



Water: biodiversity and health interlinkages

Regional workshop on the inter-linkages between human health and Biodiversity in Africa, Maputo 2013

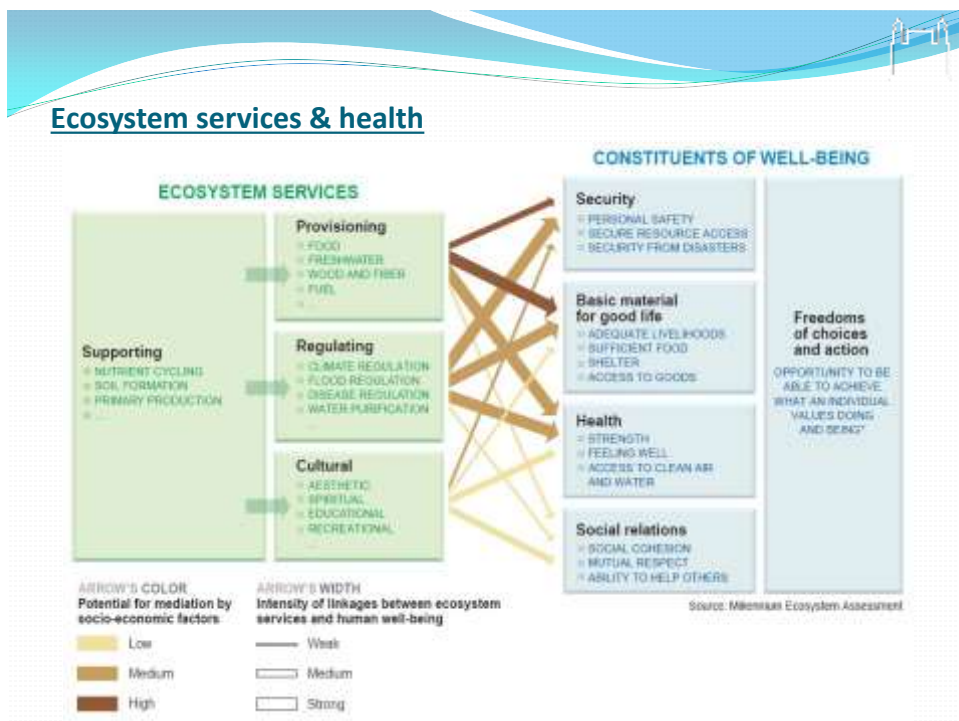




Daniel F. Buss
FIOCRUZ/Brasil



Ministério da Saúde
FIOCRUZ
Fundação Oswaldo Cruz

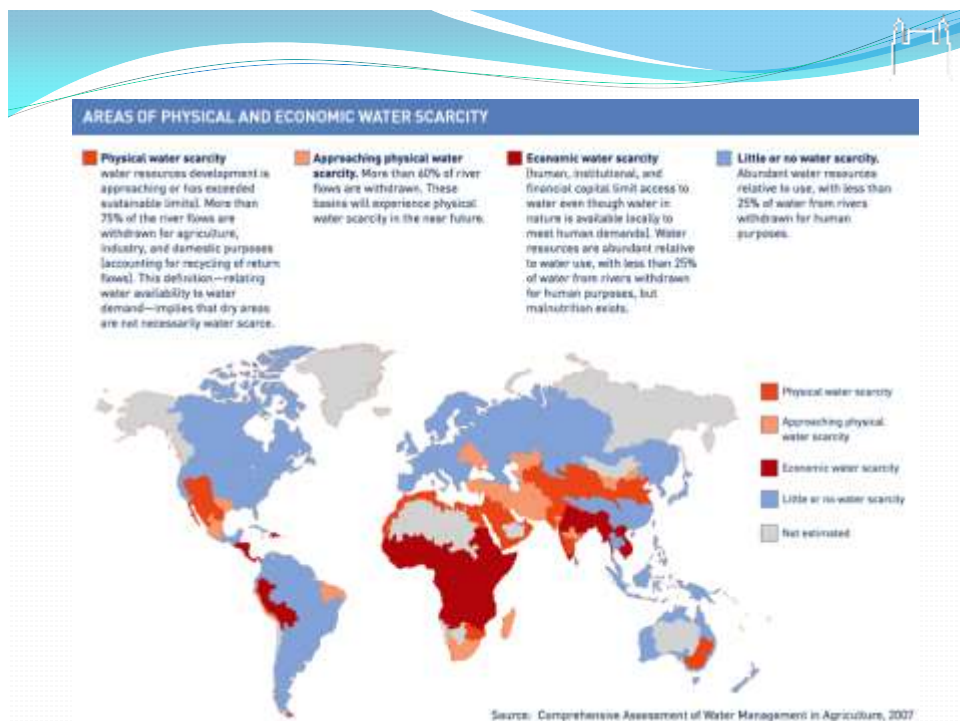


Ecosystem services under pressure

- Rapid changes and new demands from 1960-2000:
 - World population doubled (3 to 6 billion people)
 - Global economy increased sixfold

- To attend this demand for ecosystem services:
 - Food production increased 2 ½ times
 - Water use doubled
 - Use of wood for pulp and paper production tripled
 - Generation of hydroelectrical energy doubled
 - ...

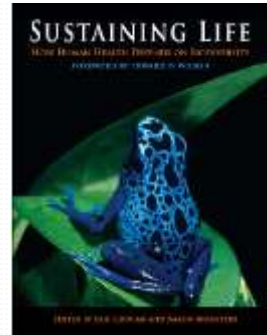
Millennium Ecosystem Assessment



Water ecosystem services → Health

PROVISIONING

- Water quantity and quality for multiple uses (consumptive/non)
- Food and medicine
 - Irrigating and growing food
 - >70% of medicinal products comes from nature
 - From the 150 most used medicines, 118 are from natural sources (74% plants, 18% fungi, 5% bacteria, 3% reptiles)



Water ecosystem services → Health

REGULATING

- Sewage treatment using wetlands
- Natural water filtering
 - Mollusks like *Diplodon chilensis chilensis* both increase substrate complexity (allowing more species to cohabit) and reduce total phosphorous, PO_4 and NH_4 by about one order of magnitude
 - Macrophytes like *Eichhornia crassipes* reduce organic contamination and eutrophication in lakes if correctly managed
 - Mangroves are effective in removing heavy metals and nitrogen from water
 - *Moringa oleifera* are used mainly in rural areas to clear the water from particles, which reduce contamination by microorganisms
- Protection and/or alleviation from storms and flooding
 - Mangroves (e.g. it is estimated that every 5.5 km of healthy coastal wetlands reduces the storm surge by 0.3 m)
 - Riparian forests
- Regulation of the hydrological cycle (inland and coastal wetlands and forests)

Water ecosystem services → Health

CULTURAL

- Recreation
- Tourism
- Spiritual



E. Brito

SUPPORTING

- Nutrient cycling (e.g. floodplain fertility)
- Ecosystem resistance to disasters and resilience (e.g. genetic pools, key species)

Old problems, same solutions...



Rugendas, "Desmanche de uma floresta", c.1820-1825.



In 1850's the city of Rio de Janeiro was suffering from lack of water because many streams and rivers have dried out due to deforestation for coffee plantations.

Major Archer (Manuel Gomes Archer, 1821-1905) – together with only 6 slaves (Eleutério, Constantino, Manuel, Mateus, Leopoldo e Maria) and a slave-master – planted from 1861 to 1872, more than 70.000 trees in the mountains that today is the largest urban forest in the world.

Old problems, same solutions...



Bad management, bad water quality: in 1997 the city of NY planned to spend US\$6-8Billions + \$300M/y to build and to maintain new water treatment plants

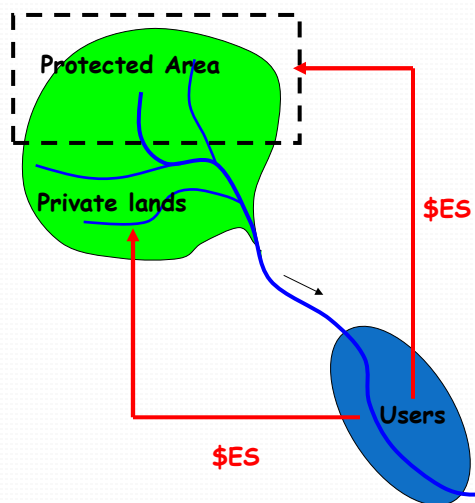
A high price to pay for whom a short time ago needed to pay NOTHING for that

New project: land rebuy, vegetation recovery and other actions: US\$1.5Billion

Catskill Mountains, NY

Old problems, new approaches

Valuation and payment for water services



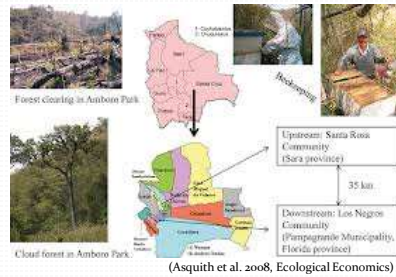
Payments can go to:

- Private landowners (including buffer zones and biological corridors)
- Protected Area budgets

Old problems, new approaches

Bolivia: Payment for ecosystem services

- Low water availability: 1ha land value with water \$7,000; without \$500
- PWS for watershed protection and bird habitat in the outskirts of a National Park
- Since 2002, 120 beehives and >1,100 hectares of forest under protection



Brasil: "BOLSA VERDE" Program

- Part of a National program for poverty eradication
- Objectives: to promote conservation, citizenship, and poverty alleviation
- Women from families living below poverty line are paid if they conserve ecosystems



Old problems, new approaches

Public participation in water management

Challenges:

- Increase participation, specially of women
- Communicate results
- Include public in decision-making, prevention and restoration actions

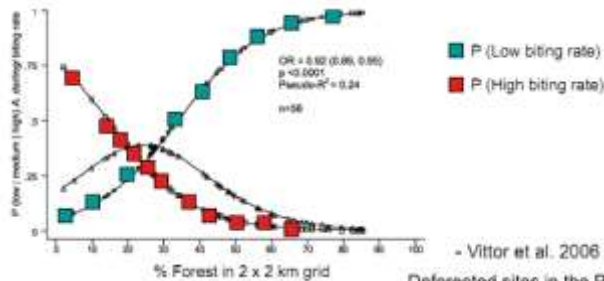
Strategies:

- Scientific & Environmental Education program
- Negotiation with other stakeholders
- Empower communities



Bad ecosystem management → impacts in health (specially the poor)...

- Degradation and deforestation have reduced the capacity of wetlands and forests to provide sufficient amounts and quality of water



— Vittor et al. 2006

Deforested sites in the Peruvian Amazon had greater mosquito (*A. darlingi*) biting rates compared to sites with less habitat alteration, independent of population density. Landscape features may be useful in predicting mosquito density.

- Physical changes in aquatic ecosystems (river damming, diversions, irrigation) may change vector/reservoir distributions and often increases dramatically prevalence of schistosomiasis, malaria and other vector-borne diseases

Bad ecosystem management → impacts in health (specially the poor)...

- Increase in waterborne diseases (cholera, hepatitis...)
- Gold-mining activities may increase mercury and methyl-mercury in aquatic ecosystems. When in these systems, it bioaccumulates in fish food chain and may cause health problems to human populations that consume those fishes

...and the other way around: impacts OF the health sector on the biodiversity!

New problems... Solutions?

Endocrine disruptors

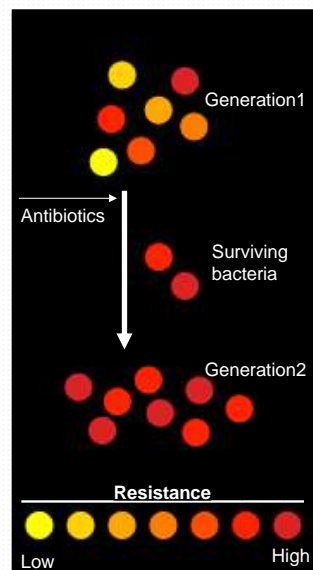
- Sources: Pesticides, Phtalates leaching from plastic products, Bisphenol A... ???
- Sources from the health sector: birth control pills, antidepressants... ???
- Effects in the environment:
 - Feminization of populations of fish and amphibians
 - In birds, caused eggshells to be so thin chicks could not survive
 - Bioaccumulation through the food chain

...and more impacts OF the health sector on the biodiversity

Antibiotic Resistance Genes (ARG)

The use of antibiotics in hospitals and food production (poultry, pigs, fish) may generate **Antibiotic Resistance Genes (ARG)** which may confer a bacteria to be considered **Multiresistant**.

These ARG may pass to other bacteria (some potentially pathogenic) and reach other organisms and environments (ex. irrigation using contaminated waters may disseminate ARGs to soils and underground waters).



Other emerging substances of concern

Cyanotoxins

- Sources: eutrophication may lead to cyanobacteria blooms in waters used for human consumption
- Species of cyanobacteria may produce toxins that affect the neuromuscular system, the liver and can be carcinogenic to vertebrates, including humans

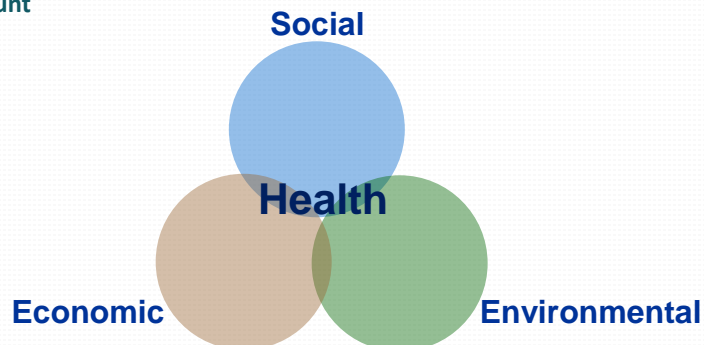
In Brazil, concentrations of microcystins in edible parts of *Tilapia rendalli* were followed during the cyanobacterial bloom season. Concentrations of toxin in Tilapia livers has been found to reach levels as high as 31.1 mg/g wet weight, so that in a typical meal an adult could be exposed to hundreds of times the seasonal Tolerable Diet Intake (TDI).

Nanoparticles

- Ultrafine particles (1-100 nanometers), variable in form and shape
- Sources: Pesticides, cleaning products + many unknown...
- Contamination and effects on biodiversity fairly unknown

MDGs and beyond (Post-2015 Agenda)

- Define a new paradigm for fully integrating Health in Sustainable Development
 - Health as an outcome of the three pillars of Sustainable Development
 - Health as a way of measuring progress towards Sustainable Development
 - Healthy people contribute for the Sustainable Development
- Build intersectoral and multilevel governance
- **Building international cooperative terms, technology transfer and funding is paramount**



MDGs and beyond (Post-2015 Agenda)

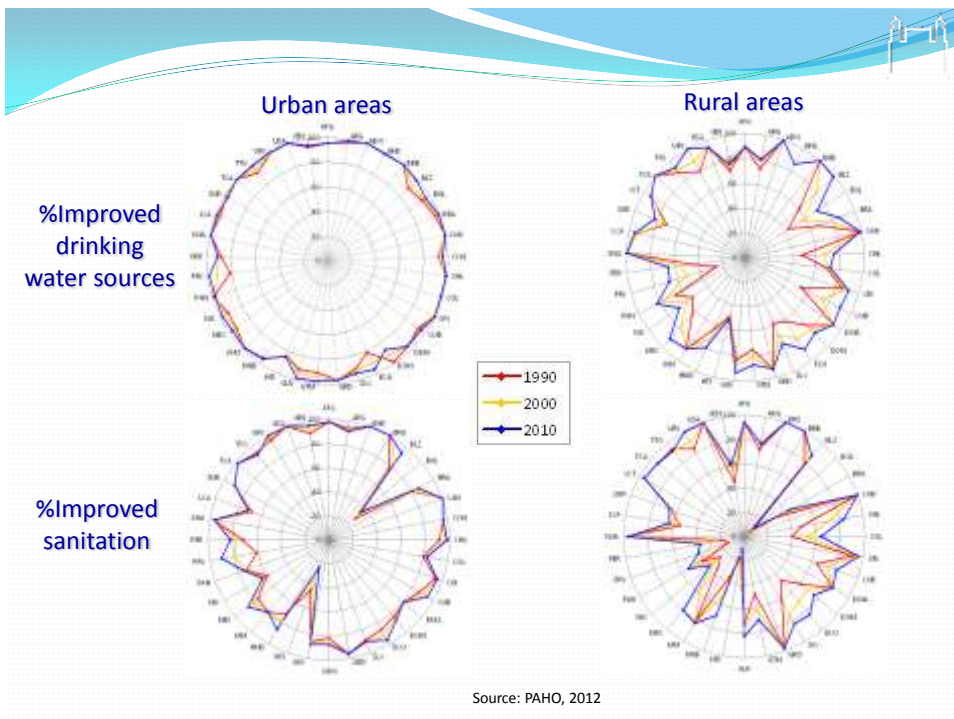
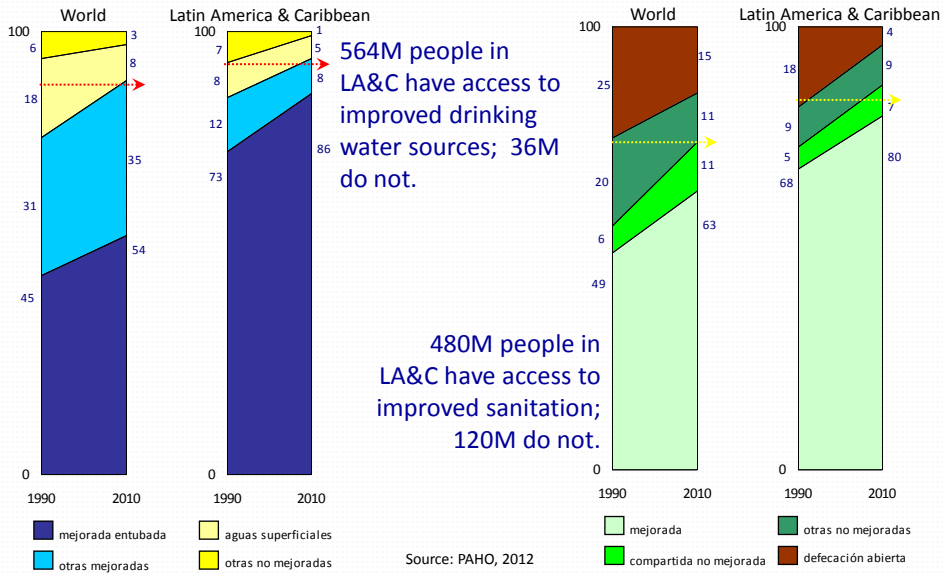
- Consider ecosystem services and water security early in economic development activities
- Undertake activities directed to enhancing ecosystem services and water security

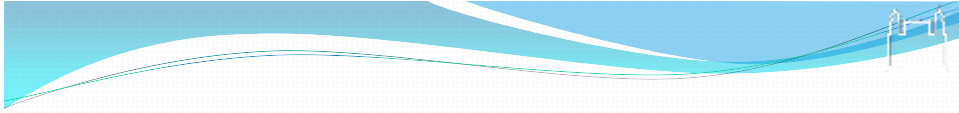
In South America, average costs of enhancement-biodiversity projects related to eutrophized ecosystems are US\$ 3 million/km of river length (or 1.5 km² of drainage basin), restoration projects cost US\$ 25 million/km of river, and renaturalization can rise costs to more than US\$ 90 million/km of river (Mendiondo, 2006). Therefore, the establishment of early-warning biomonitoring systems and strong policies related to the issue could help preventing ecosystem and human damages, reducing overall costs with mitigation.

MDGs and beyond (Post-2015 Agenda)

- Water sources → considering/analyzing the QUALITY of drinking water and for other uses
- Universal access to water and sanitation (discussing commercialization, privatization...)

Regional progress to MDG 7





MDGs and beyond (Post-2015 Agenda)

- Build management plans with multi-stakeholders
- Adaptive management to accommodate changing management goals
- Undertake appropriate ecosystem monitoring activities, stimulating the use of ecological/biological components
- Rehabilitate degraded ecosystems
- Increase public awareness about ecosystem services and water security