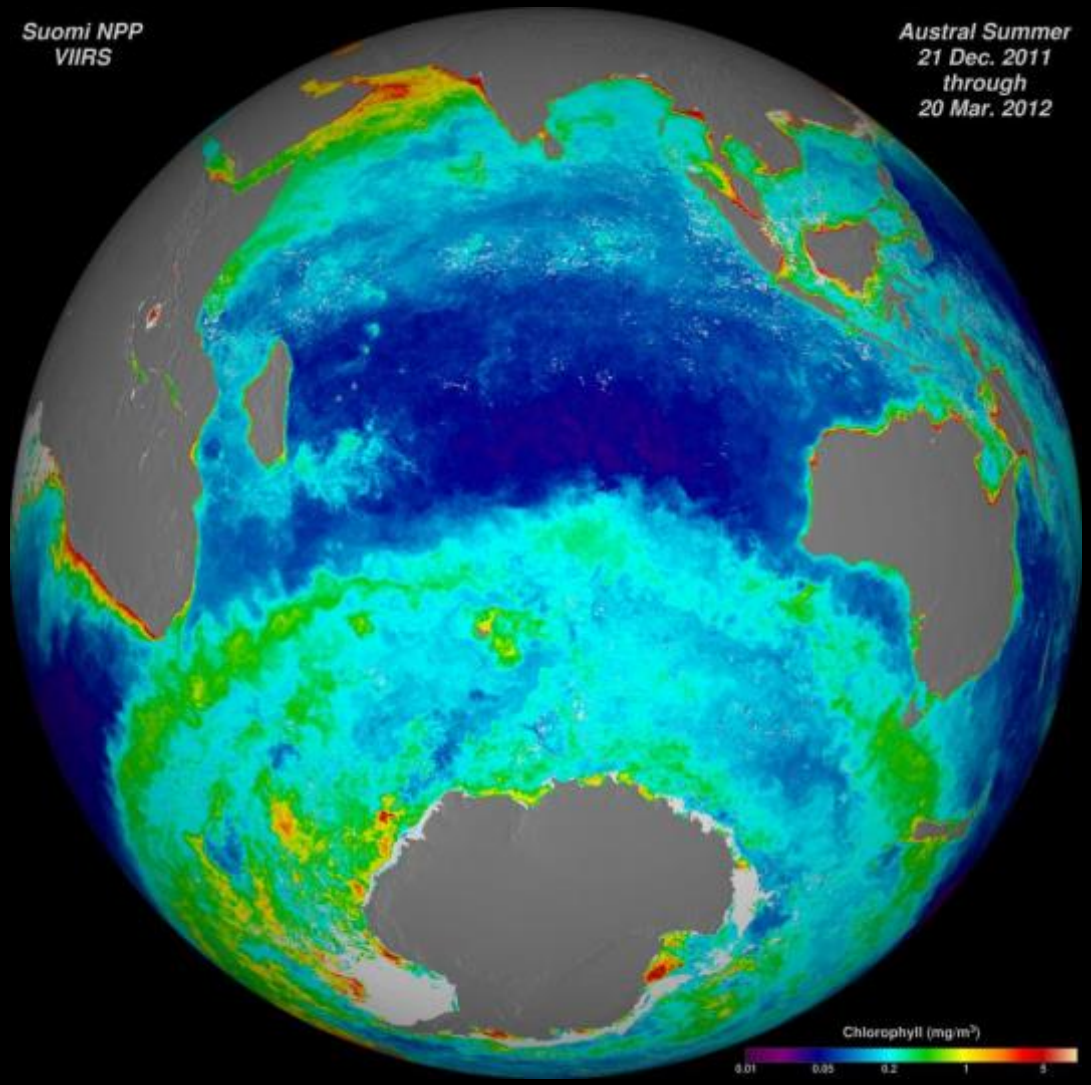
Measuring up the **Nutrient Nuisance**

Scenarios: nutrient risk (from GEF-TWAP Project)



Oxygen content in Gulf of Mexico

Ocean Chlorophyll Concentrations
Source: NASA



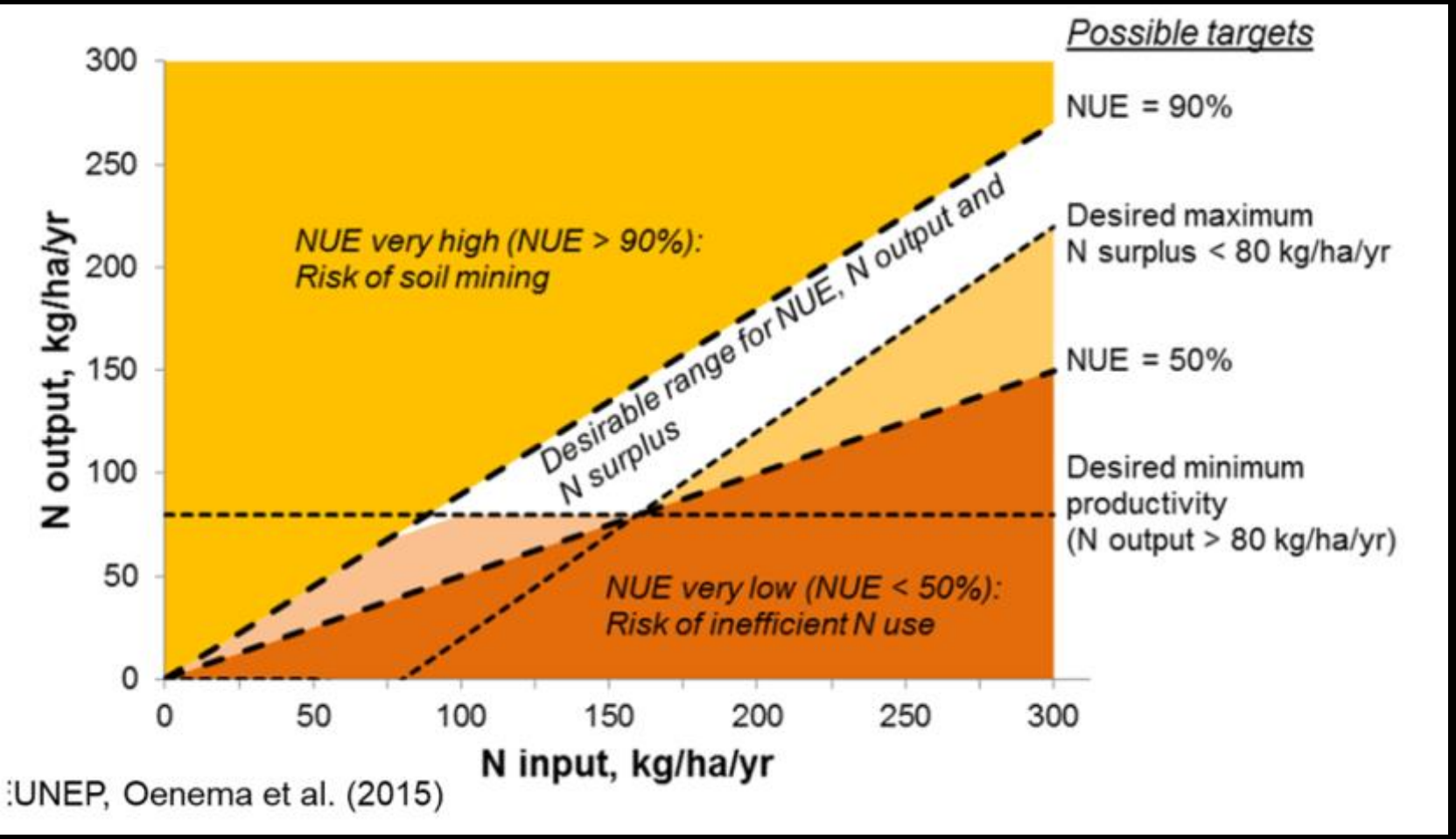
“Nickking Nutrients **NOW**!”

We got the **Tools to Tackle!!**

Global foundations for reducing nutrient enrichment and oxygen depletion from land based pollution in support of the **Global Nutrient Cycle**

INMS

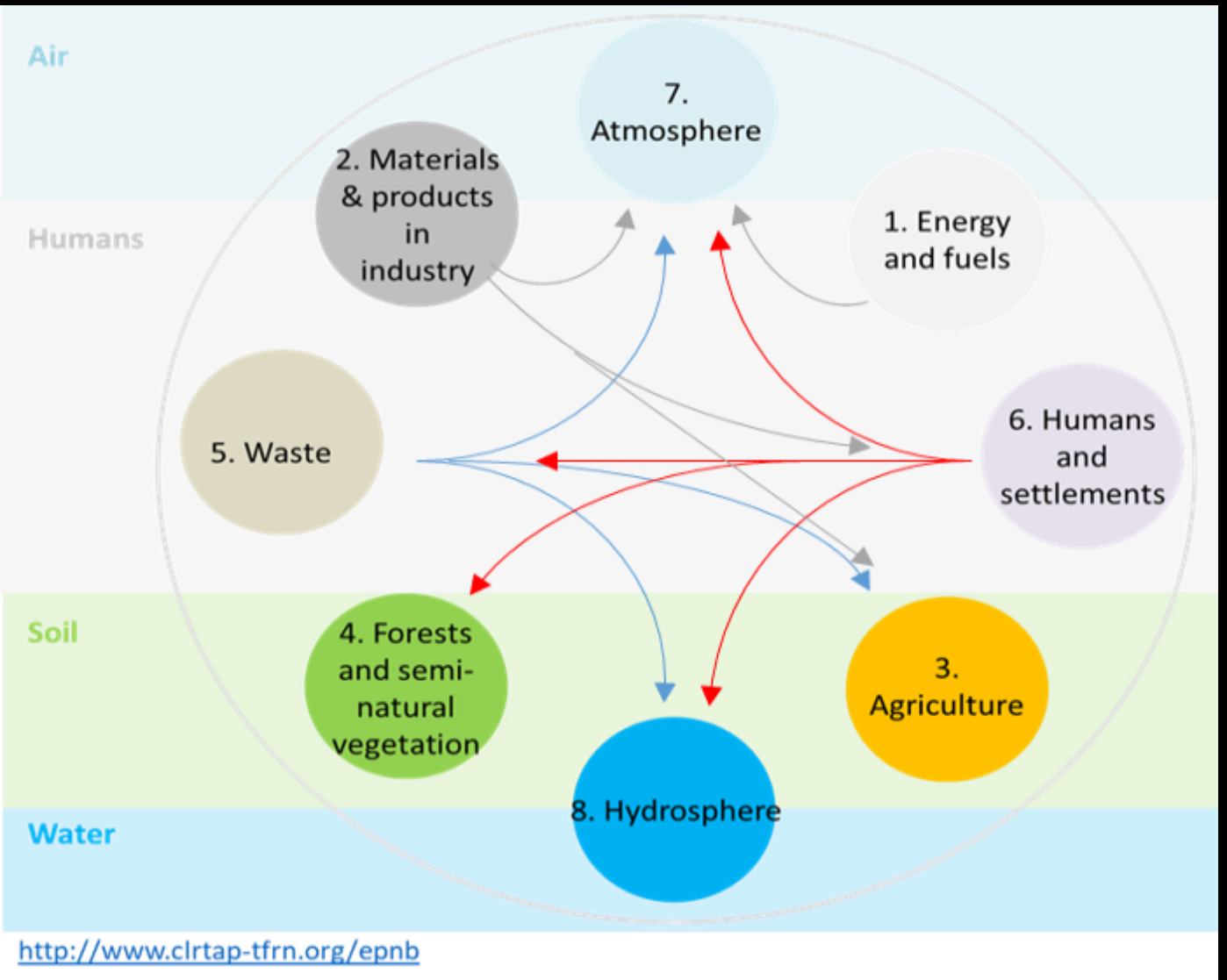
Tools
Estimate **Nitrogen Use Efficiency** (NUE)



For crop systems

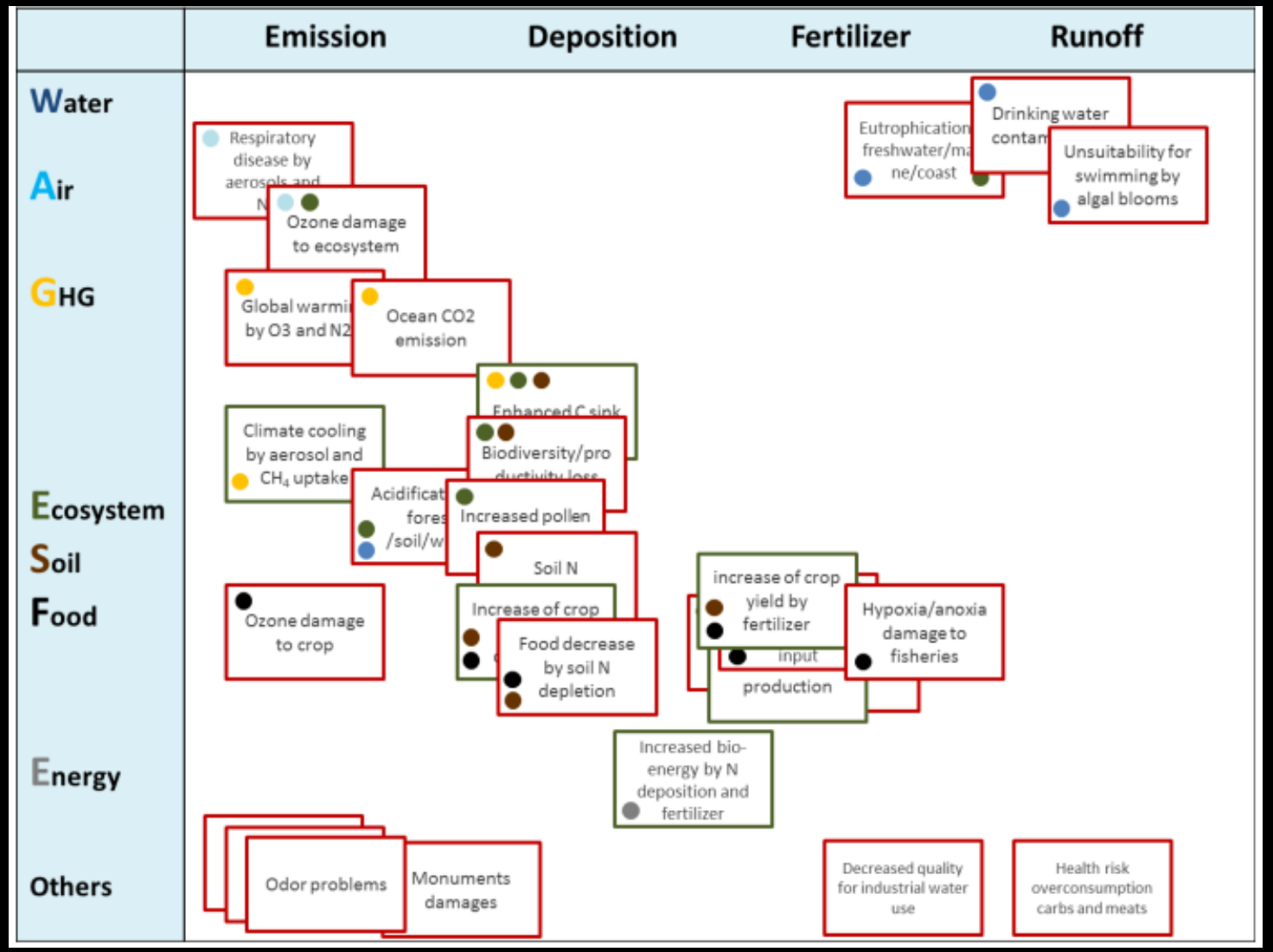
- **Determine N surplus, N input, N output and input/output ratio (NUE)**
- Compare agricultural systems
- Compare countries
- Improve efficiencies to **reduce costs and enhance environmental performance**

Tools
National Nitrogen Budgets



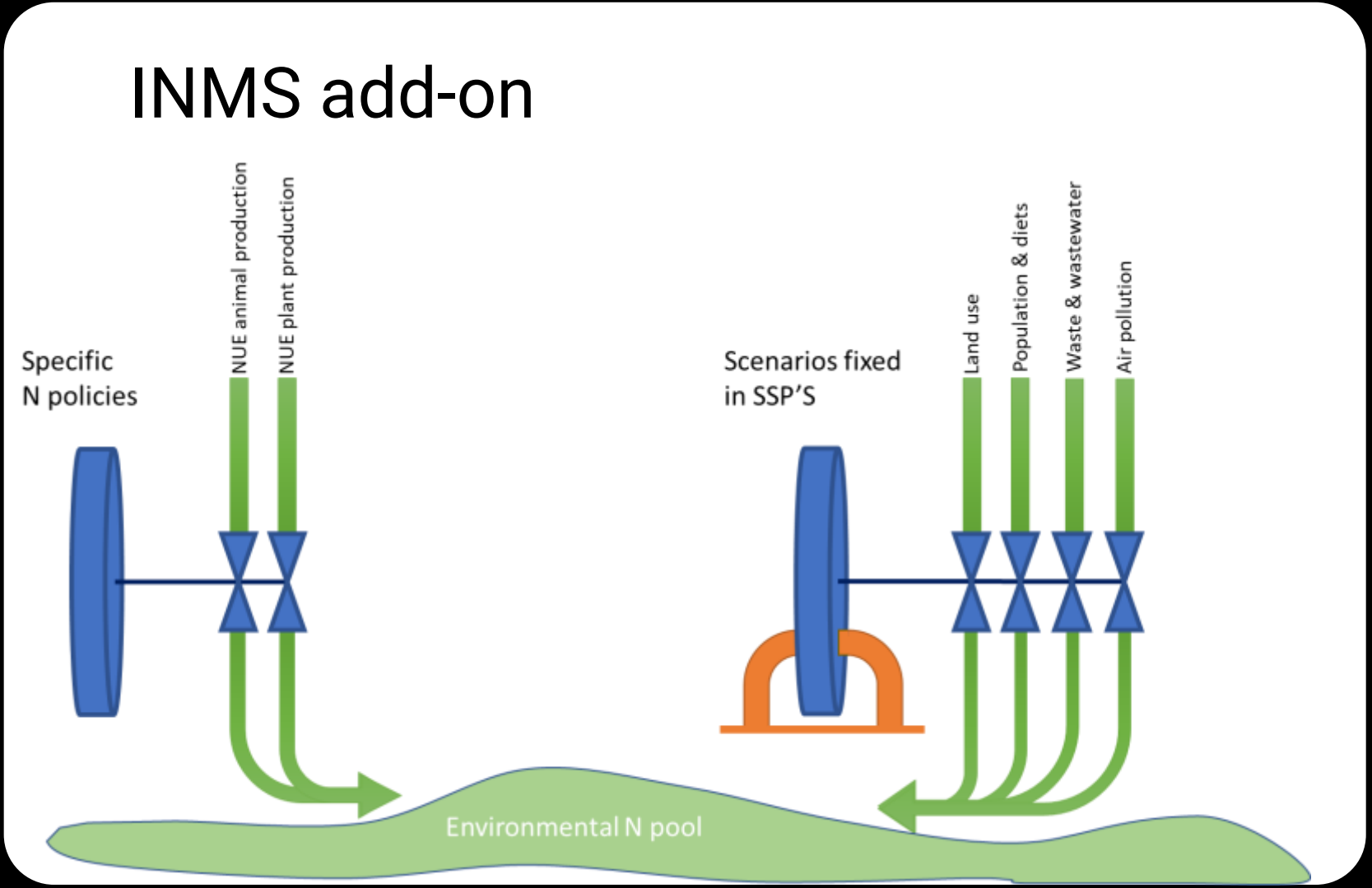
- Divide a country into pools
- Define flows between pools
- Quantify individual flows
- Identify discrepancies, derive “most probable” solutions
- Discover data limitations and improve data quality
- Rank flows and their respective impacts
- Benchmark different countries
- Derive trends

Tools
Threat – benefits mapping



- Identify multiple issues caused by single emission
- Weigh potential benefits against damage
- Cluster different effects by environmental media, by occurrence
- Allow for the allocation of the cause, or the causing agent

Tools
Future nitrogen scenarios



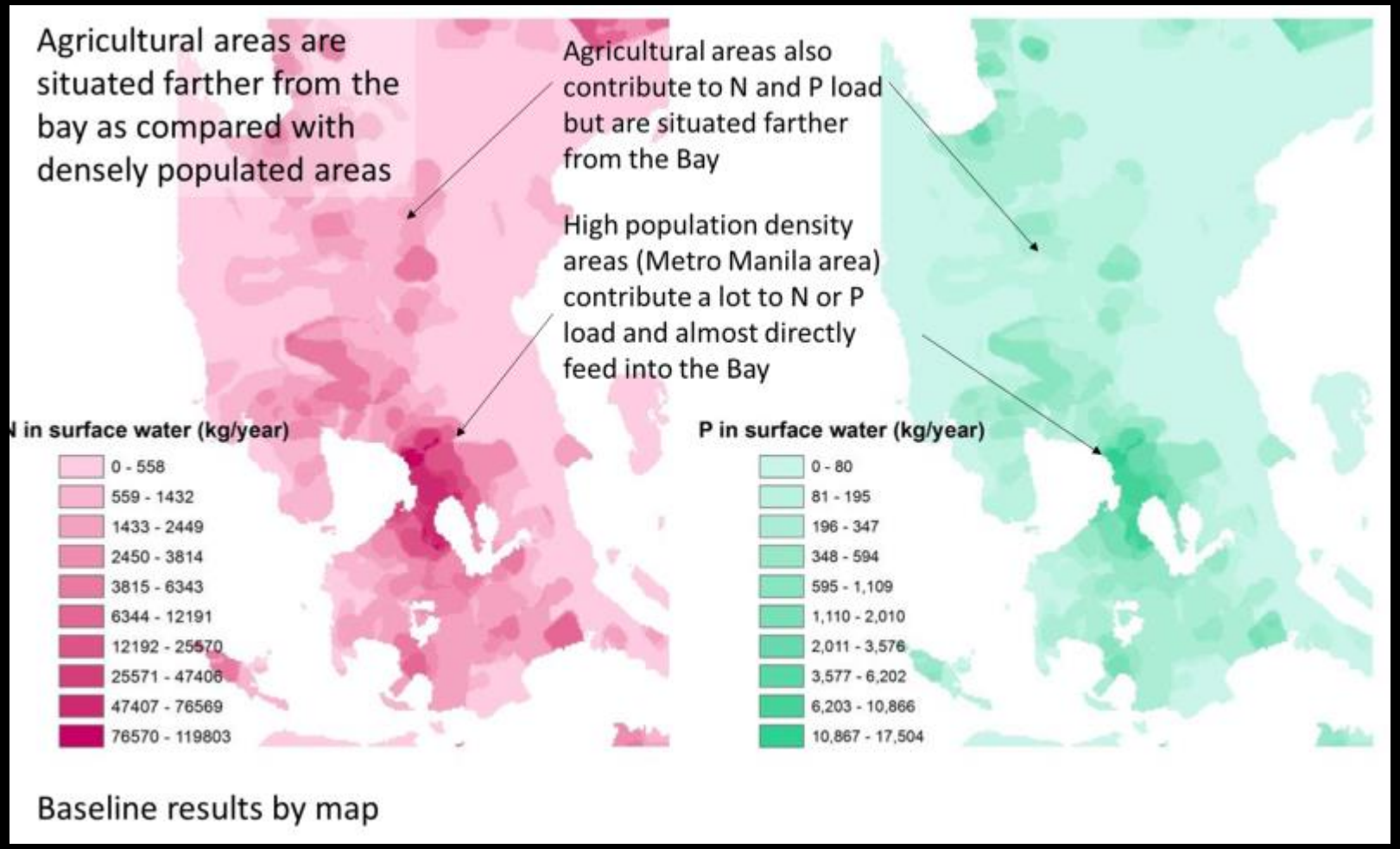
Climate Scenarios (IPCC):

- Socioeconomic Pathways (SSP's)
- GHG concentration paths (RCP's)

Matrix (5 X 4; some infeasible)

- Extends to 2100
- Rich scientific dataset

Tools
Watershed-based **nutrient flux modelling**



Baseline results by map

- **Example from Manila Bay, Philippines**
  - Population
  - N and P inputs
  - Sewage connections
  - Sewage treatment level
- Scenario evaluation based on developmental pathways

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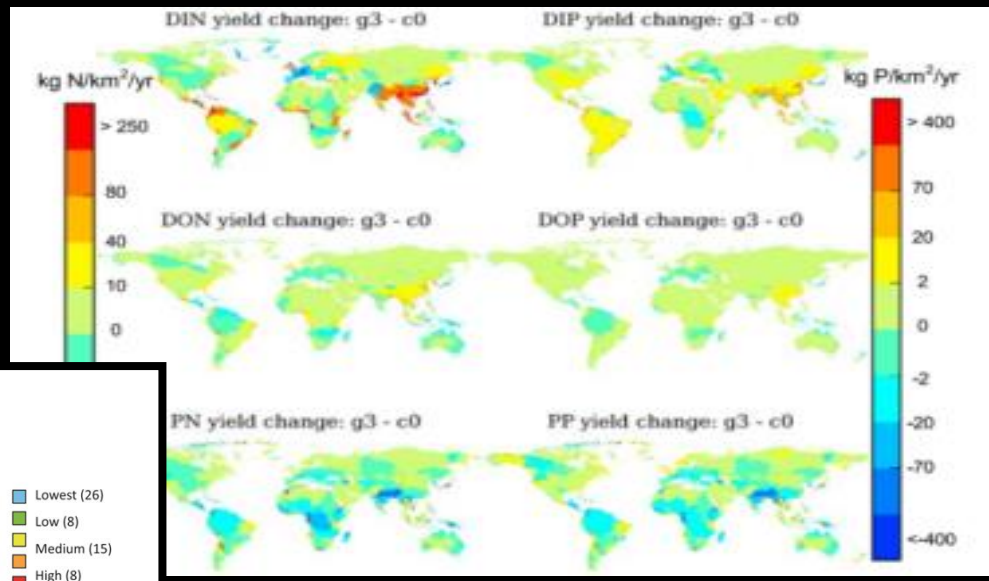
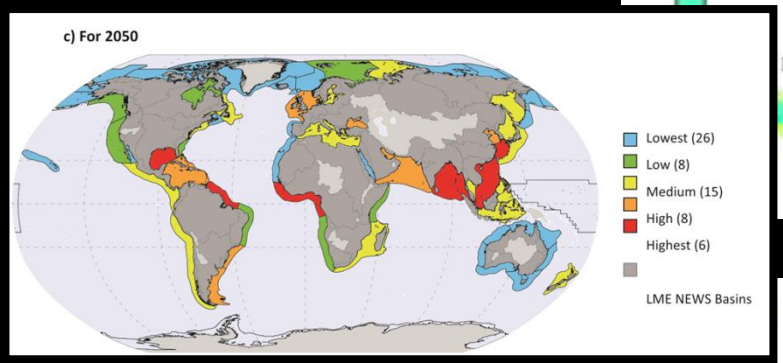
Tools

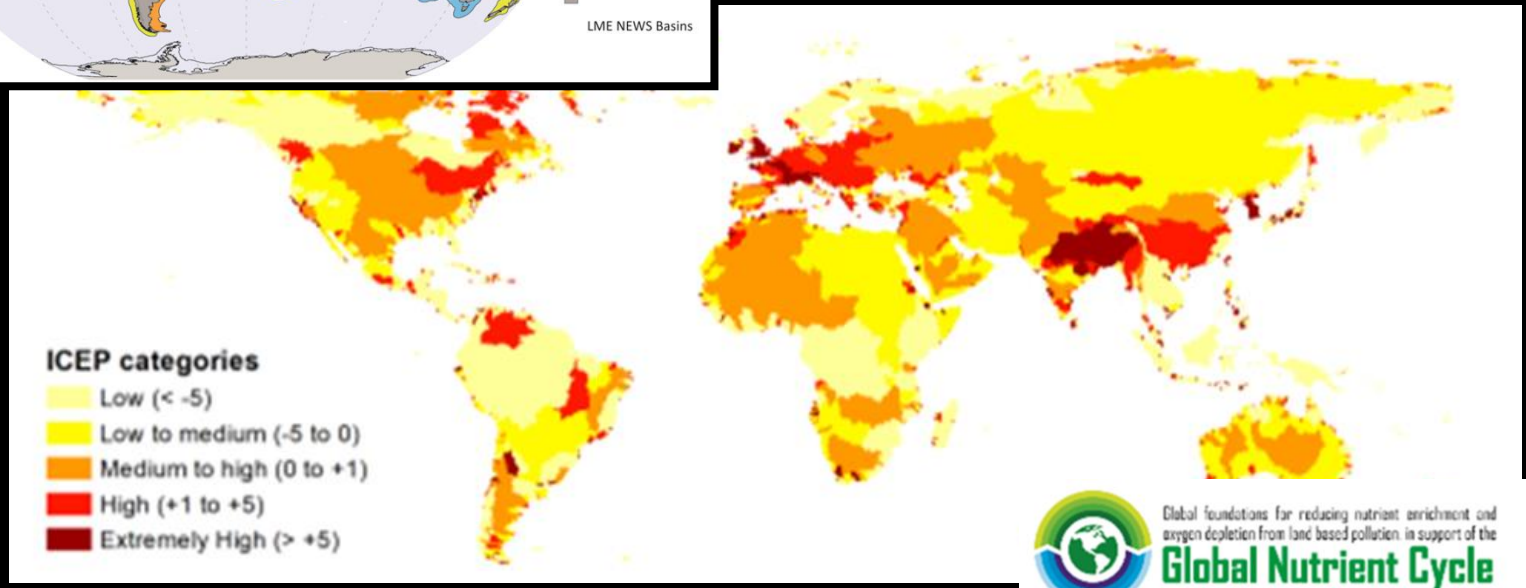
Predicting coastal eutrophication

Looking to year 2050

- Based on the **Global NEWS model** - 6,000 river basins
  - Climate/soils
  - Land use/activities
  - Population
- **Index of Coastal Eutrophication Potential (ICEP)**
  - Ratio between delivery of N, P and Si from watershed
- Indicate relative dominance between diatoms and algal species (leads to eutropic conditions)







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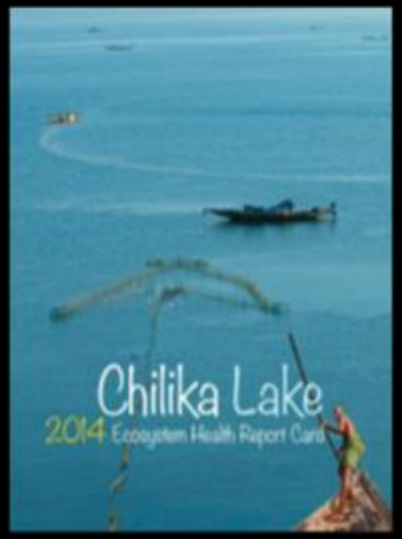
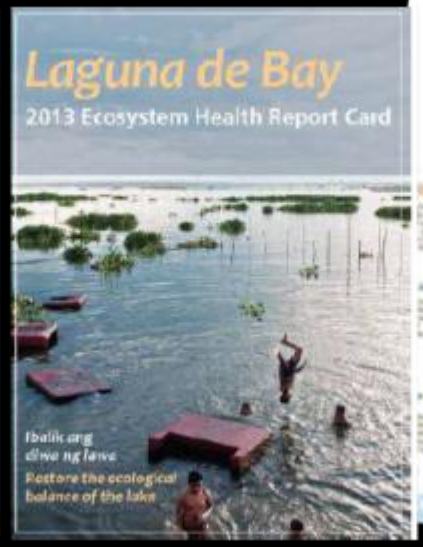
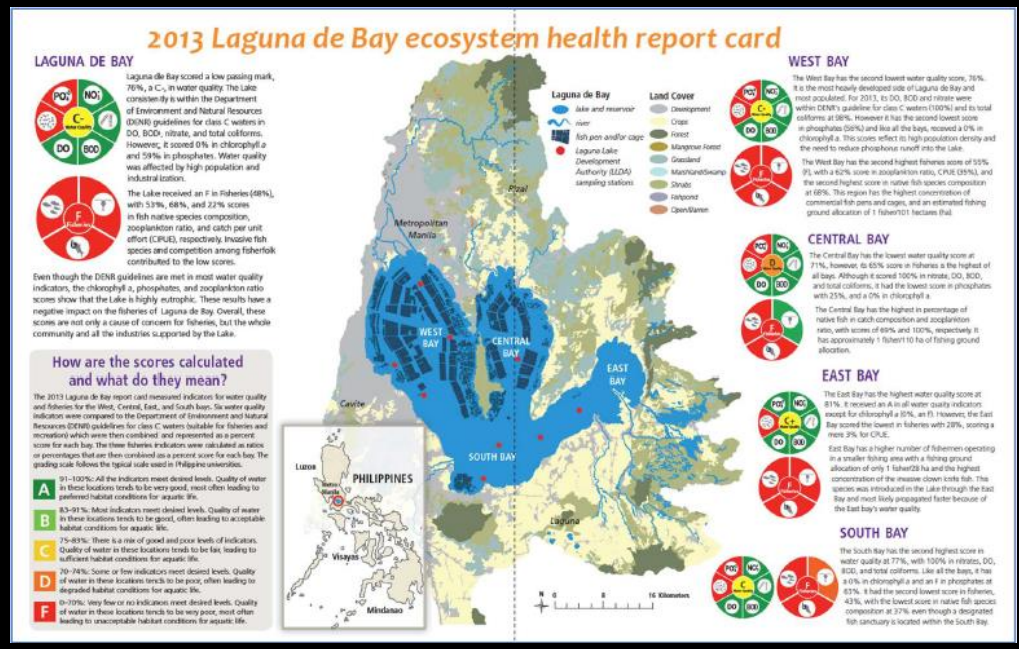
Tools
Ecosystem Health Report Cards

- Parameter selection
- Set limits and assign health scores
- Collect data; analyze and report







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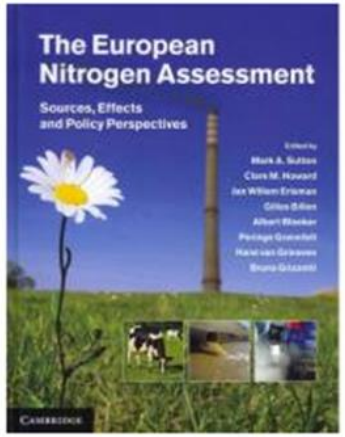
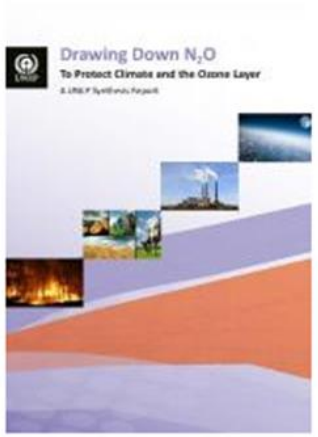
Tools
Publishing towards policy impact



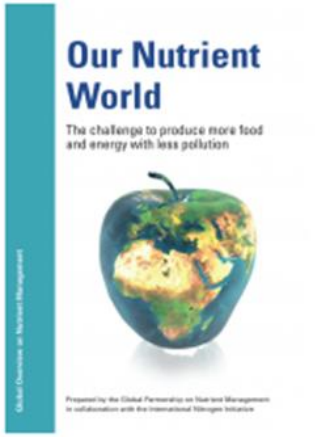
European Nitrogen Assessment...

M.A. Sutton; C.M. Howard; J.W...



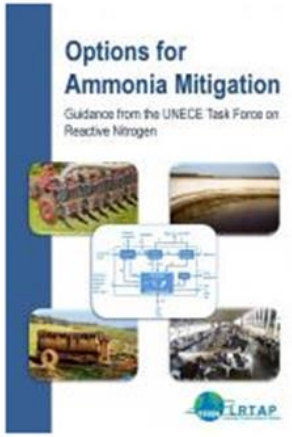
Drawing Down N2O to Protect...

J. Alcamo; S.A. Leonard; A.R...



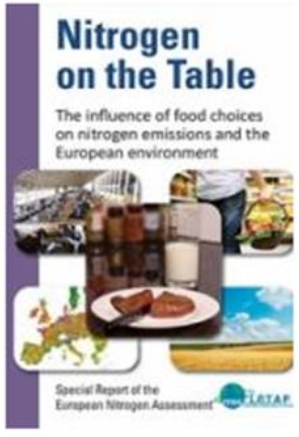
Our nutrient world: the...

M.A. Sutton; A. Bleeker; C.M...



Options for Ammonia...

S. Bittman; M. Dedina; C.M....

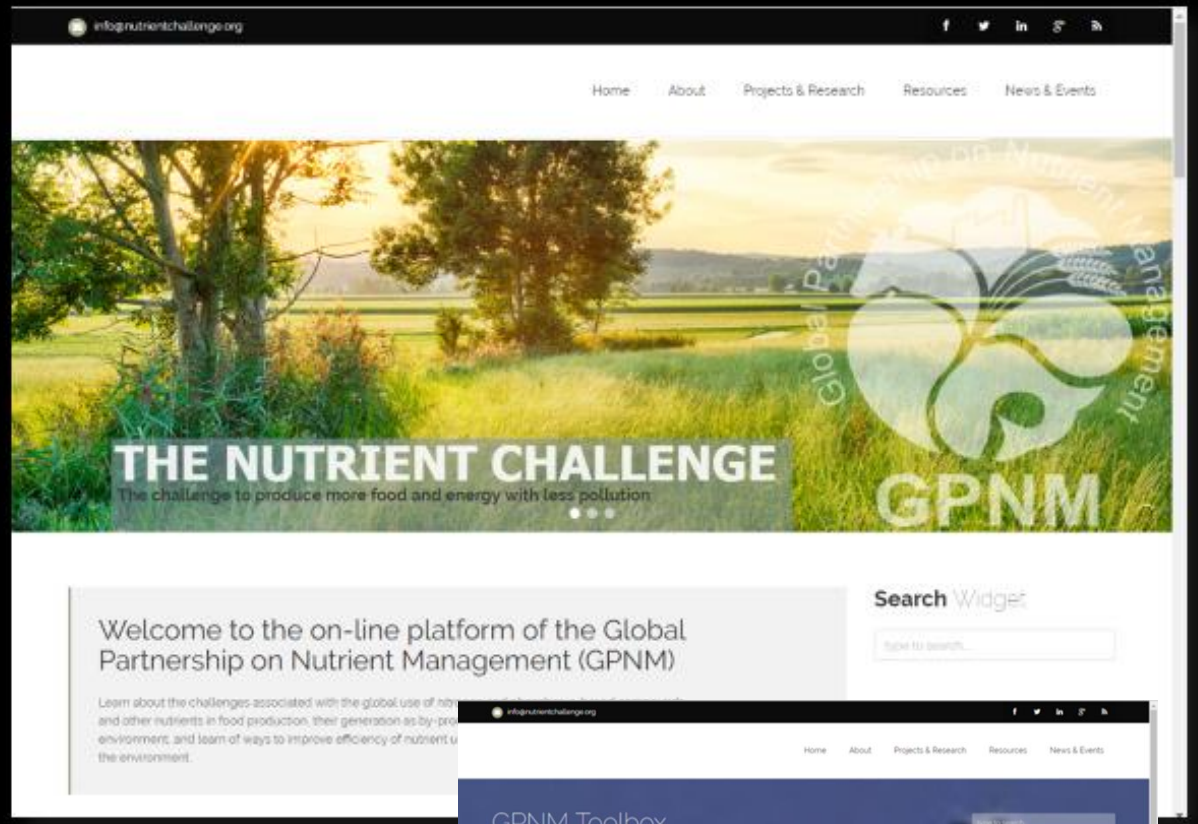


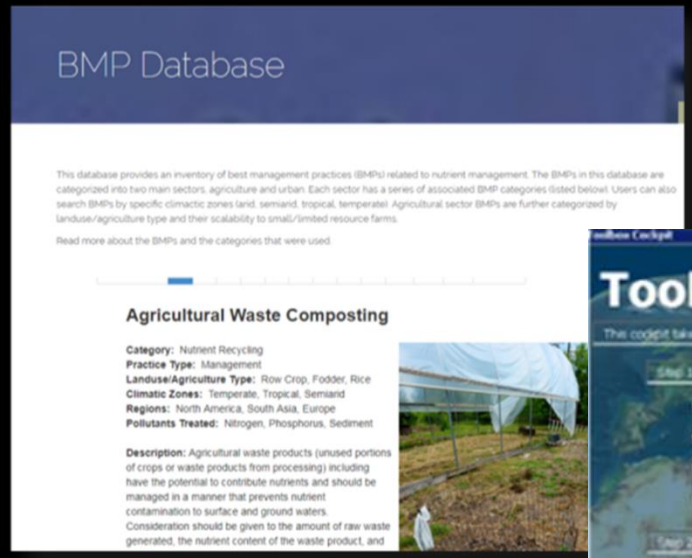
Nitrogen on the Table: The...

H. Westhoek; J.P. Lesschen; A...

- High quality assessment reports to trigger policy interest
- Taking advantage of appropriate platforms

Tools
Global Nutrient Management Toolbox





Global Partnership on Nutrient Management
GPNM

Global foundations for reducing nutrient enrichment and oxygen depletion from land based pollution, in support of the Global Nutrient Cycle

gef UN environment GPA GPNM

What will it mean for all of us?

A New Nutrient Narrative

Setting Goals!

SUSTAINABLE DEVELOPMENT GOALS

Core SDG targets related to sustainable nutrient management:

- Target 2.4 – sustainable food production
- Target 6.3 – good ambient water quality
- Target 14.1 – reduced nutrient pollution in the marine environment

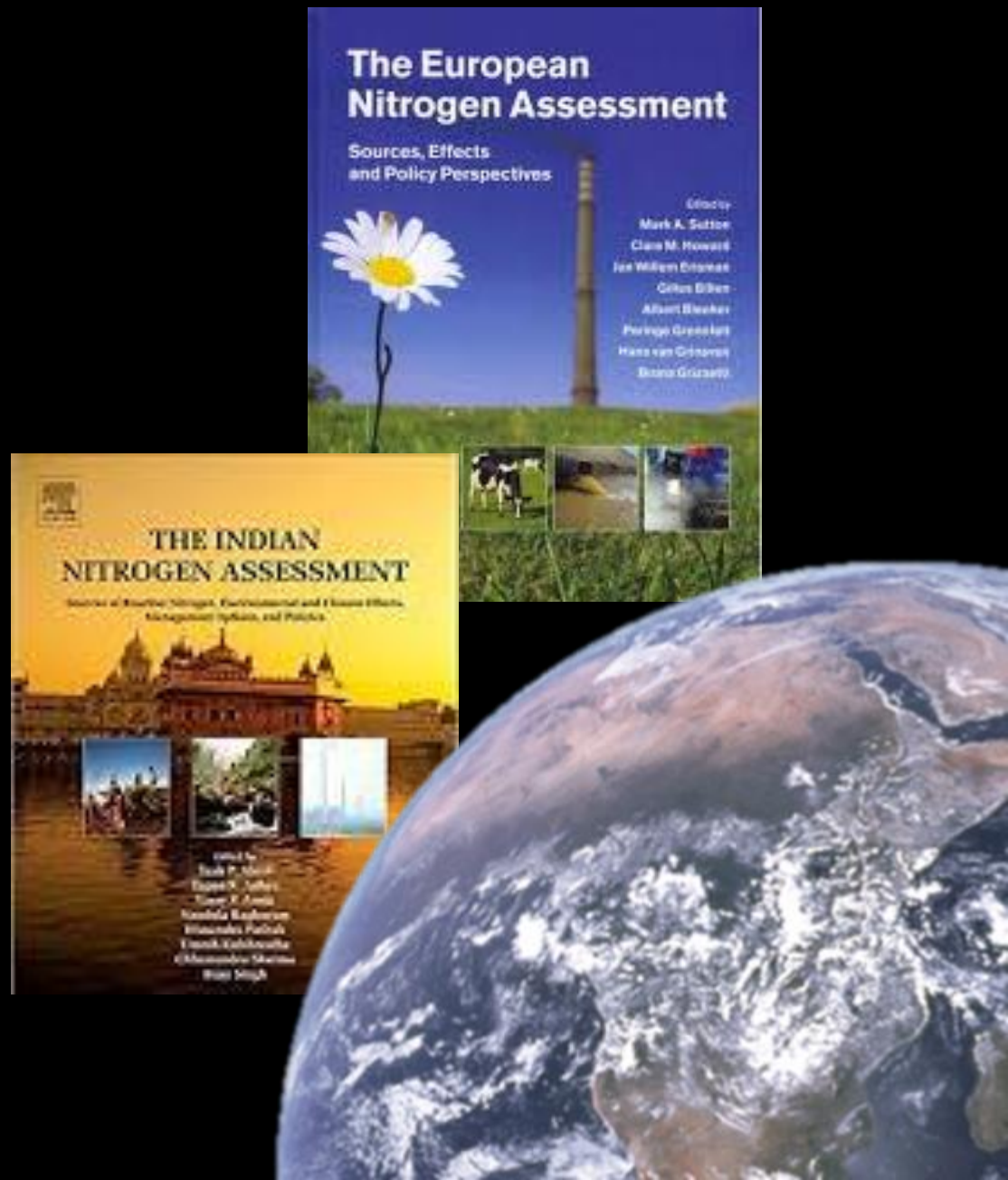
The business of nutrients
…can we sell this?

- Taking the science talk to money talk!
- **The Green/Blue Economy**
  - Fertilizer saving – increased efficiency: **US$23 bn/yr**
  - Environmental and human health benefits: **US$160 bn/yr**
  - Implementation investment costs: **US$12 bn/yr**
- **Net Benefit: US$170 bn/yr**

Source: Our Nutrient World (2013)

Countries stepping up!

- Countries are committing to the **“nikking the nutrient nuisance”**
  - UN Environment Assembly resolutions on pollution - air, soil, water, oceans
  - Emerging commitment from South Asia on addressing N
- Global Nitrogen Assessment under GEF-INMS
  - Experiences from regions - Europe and India
- Inter-Convention Coordination Mechanism???
  - Harmonize global coordinated action



For more information:

GEF Global Nutrient Cycle Project

Global Programme of Action, UN Environment

http://nutrientchallenge.org/

GEF Toward an International Nitrogen Management System

Centre for Ecology & Hydrology, UK

http://www.inms.international/

UN environment

GPA Global Programme of Action for the Protection of the Marine Environment from Land-based Activities

CEH Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL

Global Partnership on Nutrient Management GPNM