Carrying capacity estimation in common water bodies

Case studies in the Philippines

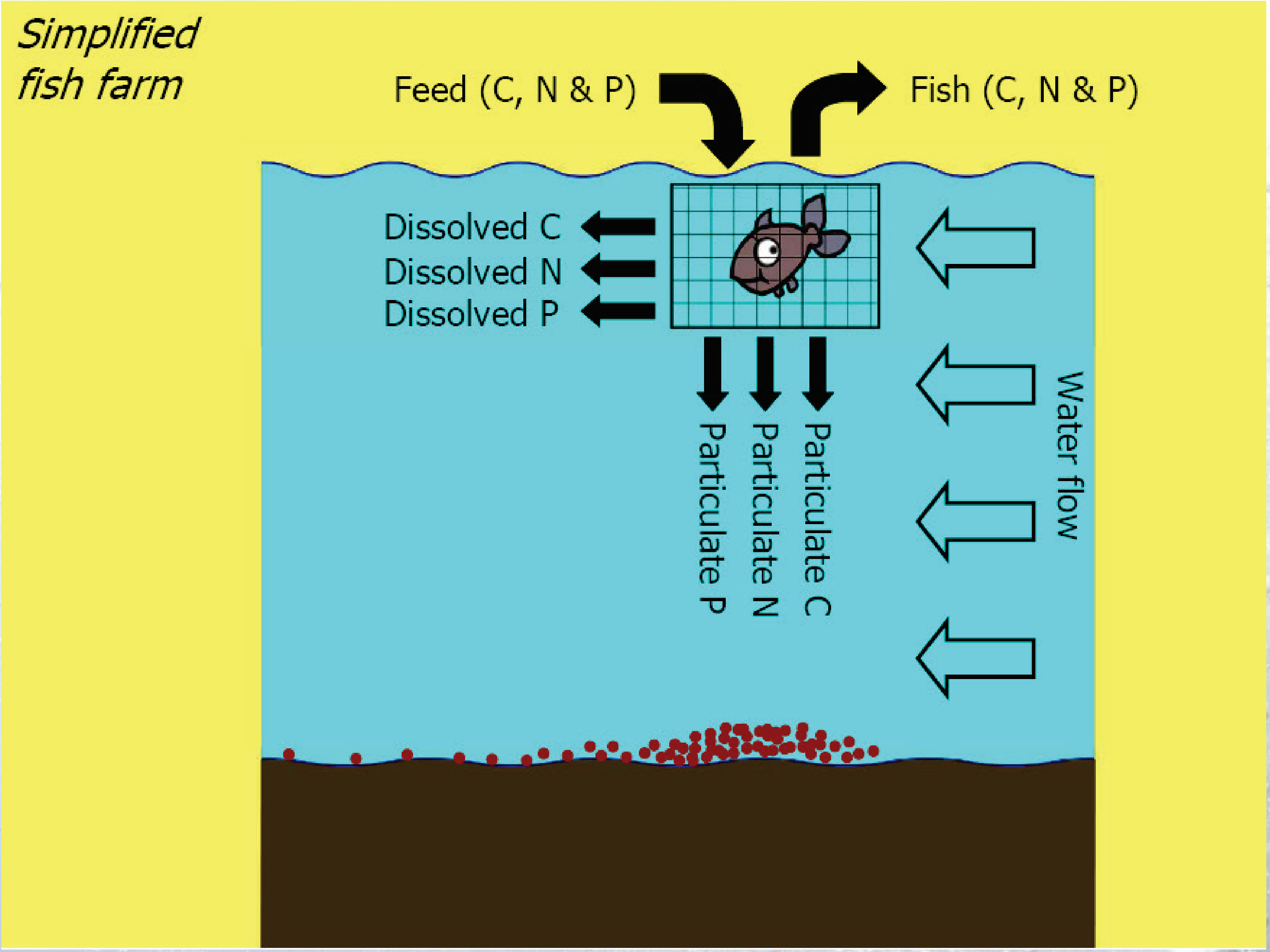
USSEC Southeast Asia Regional Symposium on Aquaculture Carrying Capacity Modeling for Common Water bodies

10-13 June 2013 Bangkok, Thailand

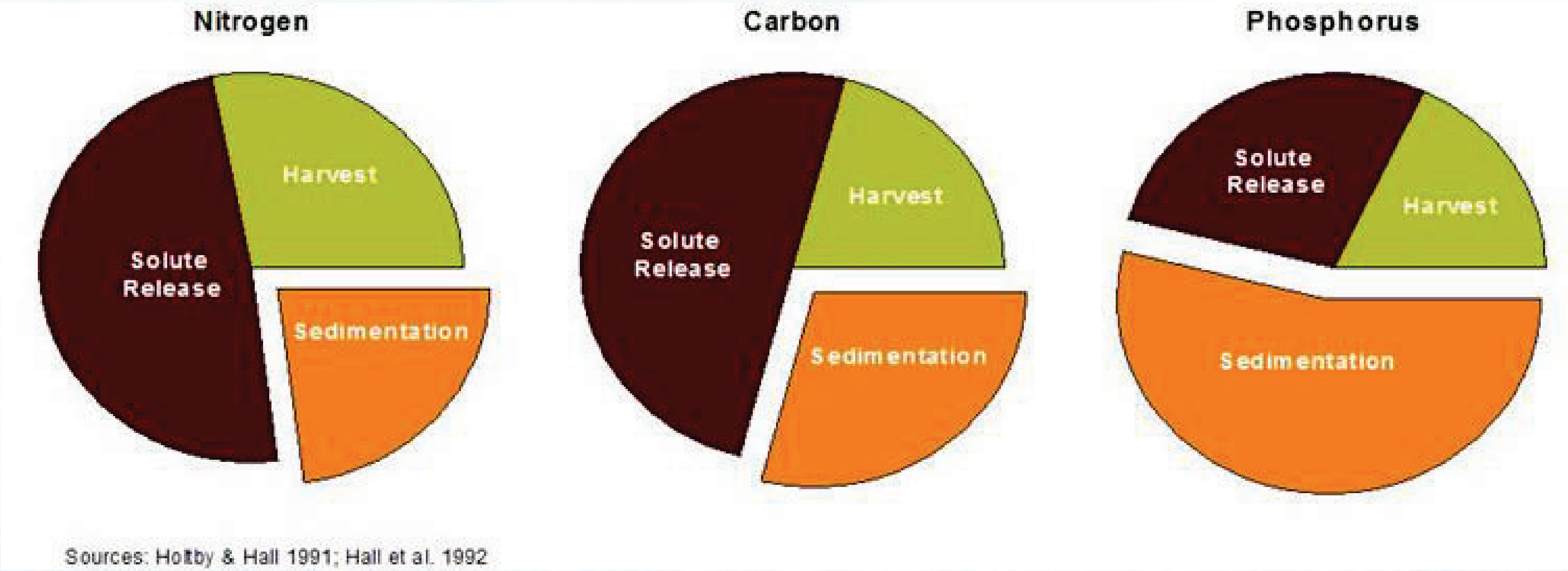
Scope of the presentation

- Aquaculture impact on the environment
  - nutrients, dissolved and particulate
- Small-scale aquaculture development
  - Bolinao, Philippines
  - Dagpan, Philippines
  - Taal lake Philippines
- Cumulative aquaculture impact
- Modelling carrying capacity
  - box models

Aquaculture nutrient balance



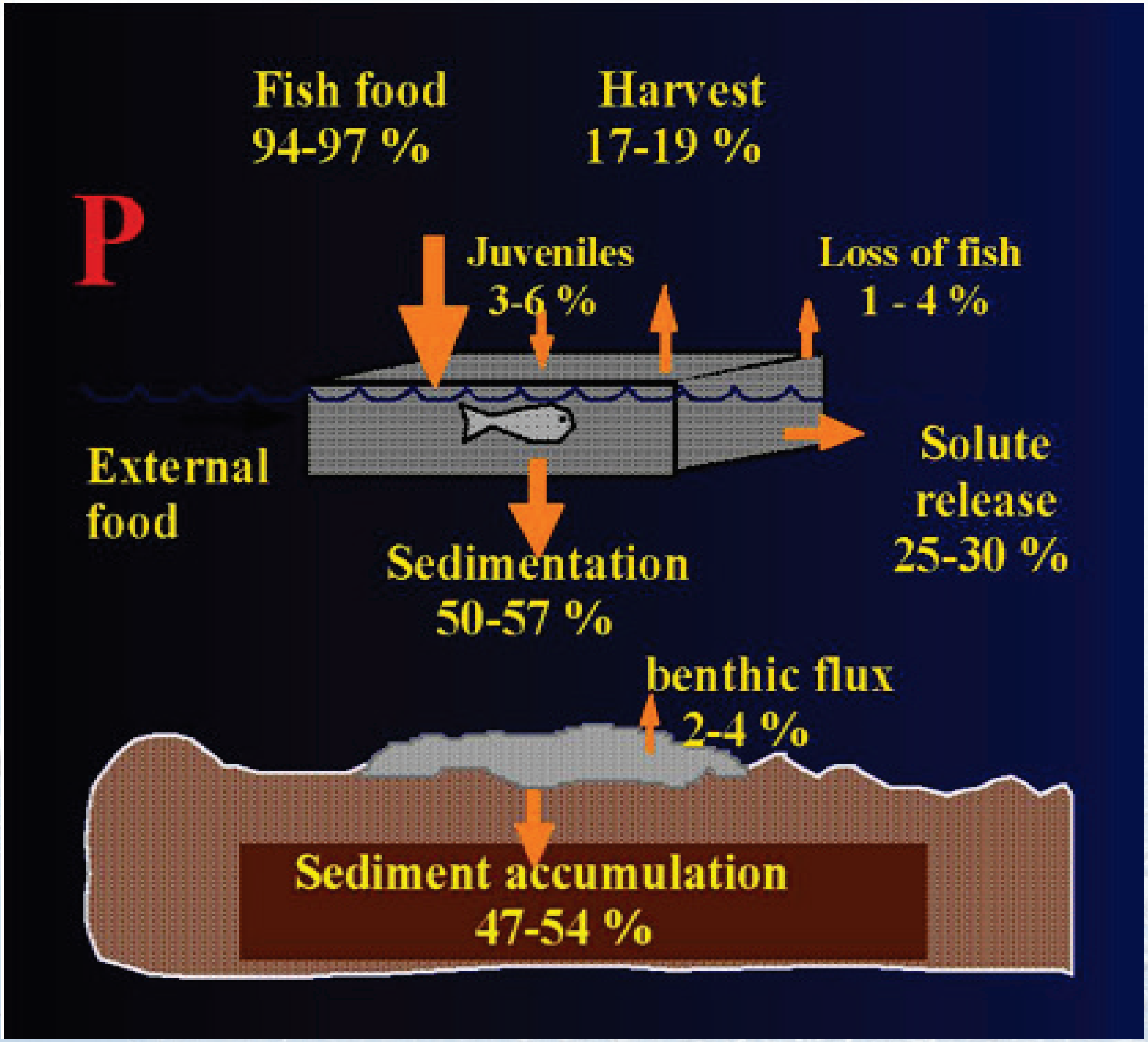
Inputs, uptake and outputs



Less than 30 % of the nutrient inputs are retained by the fish.

The remainder go into the environment where they are assimilated or concentrated

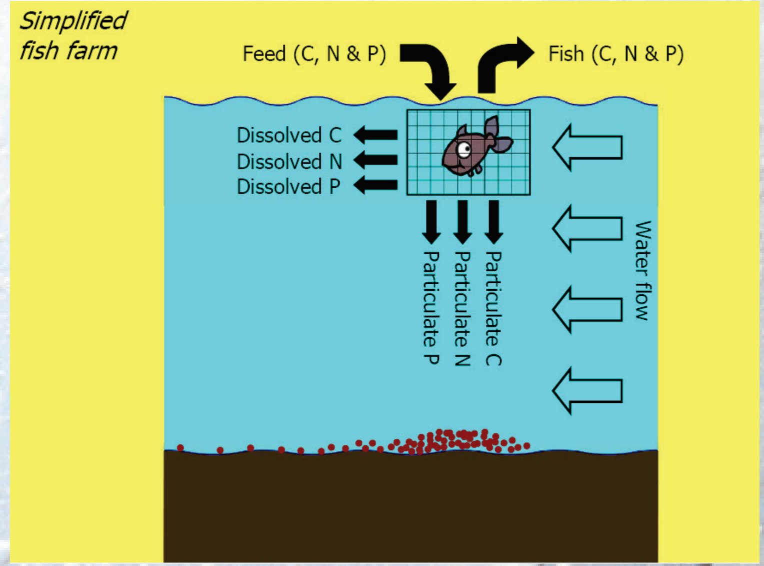
Nutrient budget and fate - Phosphorous



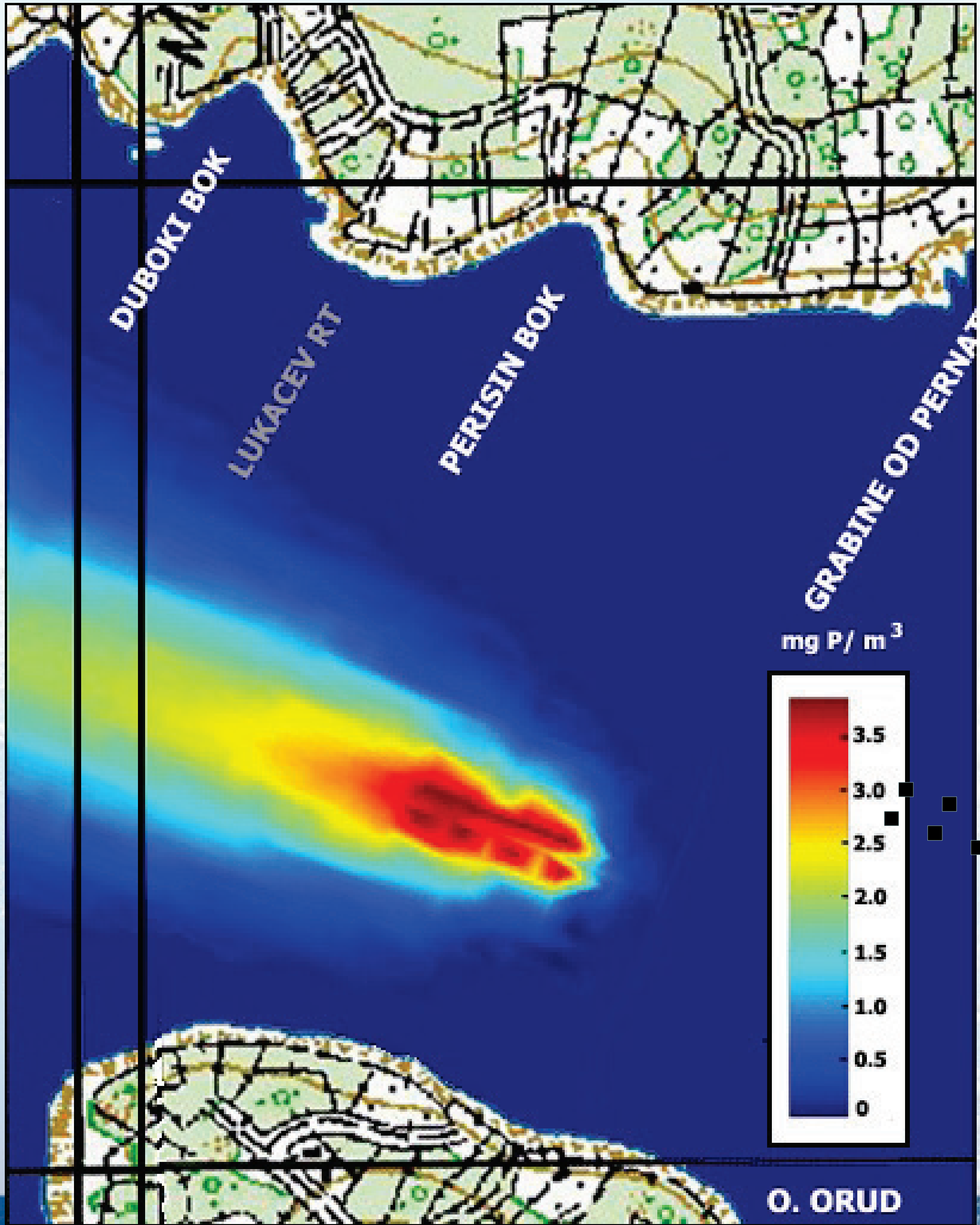
Impact on the sediments

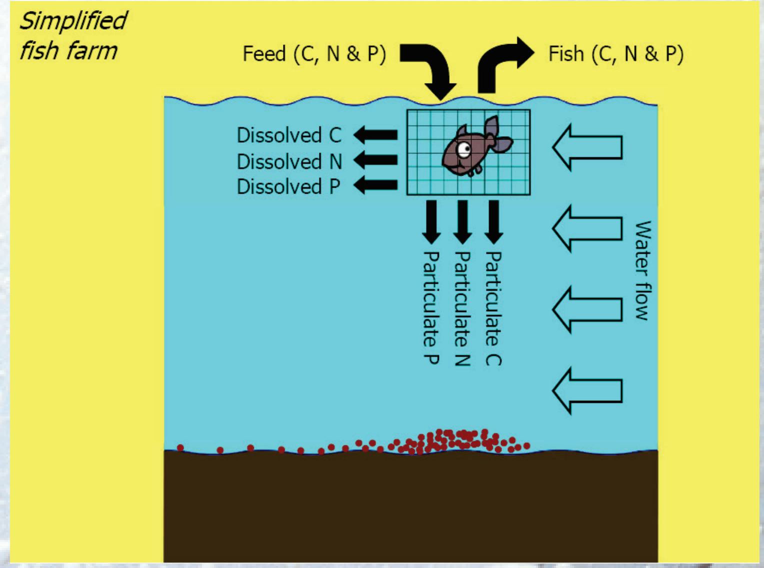
Nutrient levels in the sediment

- **Sustainable levels**
  - slight build up of organic layer on the seabed
  - Organic layer not increasing over time
- **Unsustainable level**
  - Build up of thick organic layer
  - Change in benthic diversity
  - Smothering of seagrass
  - Smothering of corals



Phosphorus plume from fish cages





Impact on water column

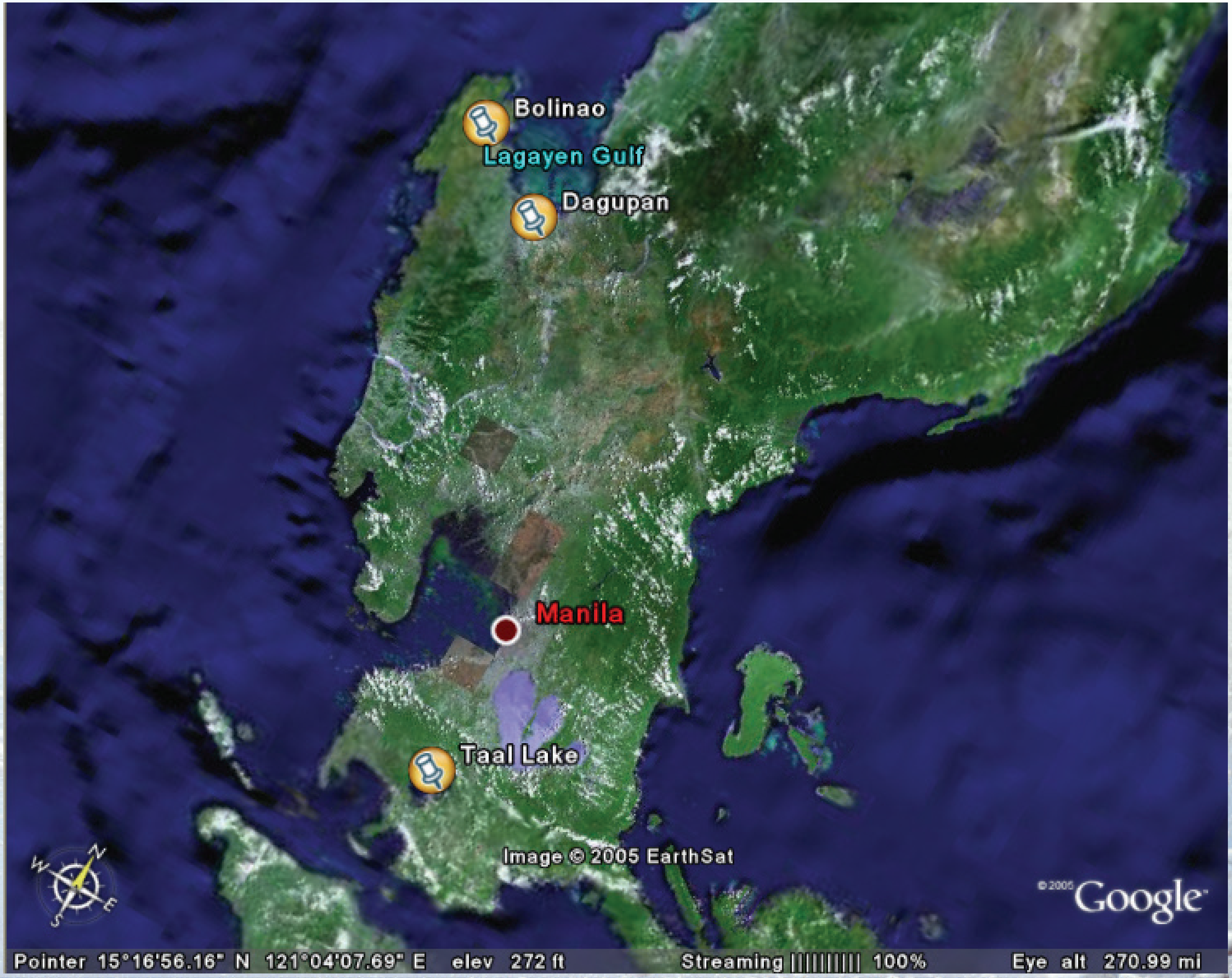
Nutrient concentration in the water

- **Sustainable levels**
  - Stable dissolved nutrient levels not breaching water quality standards
  - increased algae production and zooplankton production
  - increased wild fishery production
- **Unsustainable levels**
  - leads to high algae production
  - algal bloom – algae die off – low/no oxygen – fish kill

Small scale aquaculture development

- Often located in shared water bodies
  - Shared by municipalities, tambaks, etc
  - Lack of integrated water management plan
- Often located in sheltered areas with reduced water exchange
  - Lakes
  - Closed bays
  - Lagoons
- Often not closely regulated or monitored
  - Leading to boom – bust – boom cycle

Norad funded EMMA project 3 case study areas



Bolinao and Anda

Bolinao Bay 2006

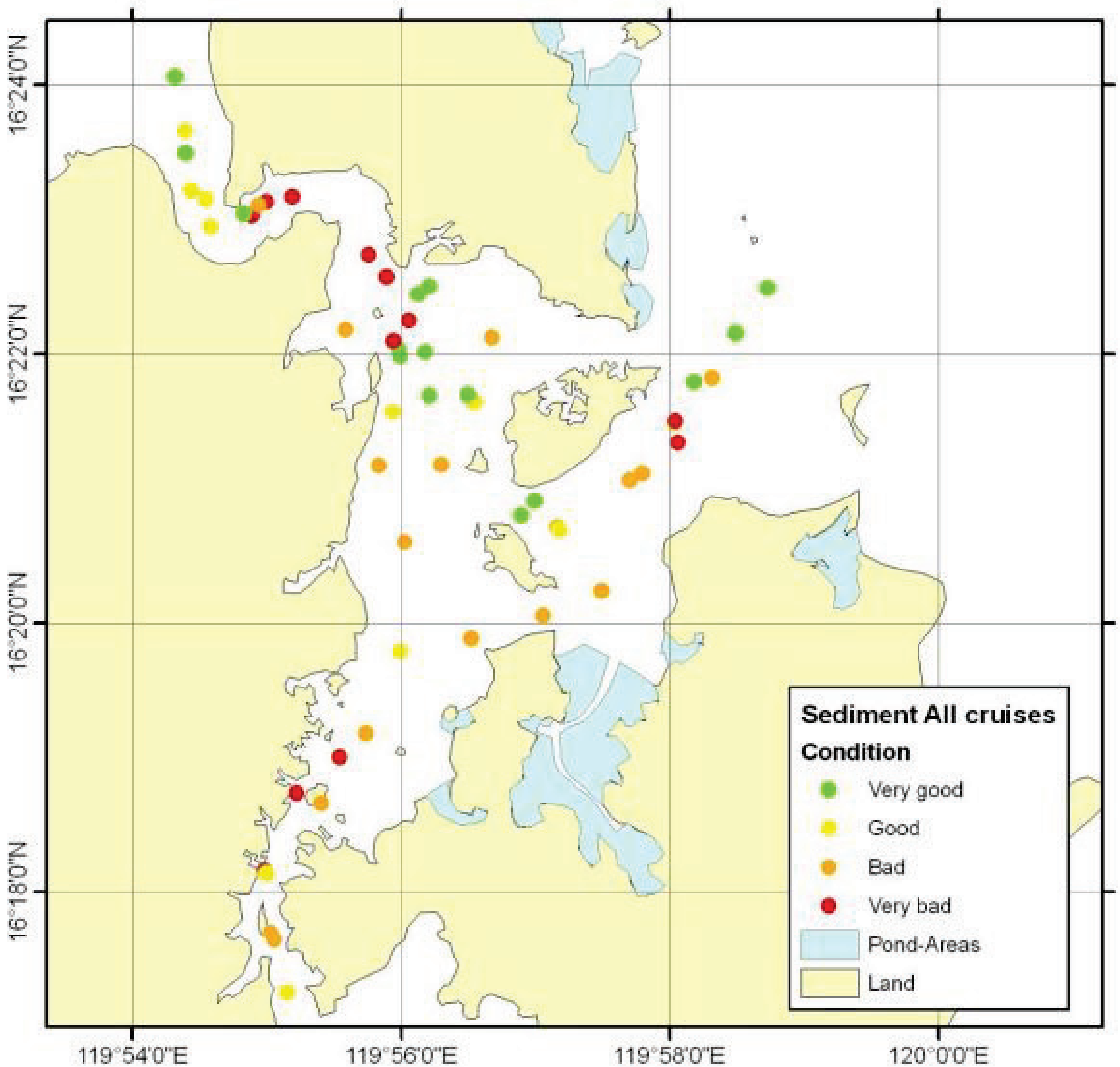
Fish cages 460

Fish pens 266

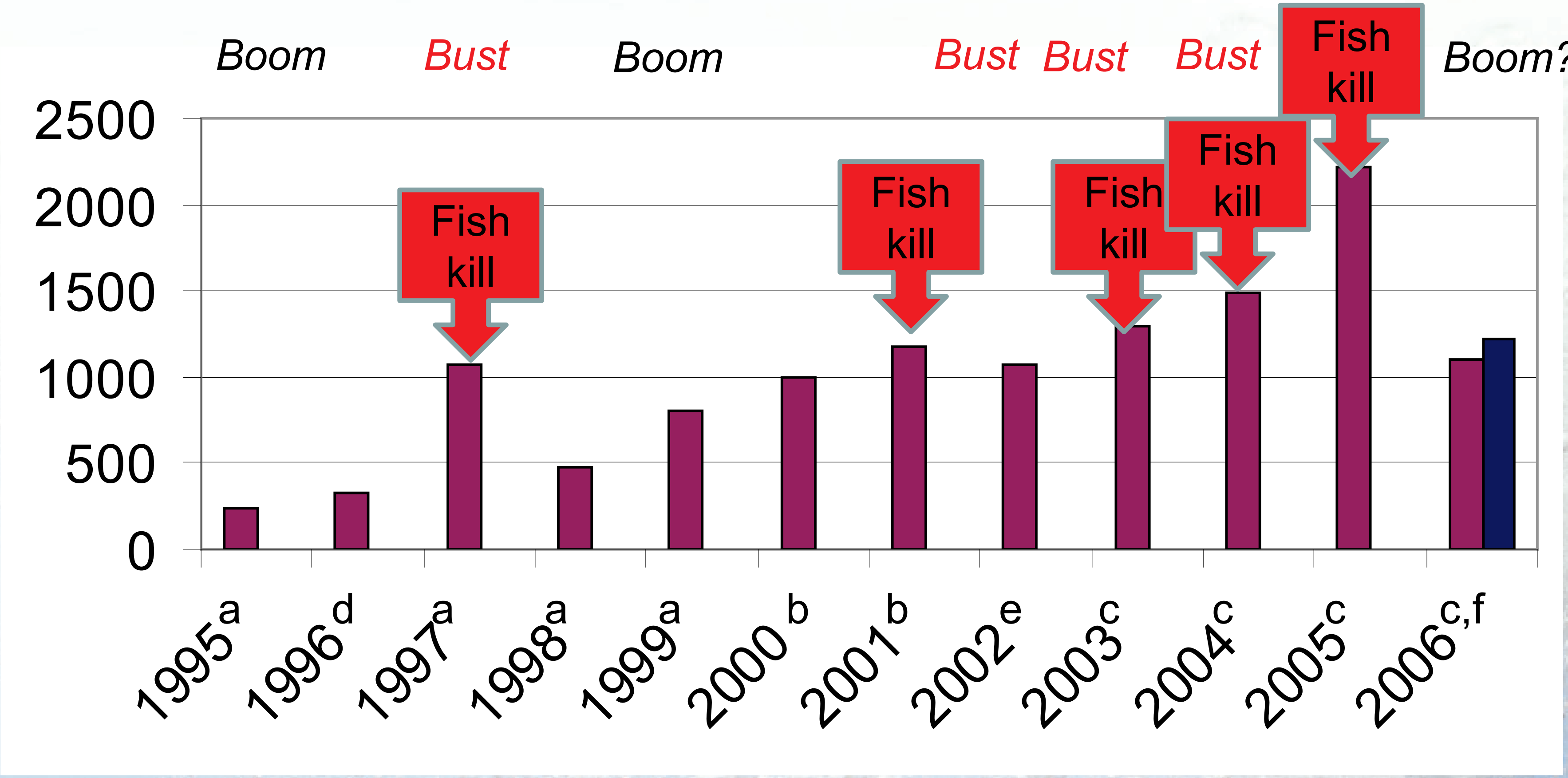
Oyster farms 254

23,000 tonne/yr
8.1 t/ha fish
0.6 t/ha mollusc

220 tonnes feed/day



Reoccurring fish Kills in Bolinao



[a] Verceles et al., 2000, [b] FRMP,2001; [c] Sagip, 2005; [d] LGCAMC, [e] PDI,2002; [f] OPAG

Dagupan estuary system

Dagupan

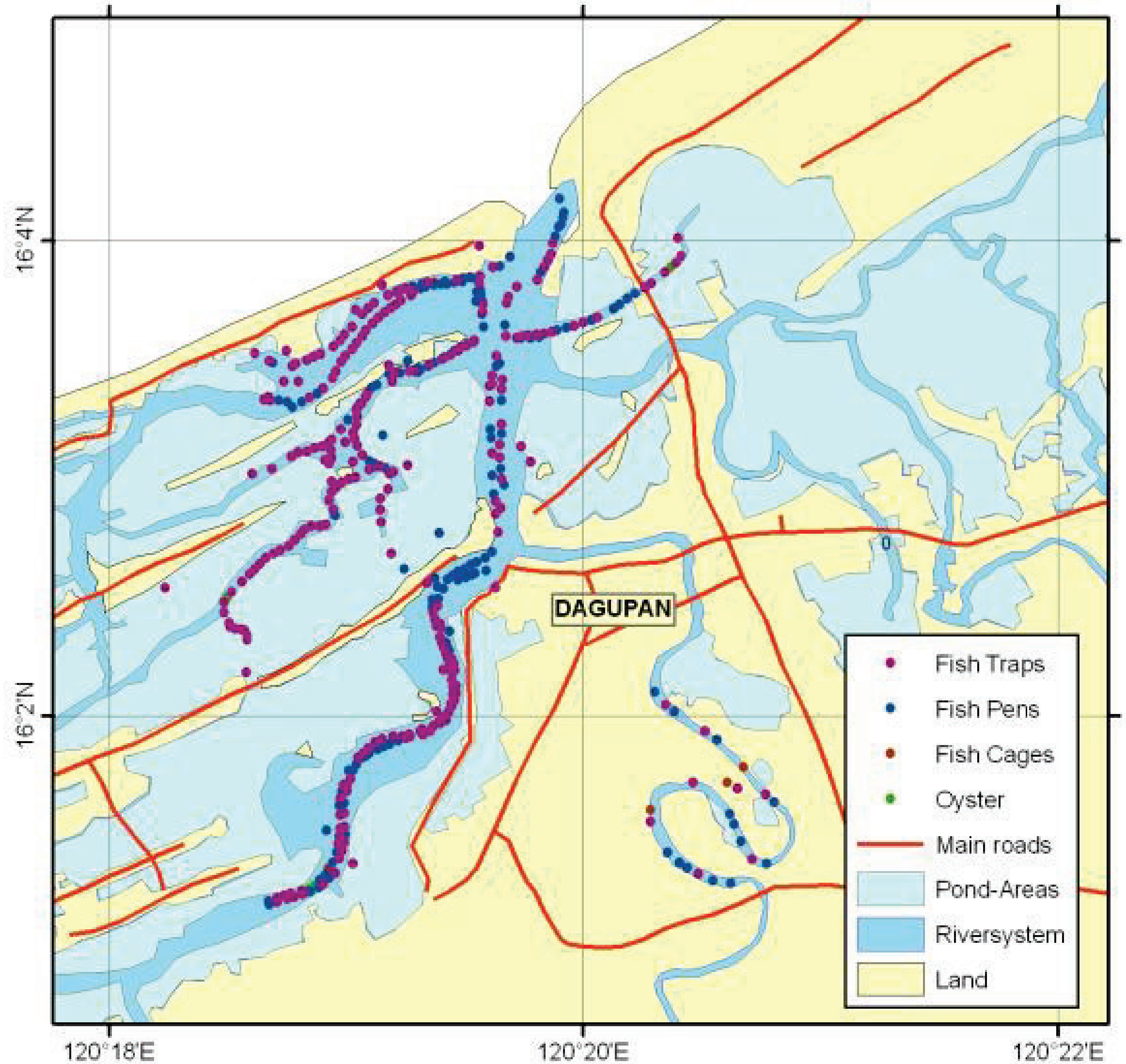
Fish pens 553

Fish cages 124

Oyster farms 94

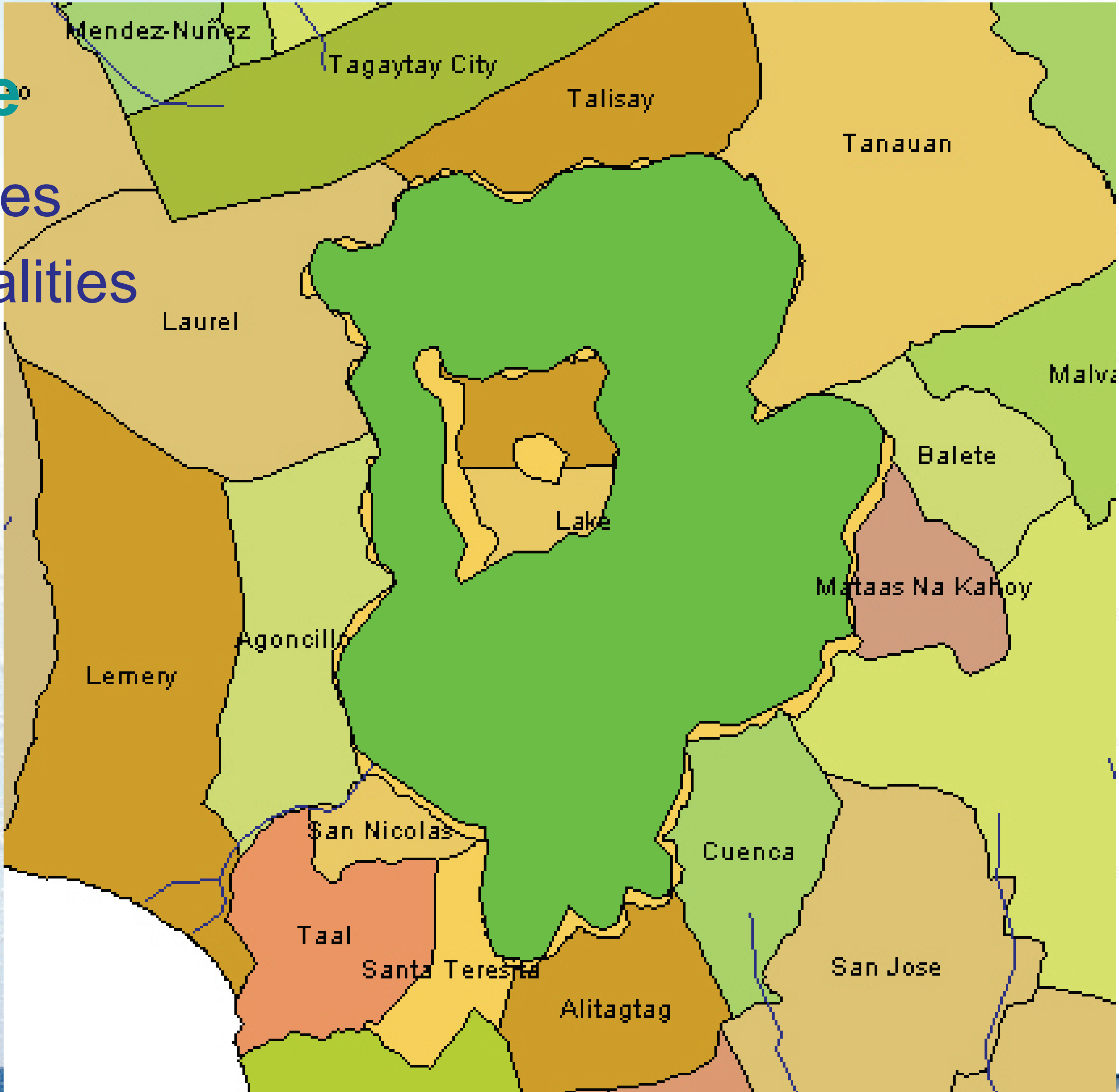
Fish traps 528

590 t/yr fish cage
4,860 t/yr fish pen
500 t/yr mollusc



Taal lake

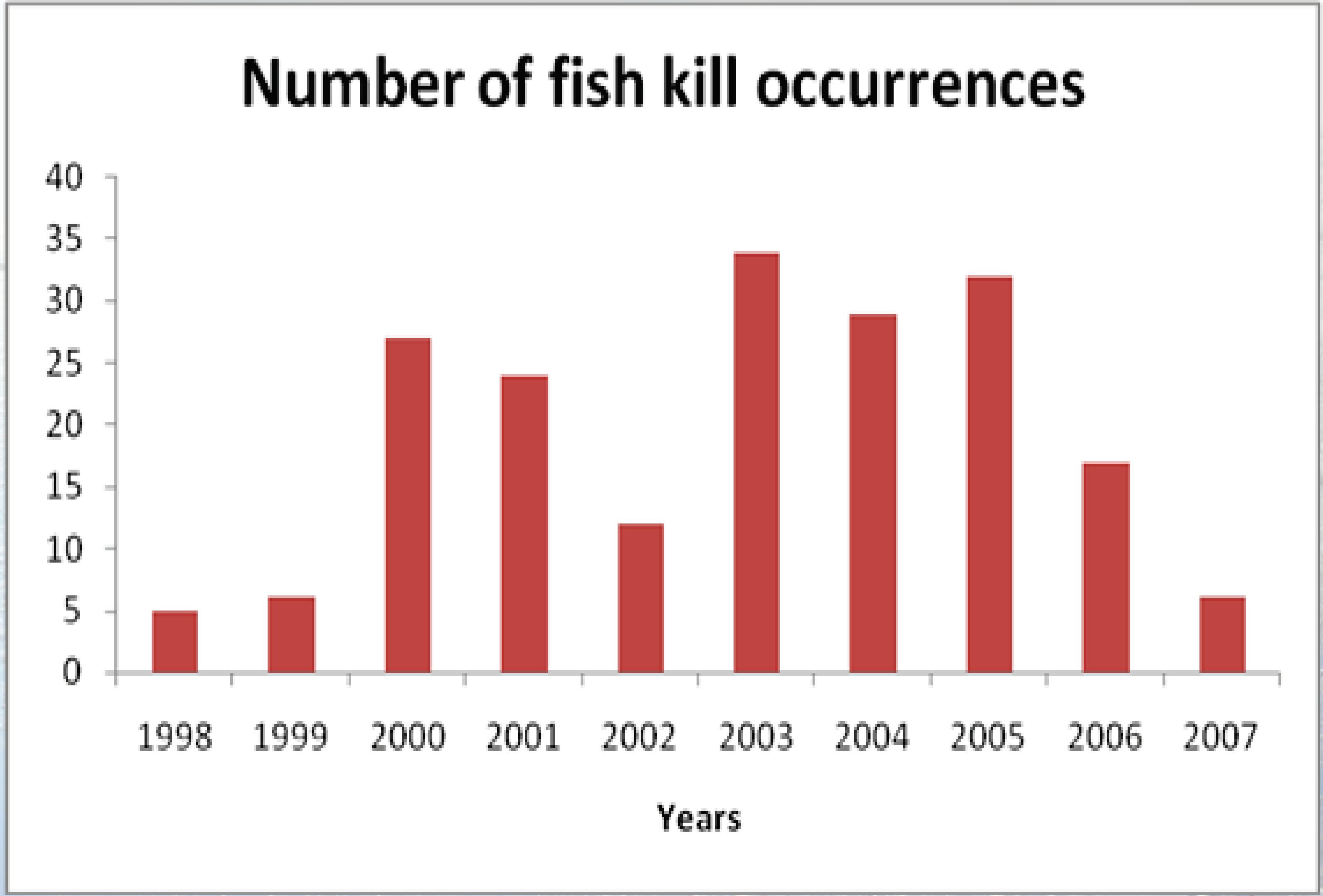
- Cage sites
- Municipalities



Taal Lake

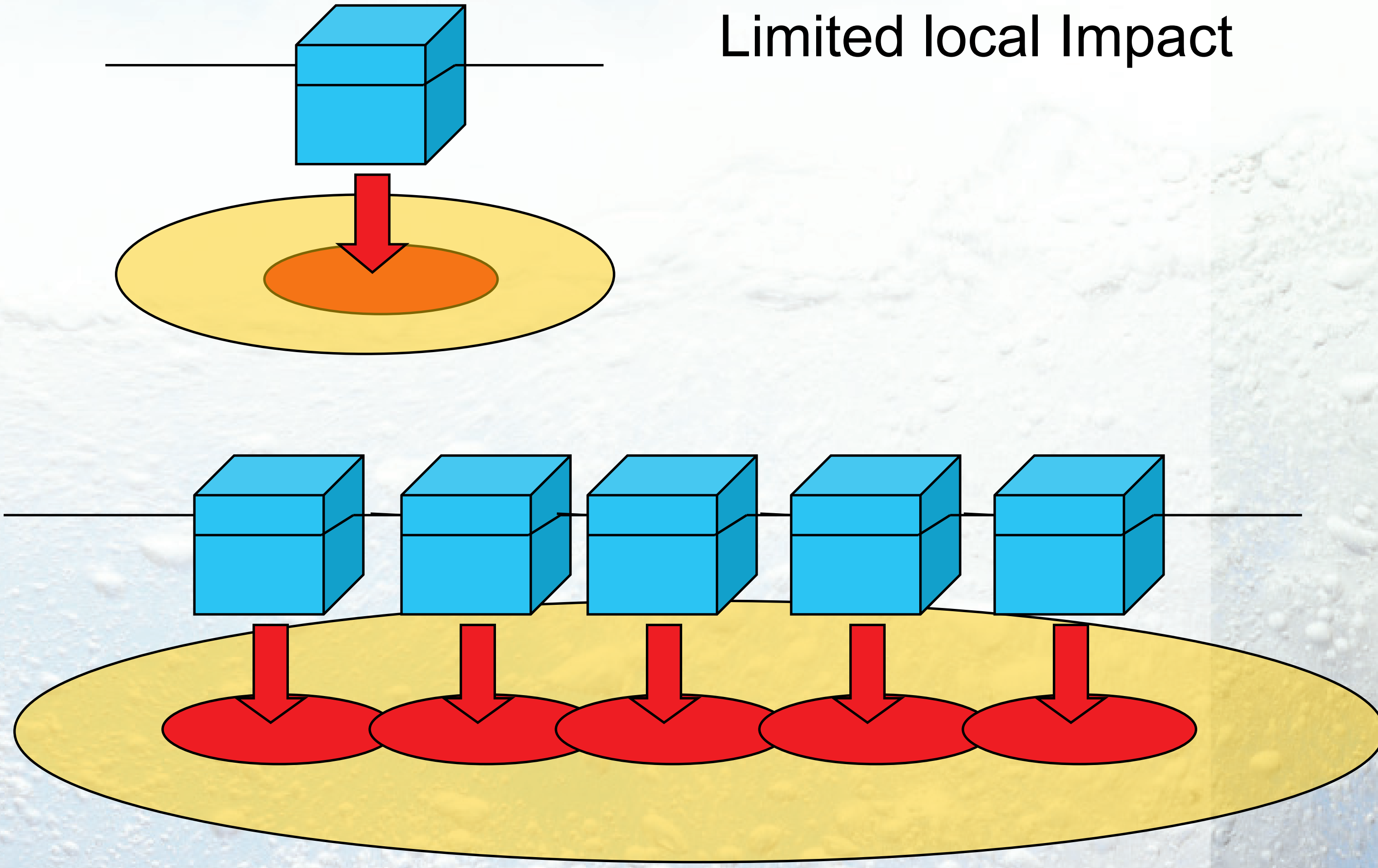

9,600 cages
112,800 t/yr
4.8 t/ha
530 t/feed/day
20 year residence time

Fish Kill occurrences Taal Lake



Environmental impact

Limited local Impact



Cumulative impact

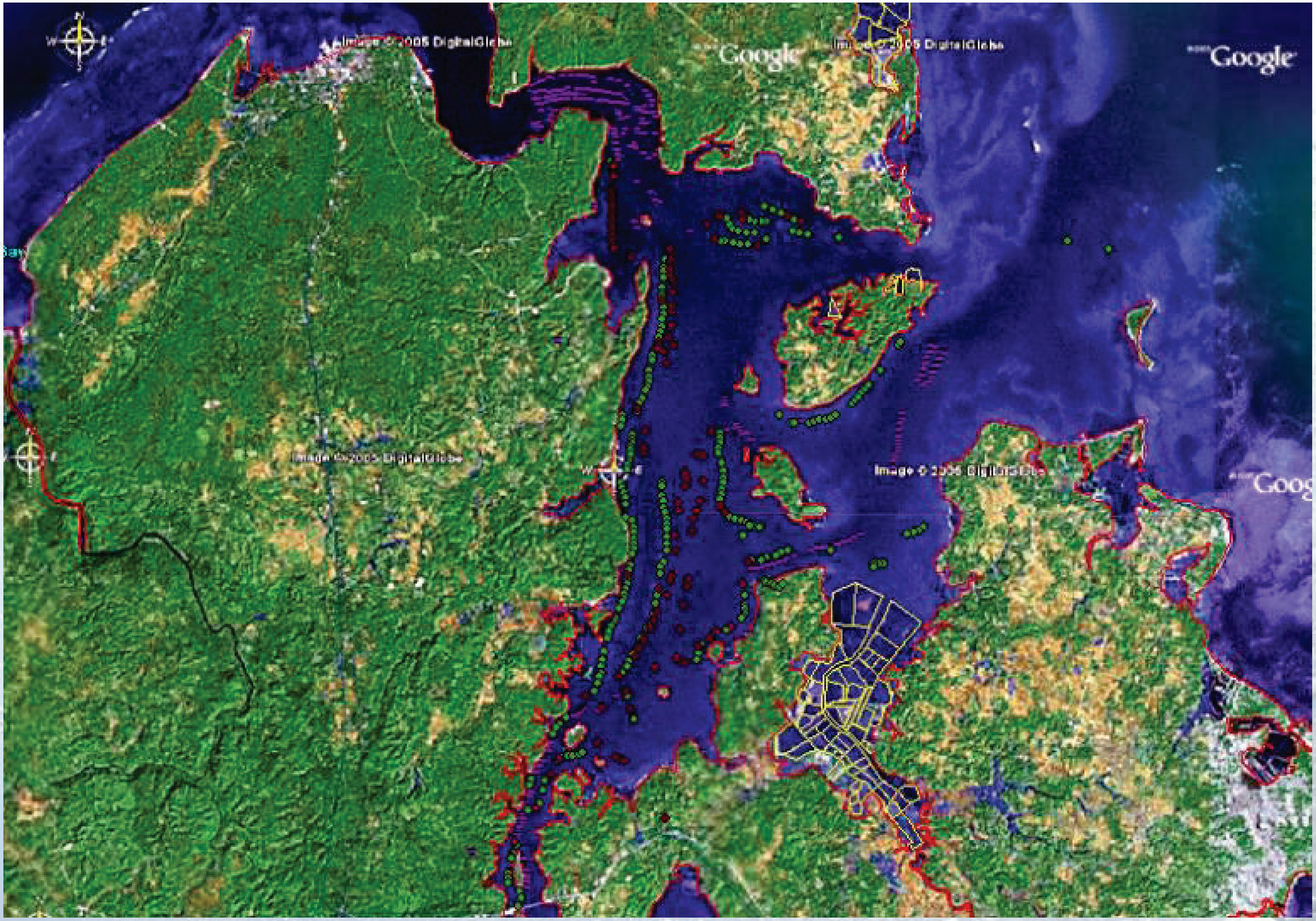
Estimating maximum aquaculture carrying capacity for Bolinao Bay

The process of determining carrying capacity for fish aquaculture based on determining the critical phytoplankton concentration

- Natural nutrient input
- Aquaculture nutrient input
- Water body characteristics, water volume and water exchange
- Natural equilibrium
  Phytoplankton growth
  Phytoplankton concentration
- Carrying capacity

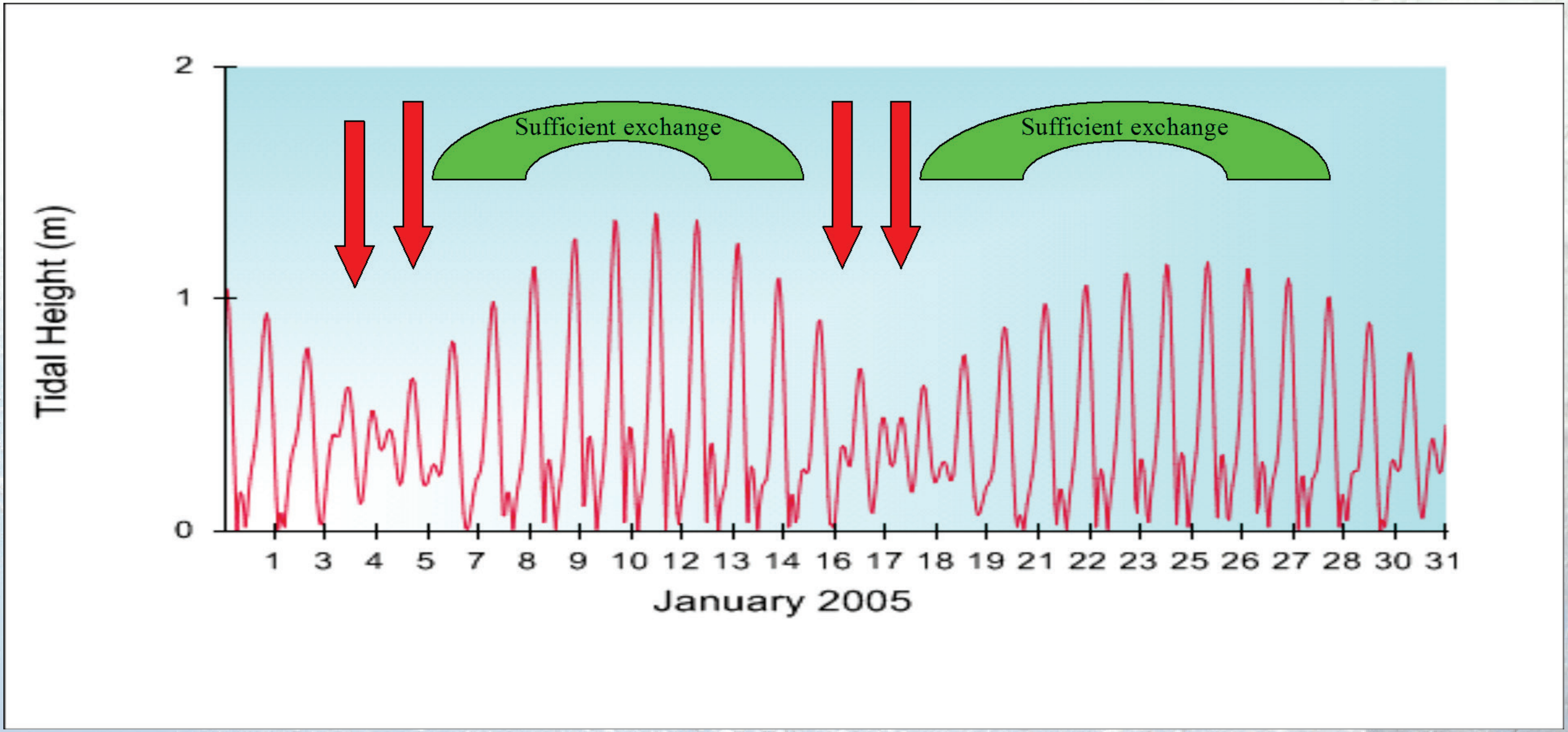
Estimation of all nutrient sources

(cages + pens + river + domestic + agricultural) – (mollusc + flushing)



Carrying capacity affected by precipitation

Carrying capacity affected by tides



Predicting times of greatest risk