Session 4. Implementing and future-proofing policies and investments

Evaluating Water Policies and Investments Around the World

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1. The Challenge

Global water extractions have climbed from 600 to 3,800 km^3/year in the last century, above the rate of population growth

The degradation of water resources is a common threat to human water security and environmental biodiversity across the world

The water governance problem gravitates around the agricultural sector because the majority of water resources are used for irrigation (2400 out of 3800 km^3/year)

Irrigation (310 Mha): 20 % of cropland and 40 % of food production

By country:

India	56 M ha
China	54 M ha
United States	22 M ha
Pakistan	18 M ha
Iran	8 M ha
(Spain	3,5 M ha)

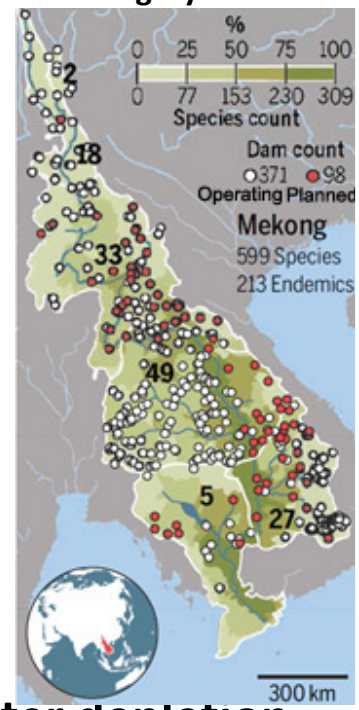
The construction of dams for irrigation has been reduced during recent decades, most dams being built for hydropower

The development of irrigation in recent decades has been based on groundwater extractions. Between 1960 and 2010, groundwater extractions from all sectors climbed from 300 to 1000 km^3/year pushing depletion up to 150 km^3/year

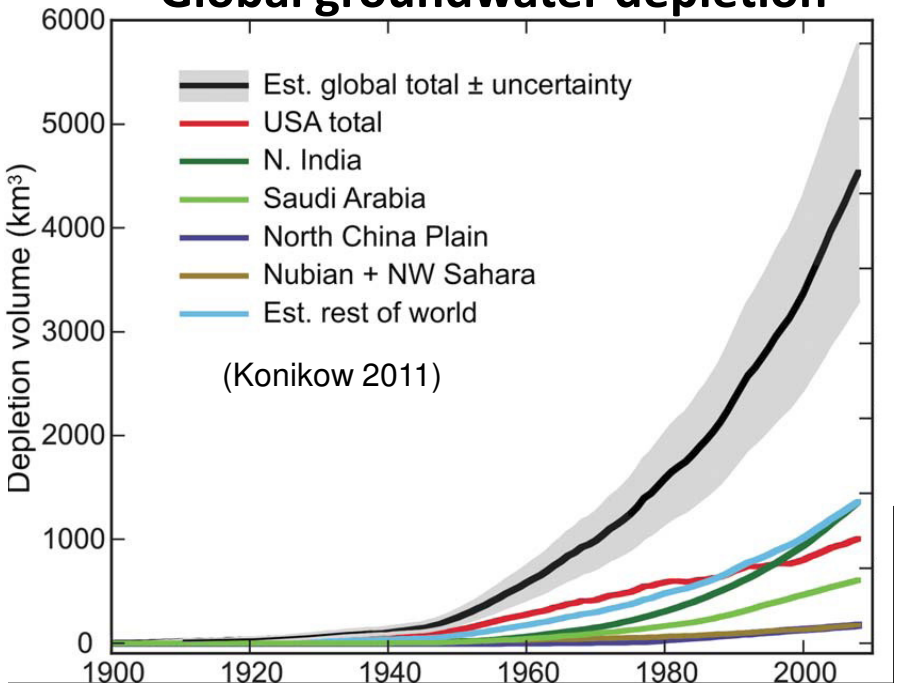
The scale of global water depletion indicates that water mismanagement is quite common, and that sustainable management of basins is a complex and difficult task

Massive investments in water technologies for human security in rich countries, but river biodiversity disregarded (Vörösmarty 2010)

Mekong Hydro Dams



Global groundwater depletion



2. The Solutions:

Implementation of policies and investments in water technologies

Australia: (WfFuture program 14 billion AU$ [6 billion spent] + 5 billion to states)

Water markets, Irrigation technologies, Water buyback for environment

European Union: (Urban wastewater directive: ~200 billion €)

Wastewater treatment plants, Nitrates legislation, Water pricing

Israel: (Supply development plan 2002-2010: 4 billion US$, with 1.6 desalination)

Command & control, Irrigation technologies, Wastewater treatment plants, Recycled water, Privatization of water companies, Water pricing, Seawater desalination

United States: (Accumulated subsidies 90 billion US$ wastewater [needed 320], 15 drinking water [needed 340]. Conservation programs 60 billion (2002-2016)

Wastewater treatment plants, Cost recovery, Conservation programs (including irrigation technologies 10 billion)

3. Shortcomings of Policies and Investments

Sustainable management of water resources is quite challenging because water goods and services could be private goods, common pool resources, and public goods

Water management characterized by collective action because of the externalities linked to the use of water (ecosystems, groundwater depletion), and because water technologies involve economies of scale and indivisibilities resulting in natural monopolies

Main message: sustainable management is impossible without cooperation among stakeholders resulting in collective action

So institutional instruments (governance) are the key issue, and economic instruments (markets and pricing) can be only ancillary

Two important shortcomings in policies and investments

Two questions are essential for any water reform in agriculture:

- One is the efficiency issue in irrigation to confront water scarcity, where the enhancement of irrigation efficiency is the common recipe advanced by national and international organizations

- The other issue is how to deal with nonpoint pollution from agriculture, which damages water quality and contributes to GHG emissions and acidification

Irrigation efficiency

Irrigation efficiency is augmented with investments in irrigation technologies, but also with water markets reallocating water to efficient irrigation areas

The issue on irrigation efficiency is the following: irrigation efficiency gains at plot and district levels could led to more evapotranspiration and less return flows, resulting in lower stream flows at basin level.

This fall in stream flows has been observed in Spain and Australia, following the multibillion dollar investments (€6 and AU$3 billion) in irrigation technologies by both countries in the past decade

The problem in water-stressed regions is over-allocation to agriculture with damages to other economic sectors and ecosystems. The investments in efficiency gains will likely worsen water scarcity in basins (e.g. Murray-Darling Declaration this month)

Nonpoint pollution

Agricultural nonpoint pollution is a serious problem, with many pollutants from a large number of sources, following transport and fate processes along different paths, and damaging ecosystems and human activities. Source emissions and pollution pathways to receptors are not observable and highly stochastic, preventing pollution monitoring or even predictions with models

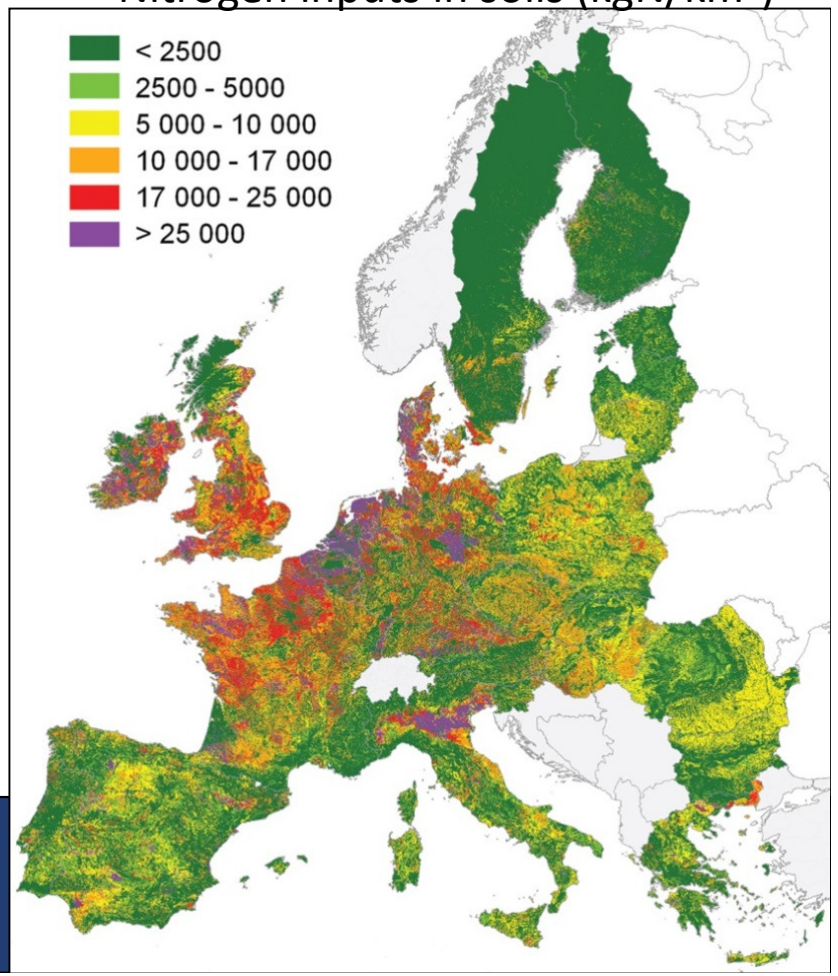
The consequence of this complexity is that nonpoint pollution abatement becomes a "wicked challenge" for economic instruments, and pragmatic solutions require the inclusion of command and control and institutional instruments, or combinations of instruments

Nonpoint pollution policies not working in Europe and the USA

In Europe, nitrogen pollution loads almost the same after 25 years of the Nitrates Directive (11 MtN synthetic fertilizers, 7 MtN manure, 6 MtN loads into rivers)

In the USA, no improvements in the water quality of rivers (Ribaudo 2015) with expenditures of US$ 5 billion/year in conservation programs (CRP, EQIP)

Nitrogen inputs in soils (kgN/km^2)



4. Evaluating water reforms

The more extensive water reforms are those of Israel and Australia motivated by the unsustainable growth of irrigation abstractions

Israel has combined command and control, investments and economic instruments: substitution of freshwater in agriculture by treated urban wastewater, water pricing, privatization of water companies, and investments in massive seawater desalination

Australia has introduced water markets: water rights changed and control of diversions. Support of farmers with multibillion investments in irrigation technologies. Payments to states to transfer control to federal basin authority. Public funds to buy water for the environment. Approach too expansive for less wealthy countries

In both Israel and Australia, environmental outcomes do not show a clear improvement

In the US and the EU, the water scarcity situation is much less severe and affects only the western regions in the US and southern regions in EU. Water reforms in agriculture are focused on agricultural nonpoint pollution, which is a widespread problem across all regions. But nonpoint pollution policies unable to reduce emission loads

In the EU, water pricing is promoted by current legislation and it works OK in urban water networks, but faces important difficulties in agriculture: i) need to convert irrigation water from common pool to private good ii) very low price-elasticity of irrigation demand that entail large increases resulting in substantial farmers' losses iii) prices to balance supply and demand during droughts so high that become politically unfeasible. Water markets more feasible because farmers maintain income

In Spain, study shows that institutional decisions by water authorities achieve results close to water markets, with more water allocated to the environment (see table)

Policies under drought: institutional, water markets, and water pricing

Water Availability	Normal Year	Drought		
Water Policy	Current policy (Institutional cooperation)	Institutional cooperation	Water markets	Water pricing
Water Use (Mm^3)				
Irrigation districts	1030	683	683	683
EM	399	304	316	316
CJT	155	107	146	146
ARJ	200	131	185	185
ESC	33	18	31	31
RB	243	123	4	4
Urban use	119	74	74	74
Environmental flows to Albufera	60	34	29	29
Private and Environmental Benefits (million Euros)				
Private benefits				
Irrigation districts	190	136	148	54
EM	80	61	62	31
CJT	45	36	39	17
ARJ	34	23	25	4
ESC	7	4	5	2
RB	24	12	17	0
Urban use	283	241	241	241
Total	473	377	389	295
Environmental benefits	75	22	19	19
Social benefits	548	399	408	314

5. Policy Recommendations

The improvement of sustainability involves solving the problem of water governance, rather than pure engineering solutions

Some pressing water governance hotspots are i) convince farmers of substituting freshwater for urban recycled water, ii) substitute synthetic fertilizers by available manure closing the nitrogen loop, and iii) in coastal areas make arrangements in order to substitute groundwater overdraft by seawater desalination

More long-term governance endeavors have to be taken to curtail irrigation surface diversions and groundwater extractions, and reallocate water to urban, industrial and environmental uses

Therefore the viability of reforms requires getting the support and cooperation of farmers by compensating farmers for the reallocation of water from agriculture to other sectors