Inland capture fisheries and freshwater aquaculture

TEEB for Agriculture & Food expert workshop,

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Food and Agriculture Organization of the United Nations

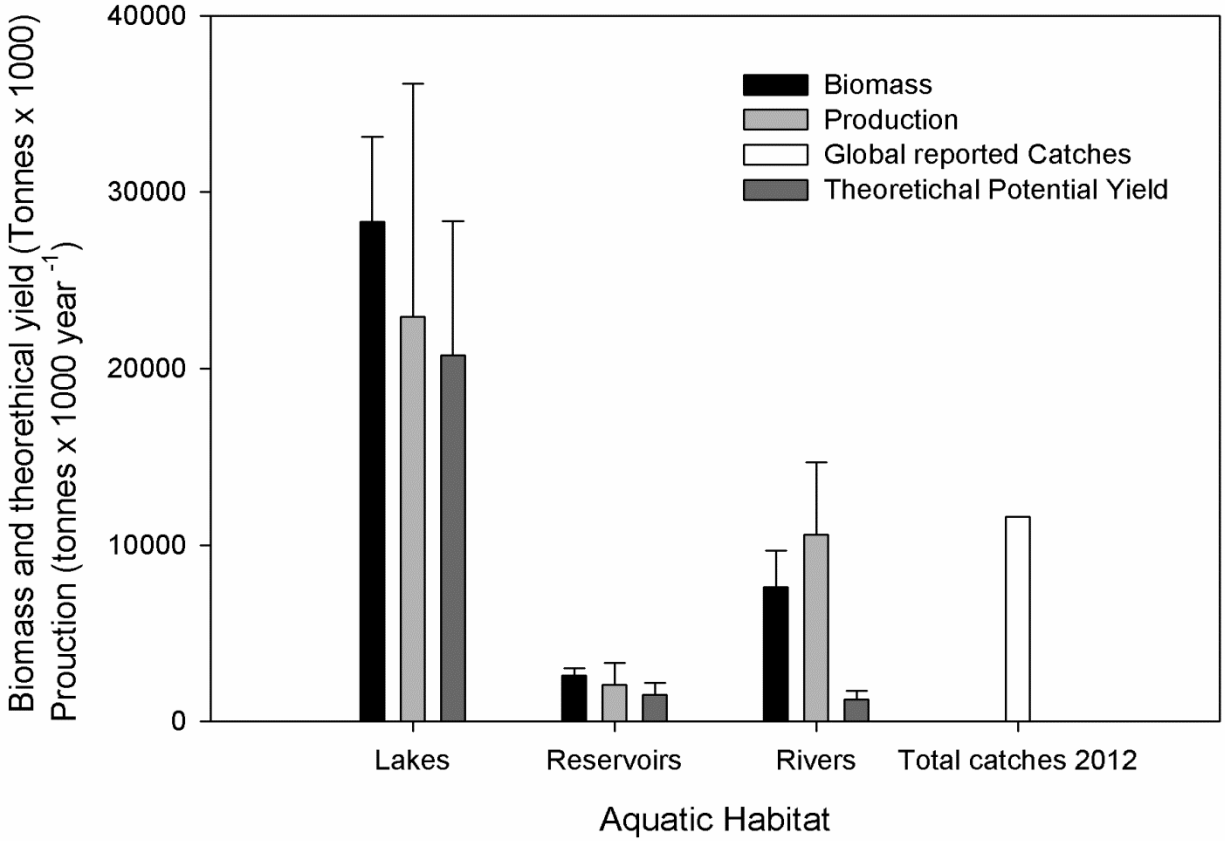
Outline

1. Context
   - Fish populations and capture fisheries
   - Freshwater aquaculture
   - Trade-offs between water uses and fish production
2. Valuation approach
   - Identifying aquatic ecosystem services and benefits
   - Case studies
   - Global (continental) upscaling
3. Early results
4. Areas of further work/attention

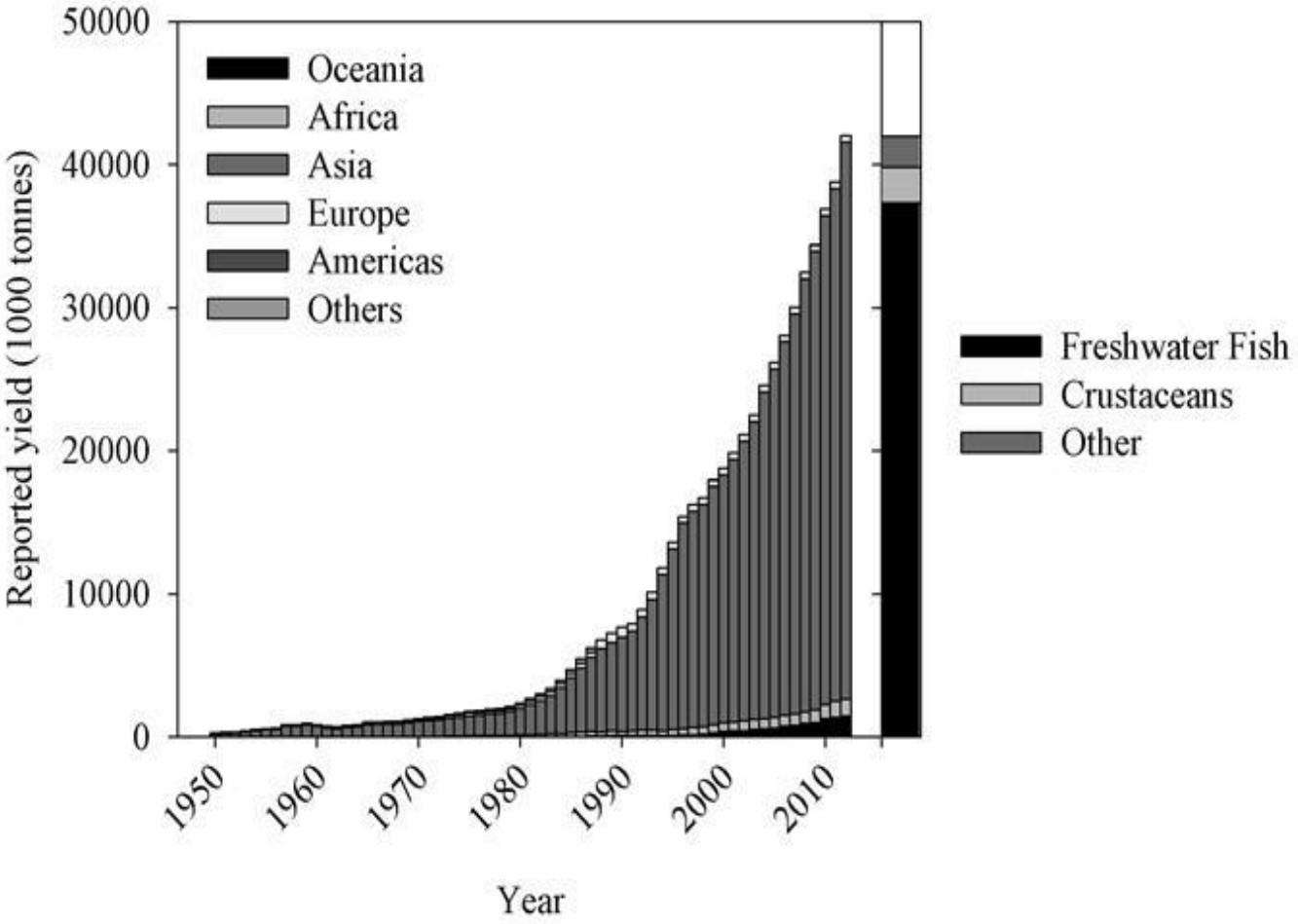
1. Context - Fish populations and fisheries

Inland capture fisheries

- Fish Biomass
- Fish Production
- Fisheries Yield



1. Context – Freshwater aquaculture



- 42 million tonnes
- Freshwater fish: cyprinids (carps) and cichlids (tilapia)
- 93% from Asia

1. Context – Trade-offs and externalities

- Between uses of aquatic ecosystems:
  - Increasing scarcity of freshwater
  - Increasing competition between water uses
  - Increasing competition between water and fisheries/aquaculture management objectives

  - Threatens the provisioning service of aquatic ecosystems, i.e. fish production

  AND

  - Threatens the services generated by fisheries and aquaculture systems
    - E.g. FI: nutrient cycling, livelihood support
    - E.g. AQ: C fixation, groundwater recharge, cultural heritage

→ Complex trade-offs and externalities at multiple levels (spatial, temporal) across multiple systems and affecting multiple stakeholders

2. Valuation approach/ Method

1. Literature review to identify the ecosystem services (and their values) provided by fish populations and aquatic habitats
2. Selection of three case studies representative of a wide range of aquatic habitats, agro-climatic zones, fish production systems and stakeholders
3. Case studies: marginality (measuring changes) to explore how different water management scenarios affect the value of a selected set of ecosystem services provided by the systems
4. Up-scaling: ES values obtained from case studies and literature scaled up to a global scenario (continental) using habitat specific wetlands areas

2. Ecosystem services – selected set

Ecosystem services	
Provisioning services	**Fish production**
	Income and livelihood support
	Food security
	Hydroelectric power generation
Supporting services	**Water quality**
	Biodiversity
	Nutrient cycling
Regulating services	Flood control
	Carbon fixation and GHG emissions
Cultural services	Cultural heritage
	Recreation/aesthetics
	Research (fisheries)
	Tourism

2. Columbia River, N. America

- Fish production systems:

Commercial, recreational and tribal salmon fisheries

- Water management scenario for irrigation and hydropower generation; fish and habitat conservation

2. Columbia River, N. America

- Value of salmon fishery:
  - Commercial: $26 million/year (fleet revenues)
  - **Recreational**: $32.5 million/year (trip expenditures) – *most valuable fishery*
  - Tribal: $332,000/year (equiv loss in social benefit if return to hydropower prioritisation)
  - Nutrient cycling: $2,977/year (equiv loss in net social benefit if return to hydropower prioritisation)

2. Columbia River, N. America

Results of management scenarios

- Net social benefits of fish conservation prioritization (+10% compared to current):
  - +$1.4 million/year from commercial fishing
  - +$1.8 million/year from recreational fishing
  - +$103,600/year from tribal fishing
  - +$1,800/year from nutrient imports

→ Management for conservation = +$3.3 million/year

Management for hydro = -$2.6 million/year

2. Lower Mekong Basin, SE Asia

- Fish production systems
  - Rice fields with fish production Culture-based fishery (in reservoir or floodplains)
  - Pond aquaculture
  - Cage aquaculture in reservoirs

- Water management for hydropower generation

2. Lower Mekong Basin, SE Asia

- Ecosystem services values in the basin (literature)

Services	Values (2014)
PROV - Fish production	$6.393 million per year (2 million tonnes)
PROV - Livelihood support	$26-945/year/ha
SUP- Water quality (wetlands)	$843-2535/year/ha
SUP – Biodiversity (wetlands + trop. forest)	$45-272/year/ha
SUP - Nutrient cycling	$10.5 million/year
REG – carbon fixation (protected areas)	$1893-3046/year/ha
CULT - Tourism	$1.95 million/year

2. Lower Mekong Basin, SE Asia

Results of management scenarios

- Losses due to hydropower prioritization (+88 dams):
  - -495,000 to -792,000 tonnes fish catch/year, equiv. to loss of approx. 440,000 Kcal x 10^6/year or approx. 75,000 tonnes of proteins/year
  - -$24 million/year in nutrients
  - -$4-13.8 million/year in wetland value (clean water, plants, fuel, flood control, wildlife habitats etc.).

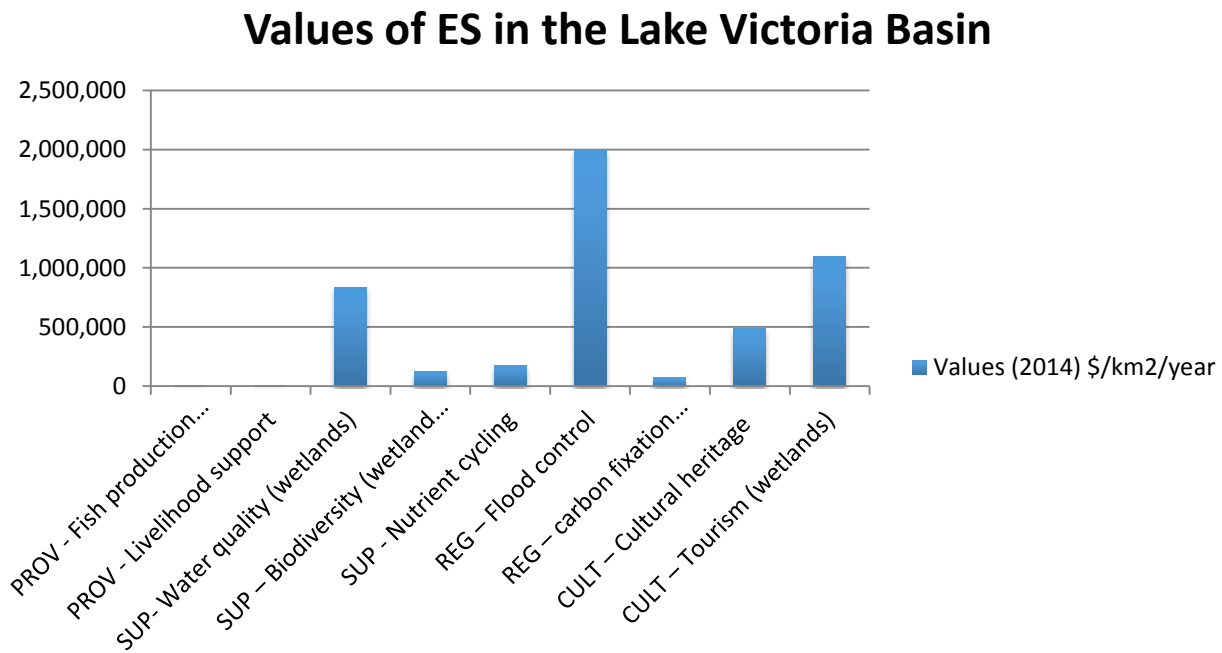
2. Lake Victoria, E. Africa

- Fish production systems
  - Industrial fisheries (Nile perch)
  - Cage aquaculture (tilapia)

- Water management for irrigation and drinking

2. Lake Victoria, E. Africa

- Ecosystem services values (literature)



- Management scenarios – *analysis still ongoing*

2. Key highlights from case studies

- Water management scenarios were used to highlight externalities of importance for inland fisheries
- Externalities generated by hydropower generation and the unsustainable use of wetlands are substantially affecting the supply and value of the benefits derived from the fish production service in all cases.

2. Global/continental upscaling

- Ecosystem service values obtained in the case studies and literature were adjusted as: US$ / ha / year
- The case values were multiplied by continental aquatic habitat area to obtain a continental value.
- Drawbacks
  - Aquatic habitat areas uncertainty
  - Transferability of values (site specific)

3. Tentative results

	Values of FW aquatic ecosystems	North America	Asia	Africa	Total across 3 continents (in billion US$/yr)	Percent of total ecosystem services value
Provisioning services	Fish production	1.16 billion	82.5 billion[b]	10.56 billion[c]	94.22	0.18%
7% of total value	Hydroelectric power generation	3,576.2 billion	n/a	n/a	3,576	Underestimate 6.7%
Supporting services	Water quality	623.3 billion	50.4 million	1,091 billion	1,714	3.21%
4% of total value	Biodiversity	2.63 billion	4.07 million	158.5 billion	161.17	0.3%
	Nutrient cycling	n/a	178.2 million	229.5 billion	229.68	0.43%
Regulating services 84% of total value	Flood control	10,119-66,162 billion	n/a	6,757 billion	44,898[d]	84.16%
Cultural services 4% of total value	Cultural heritage (fisheries)	34-2,464 US$/household/yr	n/a	636 billion US$/km2/yr	636[e]	1.19%
	Tourism	120.9 billion (fisheries)	33.6 million (wetlands)	1,427 billion (wetlands)	1,548	2.90%
				TOTAL	*53,350*	*100%*

4. Areas of future work/attention

- Aquatic habitats: fisheries and aquaculture in an ecosystem services perspective
  - Areas – global -> national or basin level
  - Fish productivity – specific to habitats
  - Better valuation of services of aquatic ecosystems + services of fish production systems needed
  - Comparatively low GHG emissions !?
- Fishing effort / culturing effort
  - Number of fishermen / aquaculturists
  - Actual catches / aquaculture production potential: HUGE data gaps
- Contribution to food security
  - Distribution - effects from externalities on social groups?
  - Nutrition – key protein and micronutrient source – how important? (can it be replaced and what are the costs)
- The bigger picture: 2 conceptual reflections
  - ES valuation ←→ equity/distribution of benefits (value to whom?)
  - ES ←→ resilience (where are thresholds? What implications for ecosystem management and food/fish production?)

The Team

- Cecile Brugere (FAO consultant/SEI)
- David Lymer and Devin Bartley (FAO)
- *Columbia River:* Cedar Morton and Duncan Knowler, Simon Fraser University, Canada
- *Lower Mekong Basin*: Rattanawan (Tam) Mungkung, Ratcha Chaichana and Santi Senglertsawai, Kasetsart University, Thailand
- *Lake Victoria*: Dismas Mbabazi and Oliva C. Mkumbo, Lake Victoria Fisheries Organisation, Uganda