UiO : **Department of Chemistry**
University of Oslo

SinoTropia

Watershed Eutrophication management in China through system oriented process modelling of Pressures, Impacts and Abatement actions

- Funded bilaterally by CAS & RCN

UNIVERSITY OF OSLO
NIBR Norsk institutt for by- og regionforskning
NIVA Norwegian Institute for Water Research
中国社会科学院城市发展与环境研究所 Institute for Urban and Environmental Studies Chinese Academy of Social Sciences

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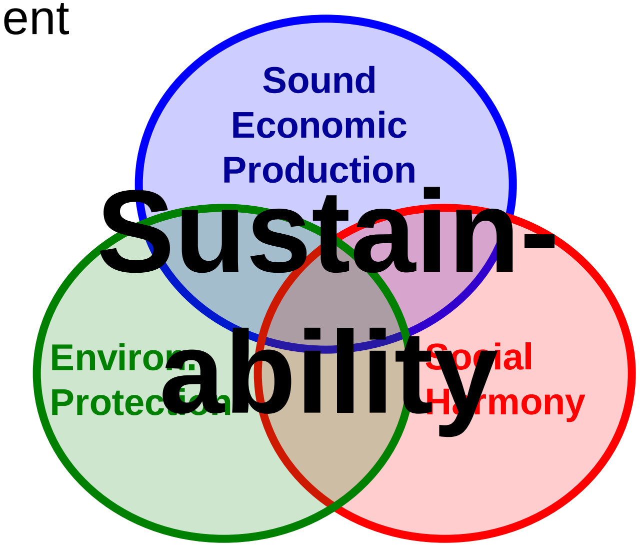
Sustainable development

- Enable decision makers
  to establish **knowledge** based abatement strategies
  on environmental challenges
  thereby **ensuring** a sustainable development

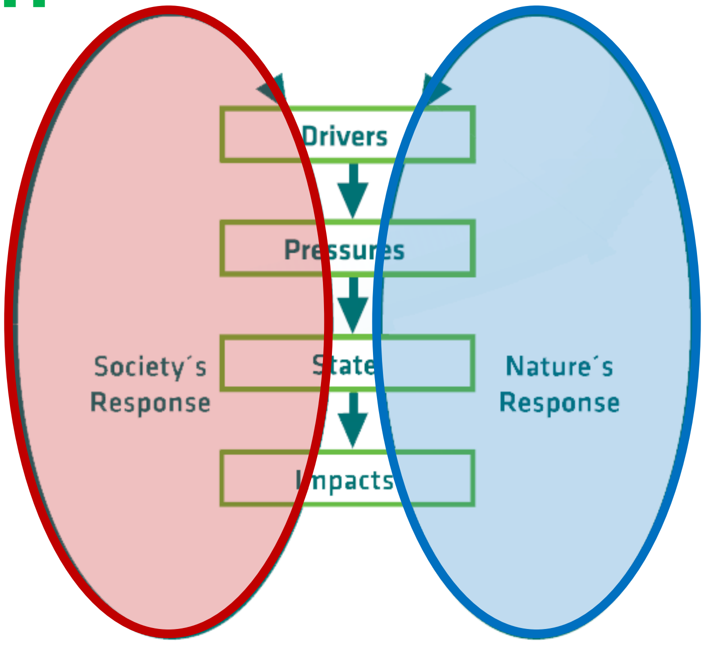
- Needs for environmental protection
  are balanced against limitation
  posed by social harmony and
  economic production



Sustainability implies
positive solutions for all components

The main point

There is a need for coherent research where **catchment processes** governing **eutrophication** are linked to **societal response**



The natural science research

- **Goal:**

  Increase our ability to **predict the effects**
  of changes in the environment and effect of abatement measures

- **Need:**

  Improve the underlying models **reliability** and **relevance**

- **Strategy:**

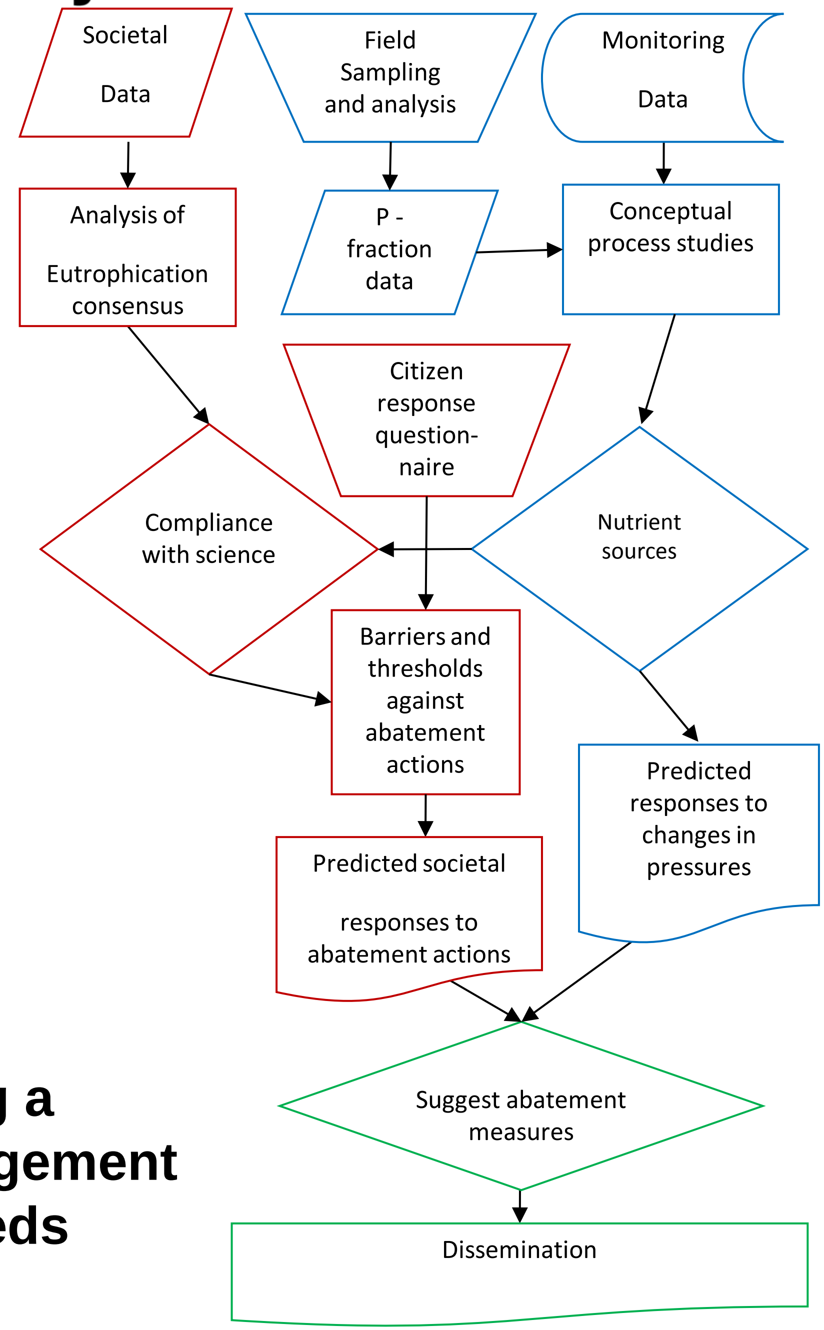
  Specifically targeting the **bioavailable** P-fraction
  and supplement empirical assessments with
  conceptual knowledge based **process understanding**

- **Prerequisite:**

  Need to **link** physio-hydrological and geochemical processes
  in the **catchment** with the **in-lake** biochemical processes controlling the
  level of nutrients (P, N, C) and its effect on water quality

Scientific approach

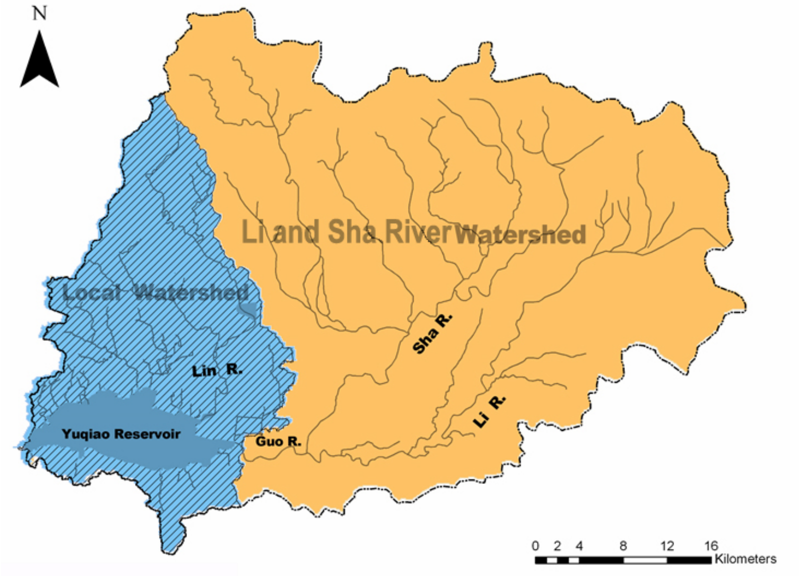
- **Trans-disciplinary** approach on the eutrophication challenge
  - Integrated natural science and social science to **improve** the:
  - Policy-making process and implementation of relevant policies

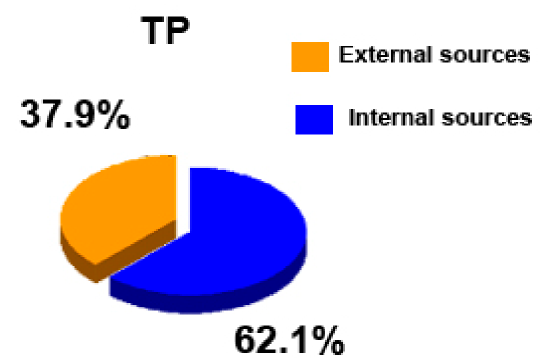


- eventually achieving a water resource management meeting society's needs

Scientific approach
– Sampling strategy in watershed

- Focus on local watershed
    - Main source of P to the lake

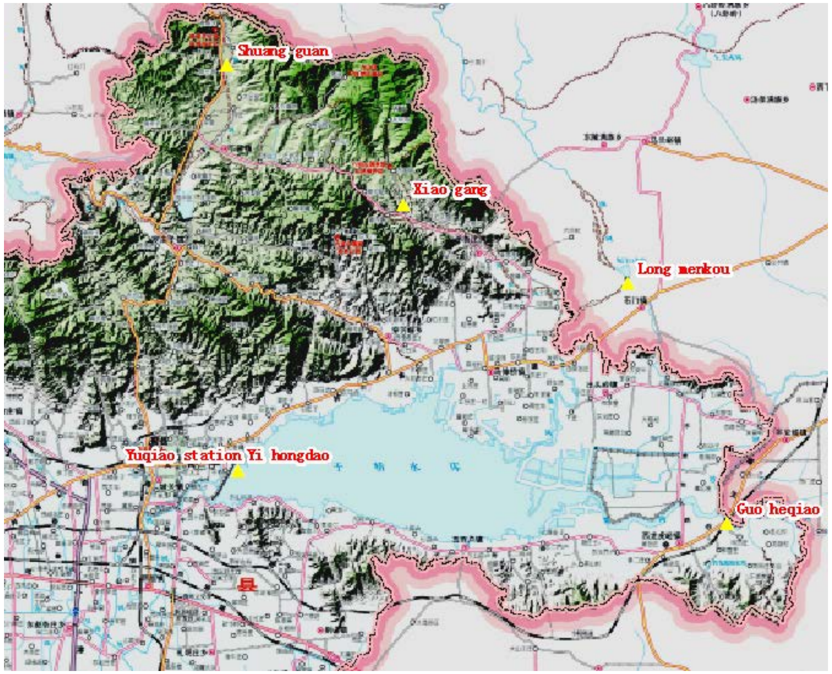




Data source: Ji County EPB (2009)

Scientific approach – Sampling strategy in watershed

- Focus on local watershed
  - Main source of P to the lake
- Soil mapping
  - Based on generic horizons from different land-use and management practices



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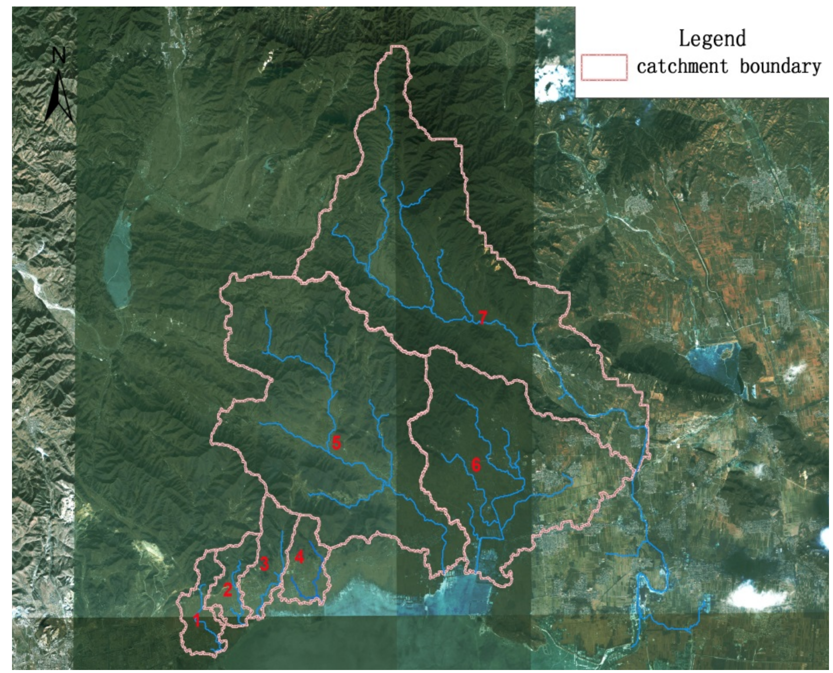
Scientific approach – Sampling strategy in watershed

- Focus on local watershed
  - Main source of P to the lake
- Soil mapping
  - Based on generic horizons from different land-use and management practices
- Water monitoring
  - Seasonal variation in major streams
  - Episode studies



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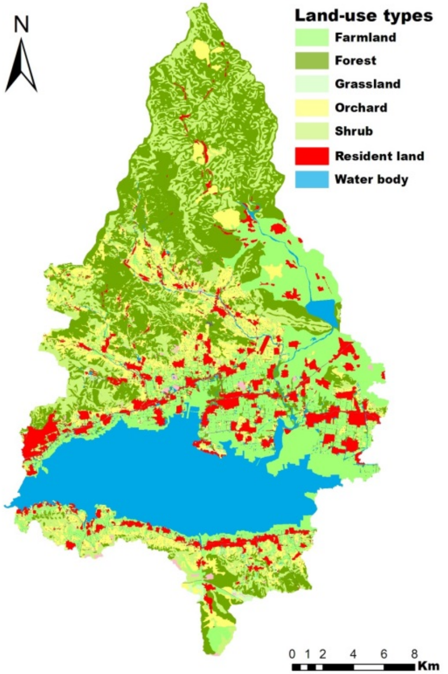
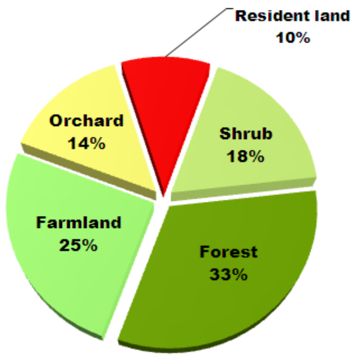
Scientific approach
– Sampling strategy in watershed

- Focus on
  local watershed
  - Main source of P to the lake
- Soil mapping
  - Based on generic horizons from different land-use and management practices
- Water monitoring
  - Seasonal variation in major streams
  - Episode studies
- Background data
  - Climate and hydrology
  - Maps



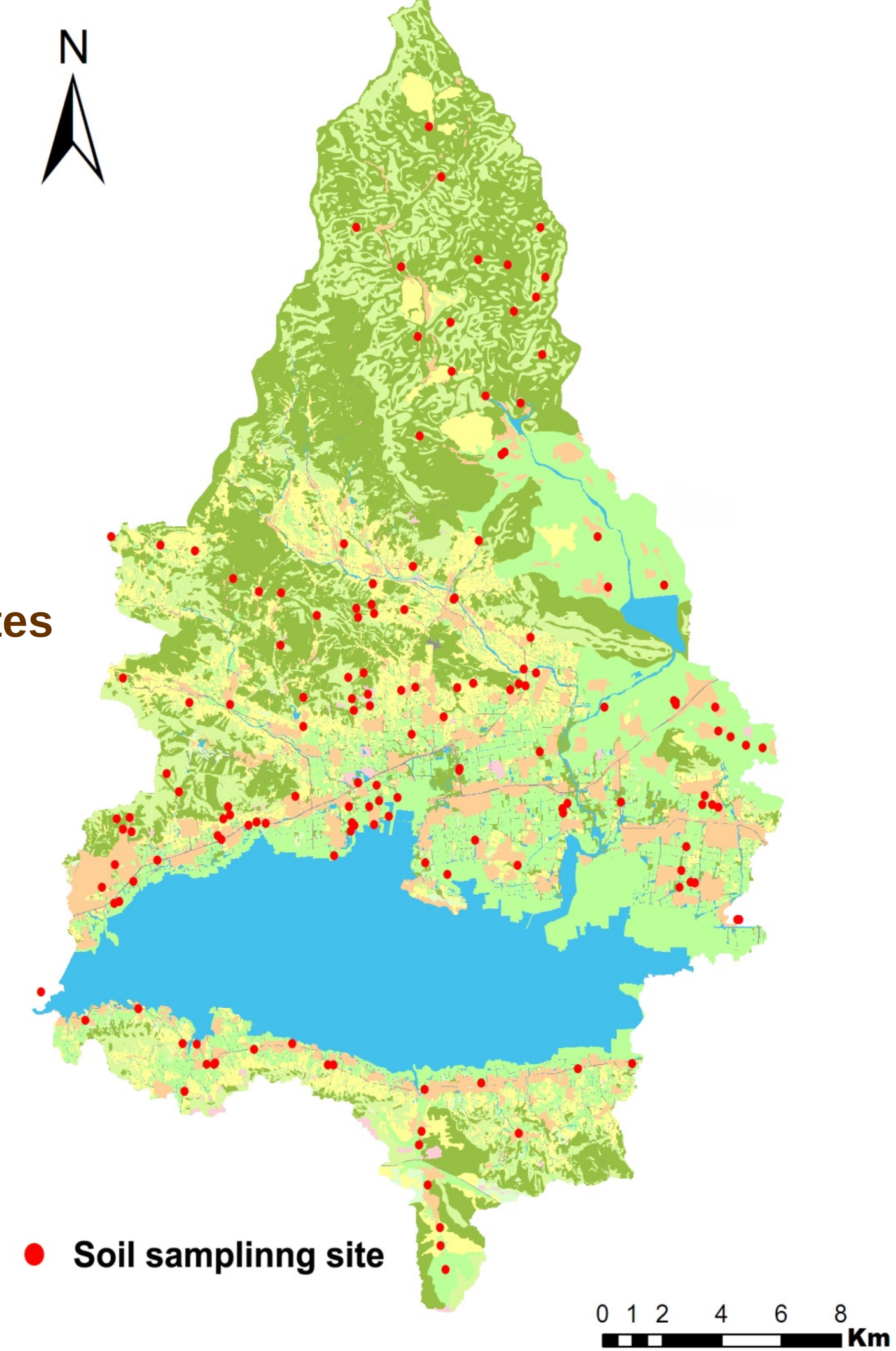


Catchment sampling

We have done monitoring and synoptic studies of soil and water.

- 226 soil samples from 126 different sites

- 287 stream samples, 80 soil water samples and 25 DGT samples



Catchment analysis

➢ Soil samples

General characteristics

pH, Organic matter (LOI%), PSD (Clay, Silt and Sand%), bulk density, CECe, Soil mineral composition (XRD)

P pools

Tot P, TIP, TOP

Indices for potential risk of P loss

BAP: Olsen P, Bray-1 P, Mehlich 3 P

PSI: P sorption index

DPS%: Degree of P saturation

P composition

^{31}P NMR

Phosphatase activities

AcP, AlP, PD and PY

➢ Stream and soil water samples

Major cations and anions

H^+, Ca^{2+} , Mg^{2+}, Na^+, K^+ , NH_4^+
Cl^-, NO_3^-, SO_4^{2-}, HCO_3^-

P fractions

Tot P, TIP, TOP, PP,
TDP, DIP, DOP

➢ Hydrological monitoring

2 sets of temperature and light intensity loggers

3 water level loggers

Scientific approach
– Analytical methods

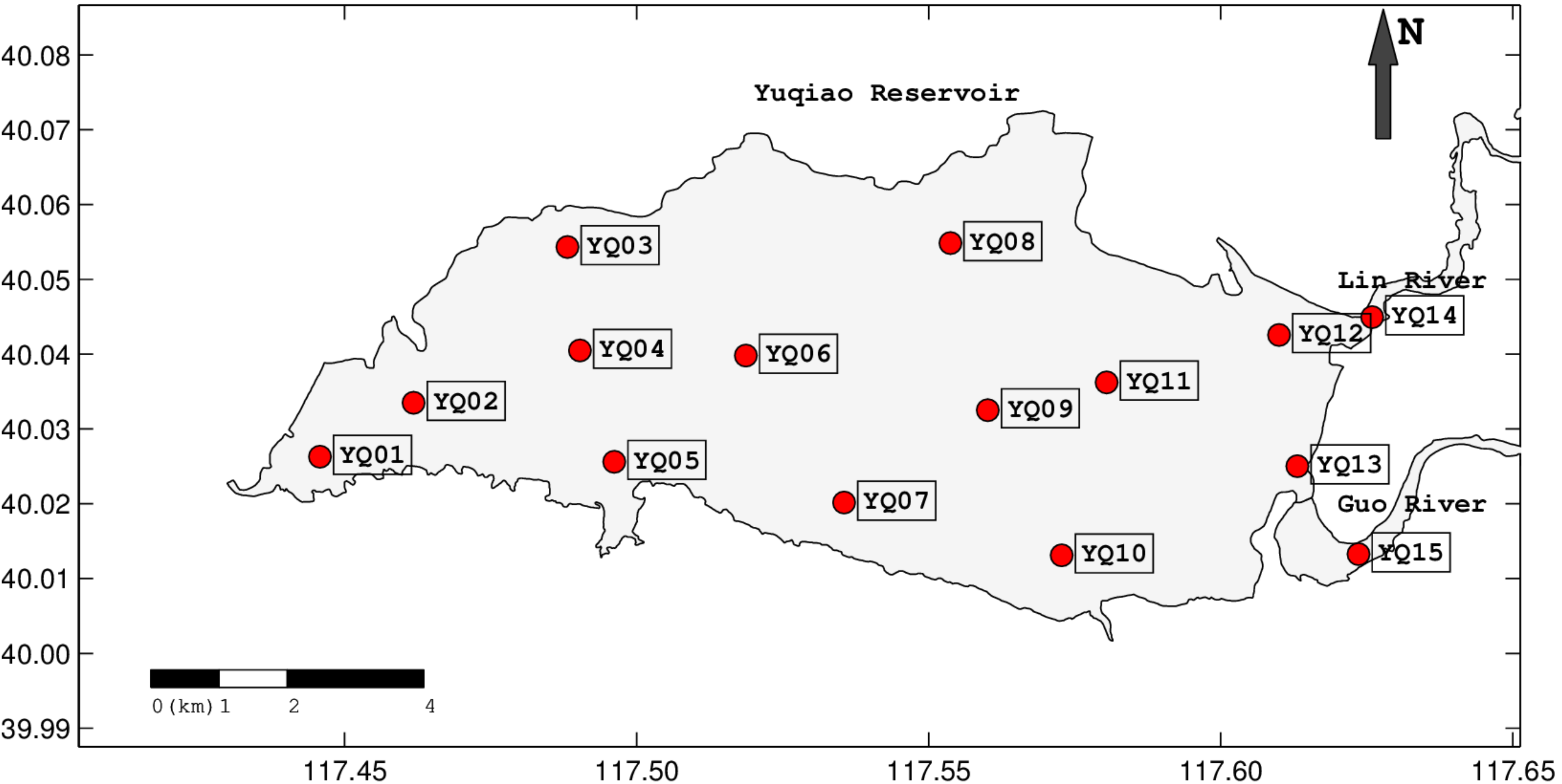
- P-fractionation enhancing our ability to identify :
  - **Source** of Phosphorous
  - **Processes** governing fluxes
  - **Fate** of the Phosphorous
  - **Effect** of bioactive P-fractions and thereby algal growth

Reservoir

Field Sampling
15 campings

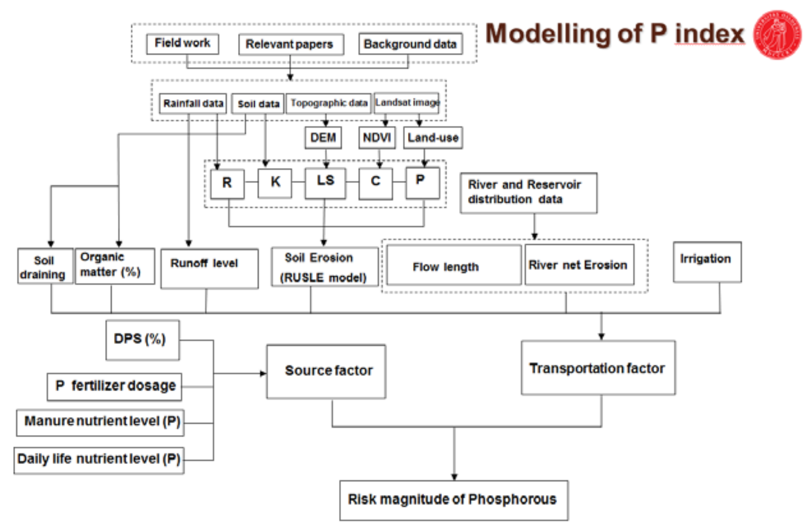
Sites
15 sites

Monitoring
Two years



Scientific approach
- Models

- Models developed elsewhere need to be **adopted** to Chinese environment
  - The main governing processes may not be the same
- Adequately **parameterize** processes governing nutrient fluxes to improve performance of the conceptual models



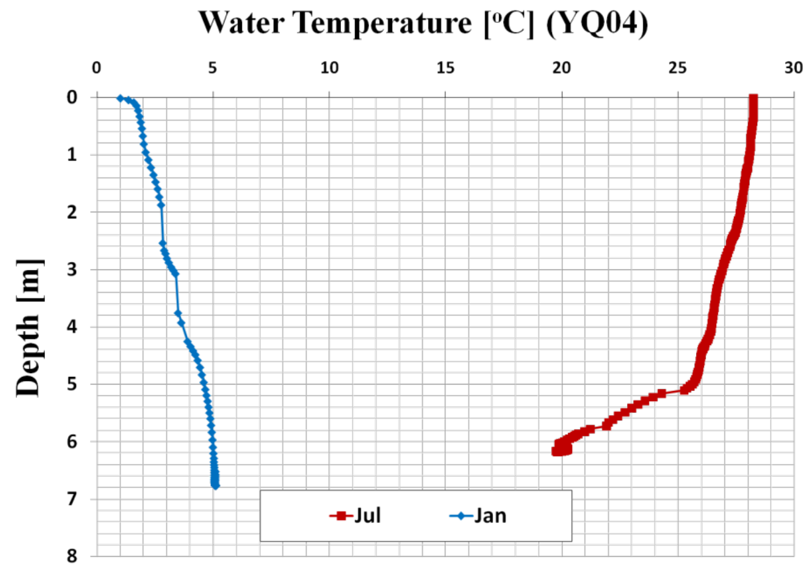
Schematic representation of the modular structure of the P Index

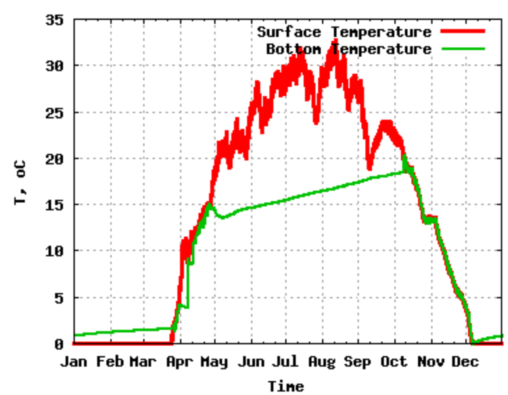
Models that are used on the watershed

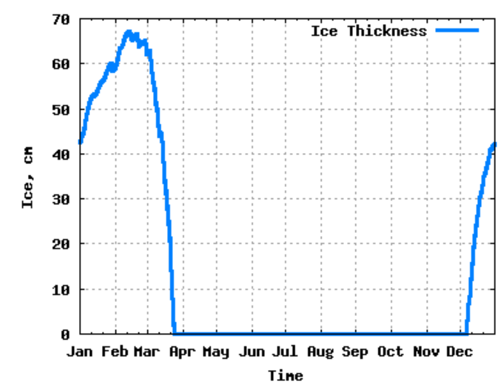
- Phosphorus index model (PI model)
  - Paper I: Establishment and validation of an amended phosphorus index: Refined phosphorus loss assessment of an agriculture watershed in northern China
- Relative importance analysis model / Sensitive analysis model (The backpropagation network (BPN) with Garson's algorithm)
  - Paper II: Relative Importance Analysis of a Refined Multi-parameter Phosphorus Index Employed in a Strongly Agriculturally Influenced Watershed
- Land-use change model (CLUE-S model)
  - Paper IV: Land use change and its effects on the variation of Phosphorus level in targeted reservoir: a case study of a strongly agriculturally influenced watershed

Models that are used on the reservoir

- MyLake
  - 1-D physics + Eutrophication
  - Used for Vansjø
  - Underestimates temperature?
- Flake
  - Physics only (0.5-D)
  - Realistic temperature & stratification

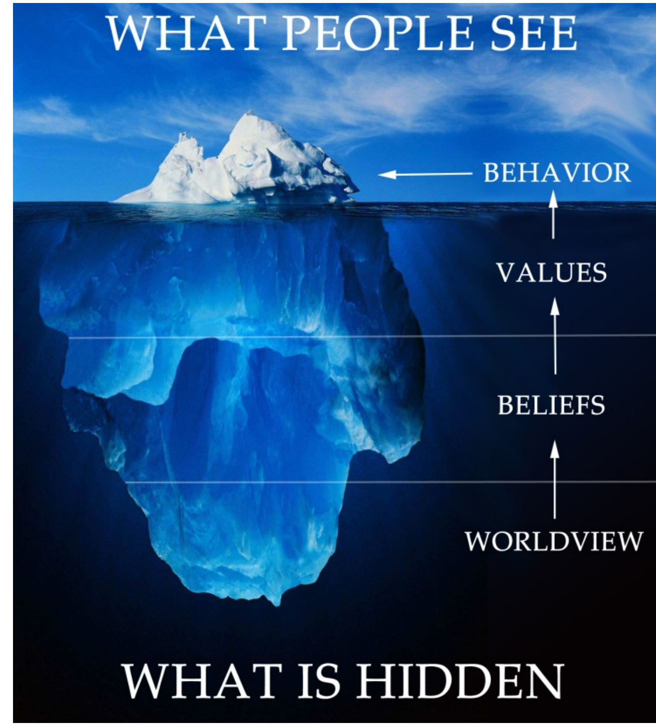






Scientific approach – Societal response

- Knowledge -
  - Of stakeholder **values and attitudes** are essential for the success of the public policies abating eutrophication
  - Constitute a necessary basis for sound environmental management through **facilitating** collective action and public policies



Social research survey

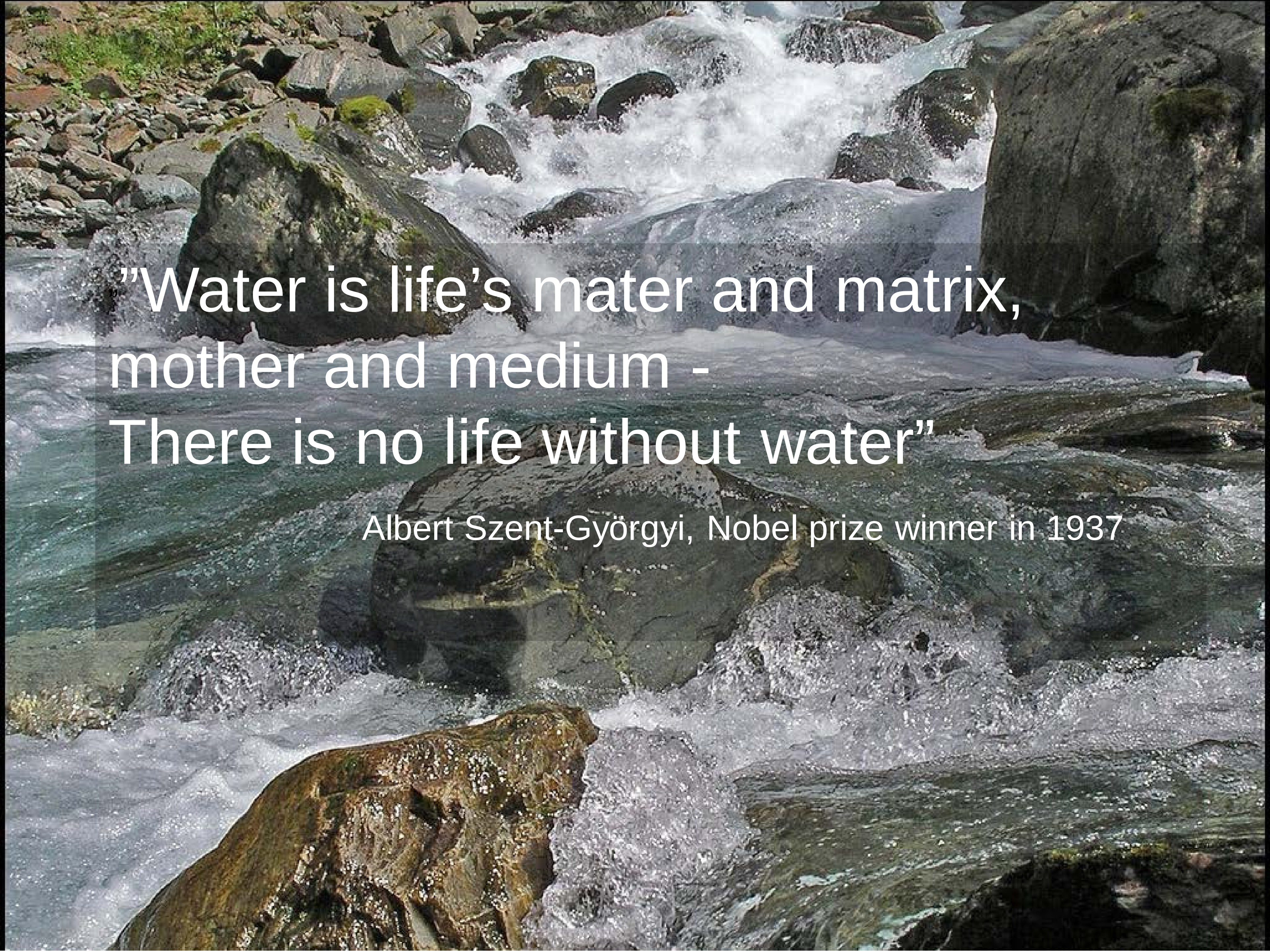
- Survey questionnaires are answered by 545 residents in 11 villages
- Face-to-face interviews (47) have been conducted in predominantly cereal, pig farming, fishing farming and orchard villages

Topics:

- Environmental values/attitudes
- Place attachment
- Learning and knowledge about farming and the use of fertilisers
- Water resource issues

To be presented today:

- **Eutrophication** in Yuqiao reservoir:
Status, seasonal fluctuations, pressures and drivers
- **Processes** and their governing factors controlling fluxes of phosphorus fractions from the watershed to the reservoir
- **Environmental behaviour** among farmers in Yuqiao; farming production mode and ecological construction; and policies for reducing the leaching of phosphorus into the reservoir


”Water is life’s mater and matrix,
mother and medium -
There is no life without water”
Albert Szent-Györgyi, Nobel prize winner in 1937