

Scarcity is the Mother of Invention: Policy Implications in an international Setting

INTERNATIONAL WATER SCARCITY and VARIABILITY

Managing Resource Use Across Political Boundaries

SHLOMI DINAR | ARIEL DINAR



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Ariel Dinar
School of Public Policy
University of California,
Riverside

(adinar@ucr.edu)

UC Center, Sacramento
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US, Mexico reach deal to conserve Colorado River water (10/25, 2017)



The United States pledged to invest \$31.5 million in water conservation. In the US?

No, in Mexico

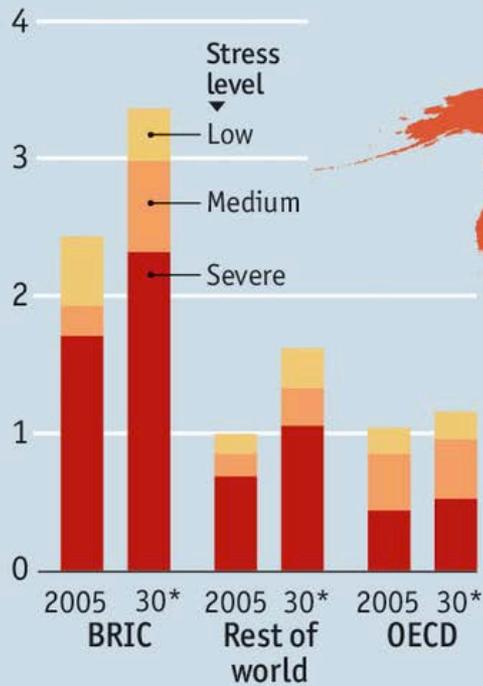
The water saved would be divided among the two nations and environmental projects.

<https://www.apnews.com/46ab7f5fd0c04ffa969efcdb7aba3e23/US,-Mexico-reach-deal-to-conserve-Colorado-River-water>

World Water Pressure

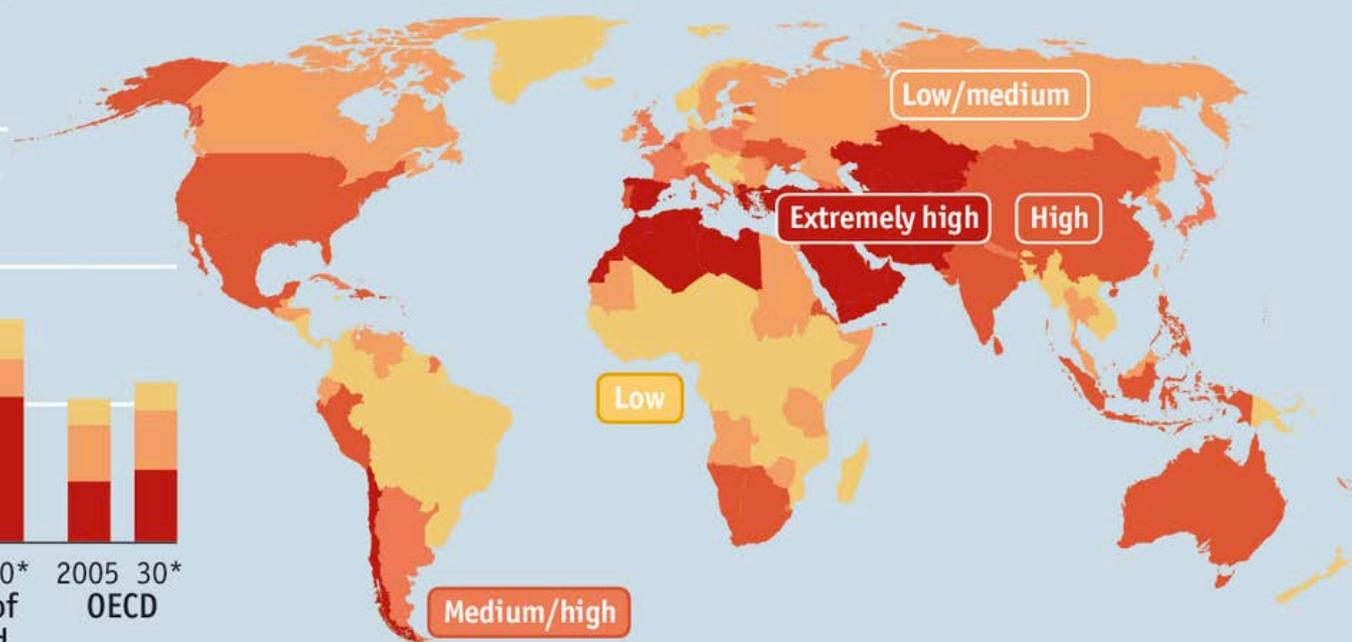
Water pressure

People living in areas of water stress, bn



Water stress, ratio of withdrawals to supply, 2040*, %

Below 10 10-20 20-40 40-80 Over 80

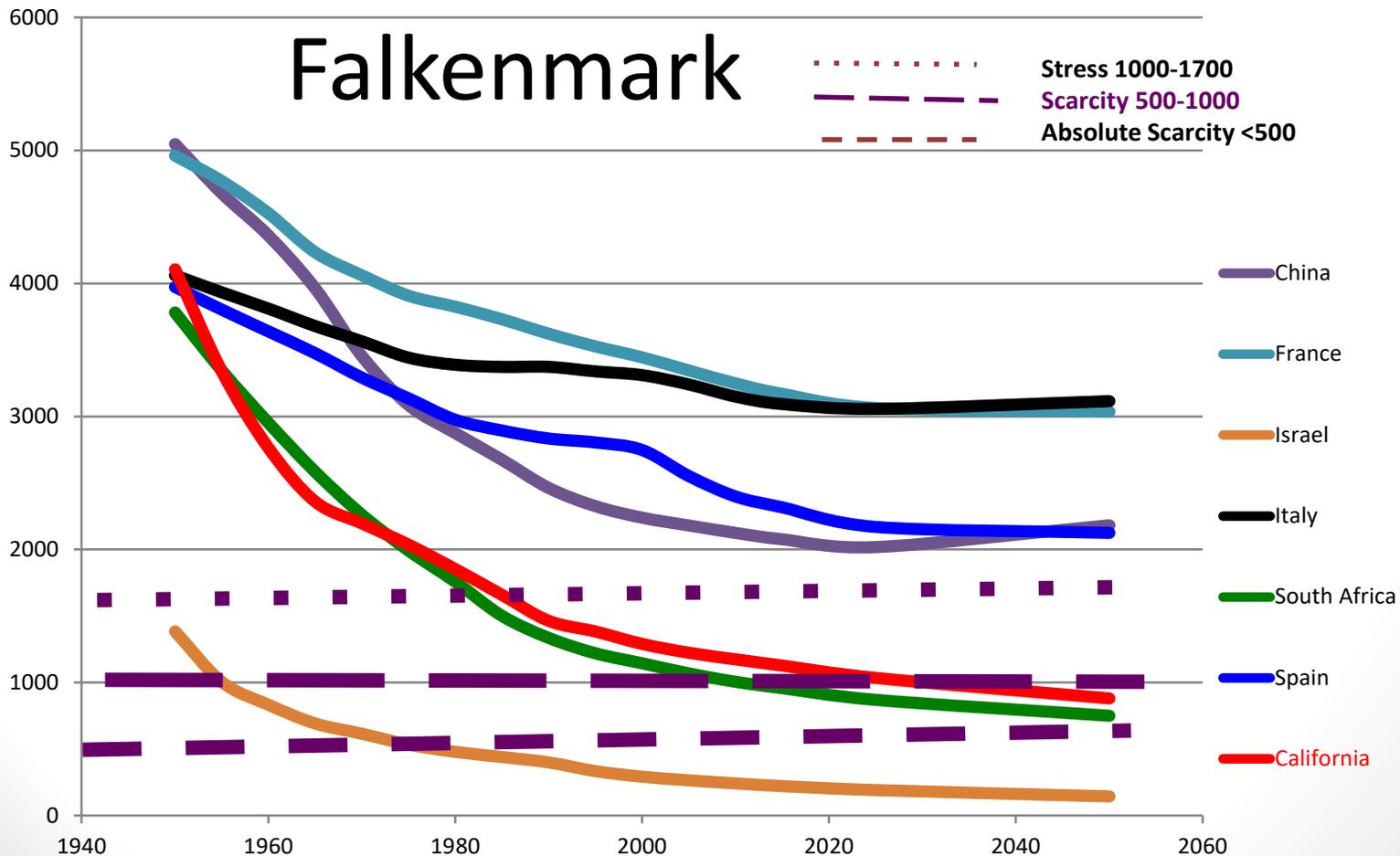


Sources: OECD; World Resources Institute

*Forecast

Available Renewable Water Resources (m³/capita/year)

1235m³ = 1af



The War School: popular press and global politicians

- Ismail Seragaldin, World Bank: the wars of this century will be fought over water (1995)
- The Economist: Water shortages will grow even more serious; the stuff of future wars (2000)
- Kofi Annan, UN: Fierce competition for fresh water may well become a source of conflict and wars in the future (2001)
- Wangari Maathi, Nobel Peace Prize Winner: Old conflicts will rage on and new resource wars will erupt (2004)
- Ban Ki Moon, UN: Water scarcity threatens economic and social gains and is a potential fuel for wars and conflict (2007)

“Water is 'catalyst' for peace, not conflict”

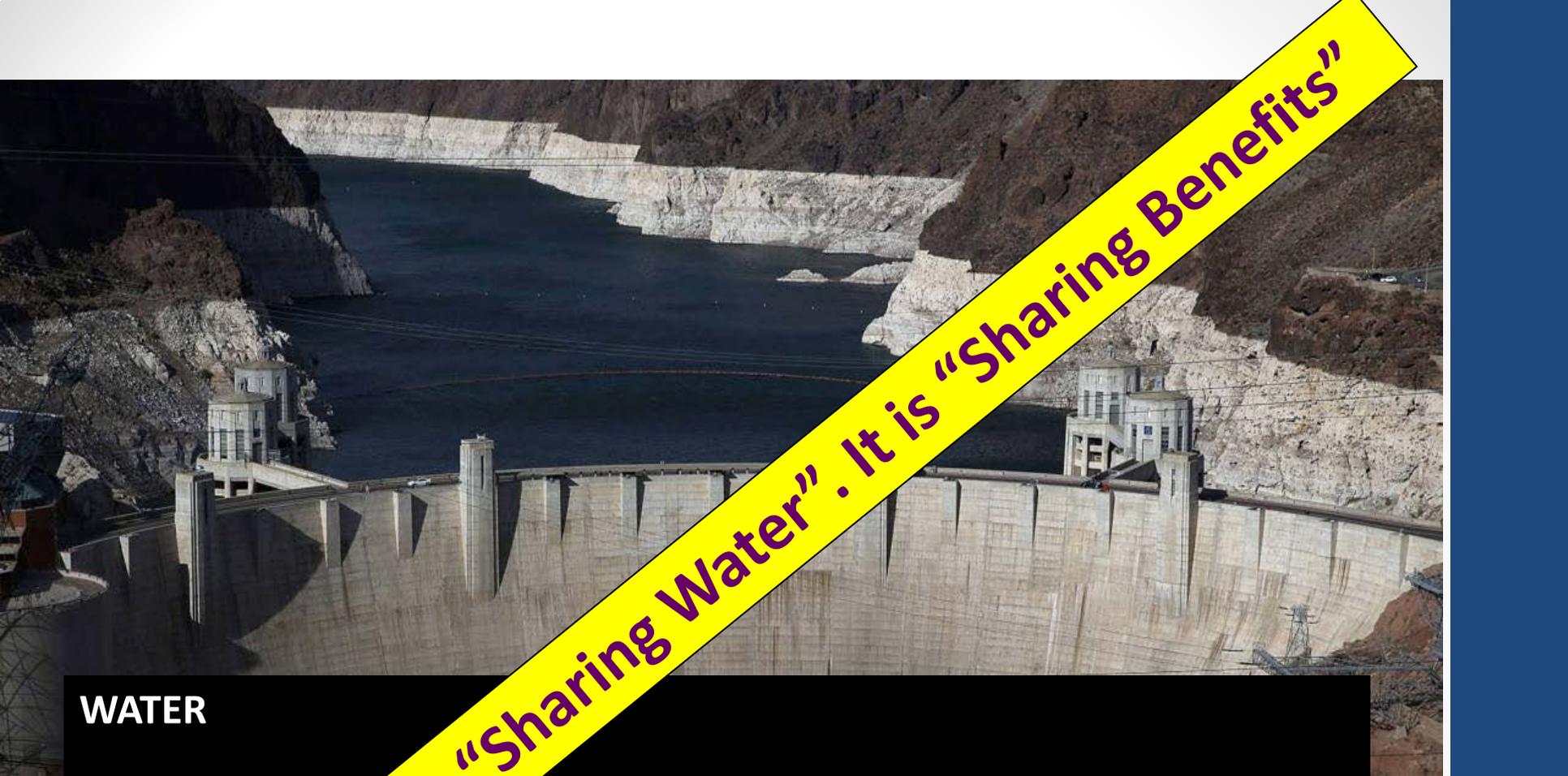
António Guterres UN Secretary-General at United Nations Security Council, June 8, 2017



<http://www.un.org/apps/news/story.asp?NewsID=56918#.WXui0dPytwd>

The Anti-Thesis: Wendy Barnaby

- A Book on water and wars that was not written...
 - “...it is still important that the popular myth of water wars somehow be dispelled once and for all. This will not only stop unsettling and incorrect predictions of international conflict over water. It will also discourage a certain public resignation that climate change will bring war, and focus attention instead on what politicians can do to avoid it. ...And it would help to convince that ...the solutions to water scarcity and security lie outside the water sector in the water/food/trade/economic development nexus” (Wendy Barnaby, Nature 2009, 458:283)



WATER

Drought in Colorado River Sparks Revolutionary Idea: Sharing Water

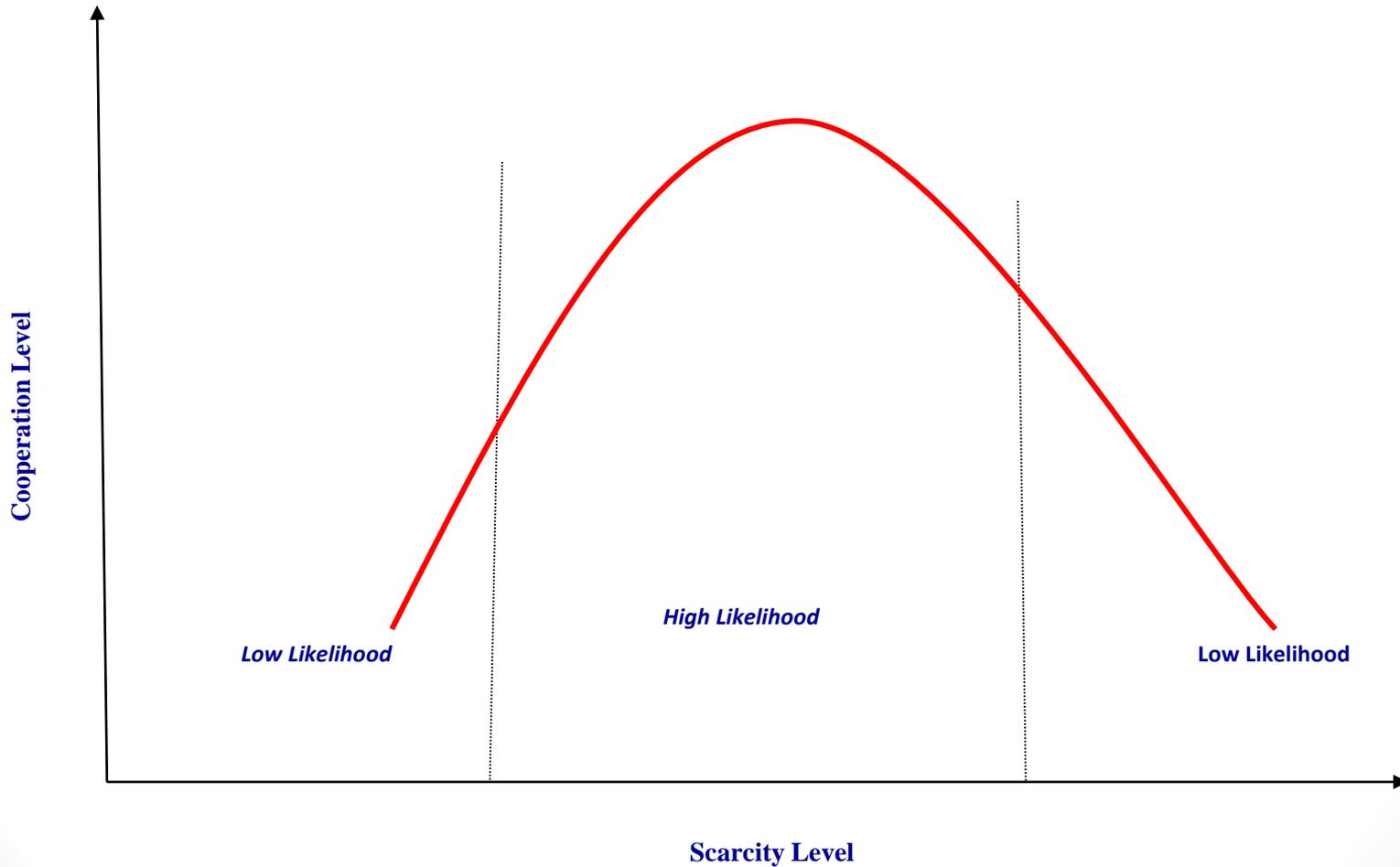
It is more than just "Sharing Water". It is "Sharing Benefits"

by Lauren Sommer, KQED and Grace Hood, CPR
NOVEMBER 16, 2016

The Basis for Our Theory

- **Philosopher John Rawls: “...when natural and other resources are abundant, schemes of cooperation become superfluous. But conversely, when conditions are particularly harsh, fruitful ventures break down. A situation of moderate (or relative) scarcity, therefore, provides a suitable impetus for action between parties” (Rawls 1971, 127-128).**
- **Similarly, Ostrom et al.: “...resource conditions must not have deteriorated to such an extent that the resource is useless, nor can the resource be so little used that few advantages result from organizing” (Ostrom et al. 1999, 281).**
- **By extension, if water resources were abundant, a treaty dividing the waters may be unnecessary. Instances of very high scarcity would also discourage cooperation. If water were extremely scant, the parties would have very little to divide amongst themselves, nor could they share any of the benefits that could be thereby derived.**

A Stylized Scarcity-Cooperation Continuum



What Does Our Book Do?

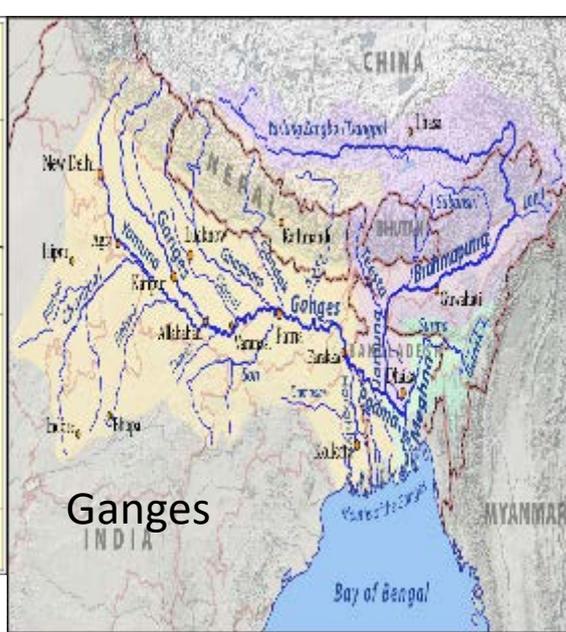
- Motivates the book message (Chapter 1)
- Combines evidence from economics, political science and international relations to develop a theory of scarcity-cooperation (Chapter 2)
- Demonstrates, using global international water treaty data, the existence of the inverse U-shape of the scarcity-cooperation relationships (Chapter 3)
 - Water availability
 - Water variability
- Identifies and quantifies the role of institutions in securing stable cooperative arrangements under scarcity and variability (Chapter 4)
- Uses political and economic instruments to promote cooperation (Chapter 5)
- Case studies demonstrating how countries cope with scarcity and variability in sharing their shared water (Chapter 6)
- Conclusion and policy implications (Chapter 7)

Case Studies

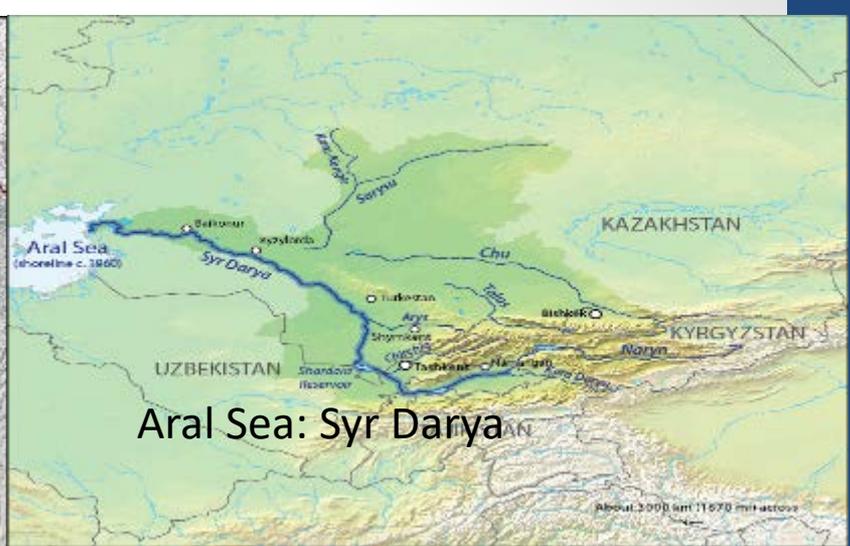
- Colorado-Rio Grande/Rio Bravo (Mexico, USA)
- Ganges (Bangladesh, India, Nepal)
- Jordan (Israel, Jordan, Palestinian Authority)
- Syr Daria (Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan)
- Tagus/Tajos (Portugal, Spain)



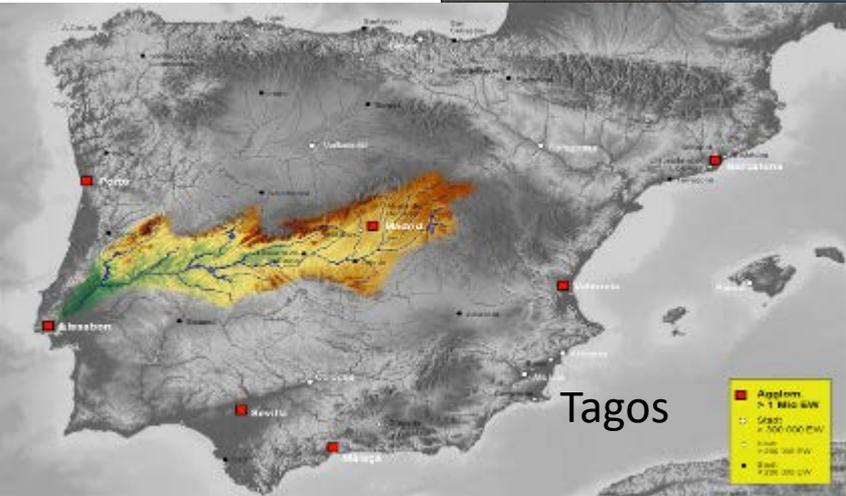
Jordan



Ganges



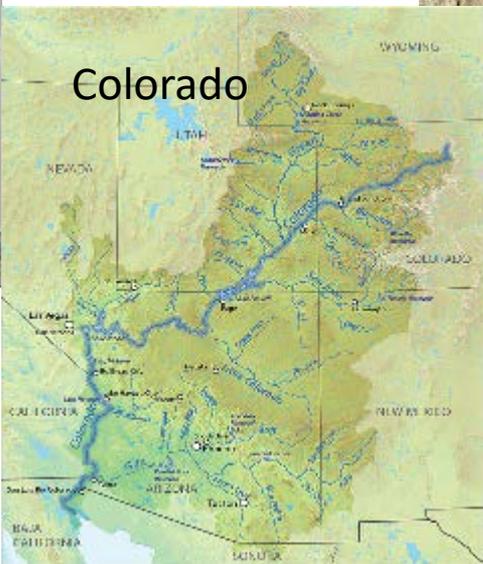
Aral Sea: Syr Darya



Tagos

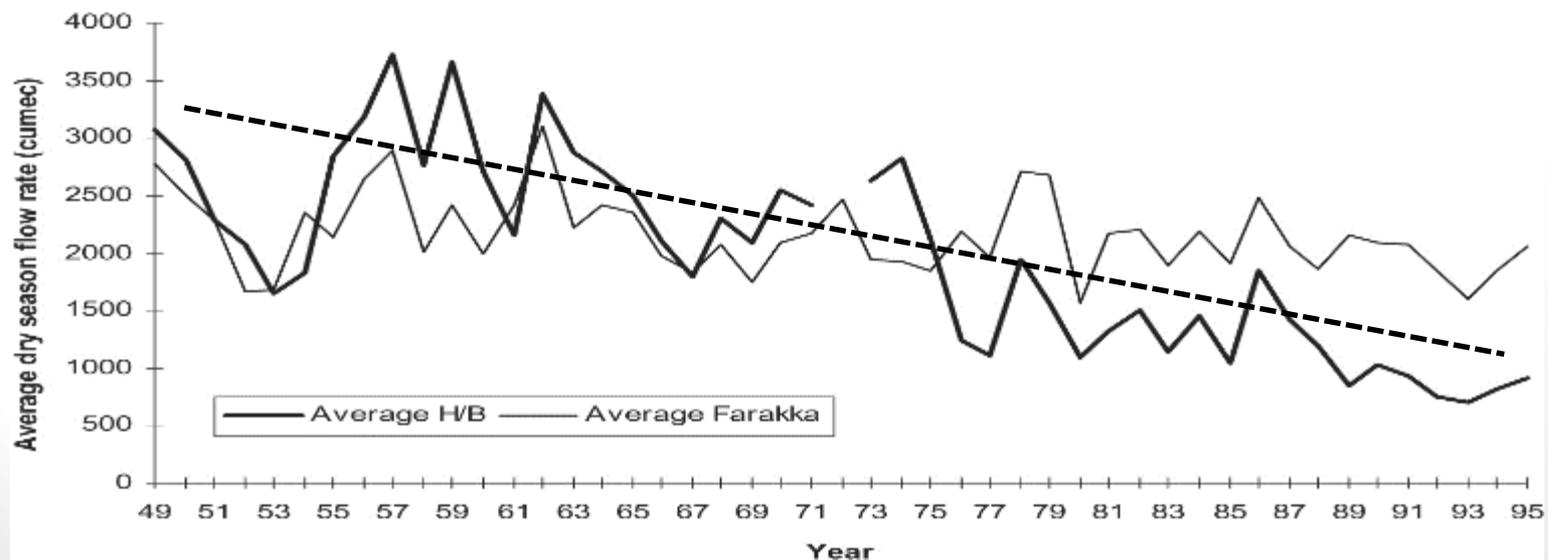
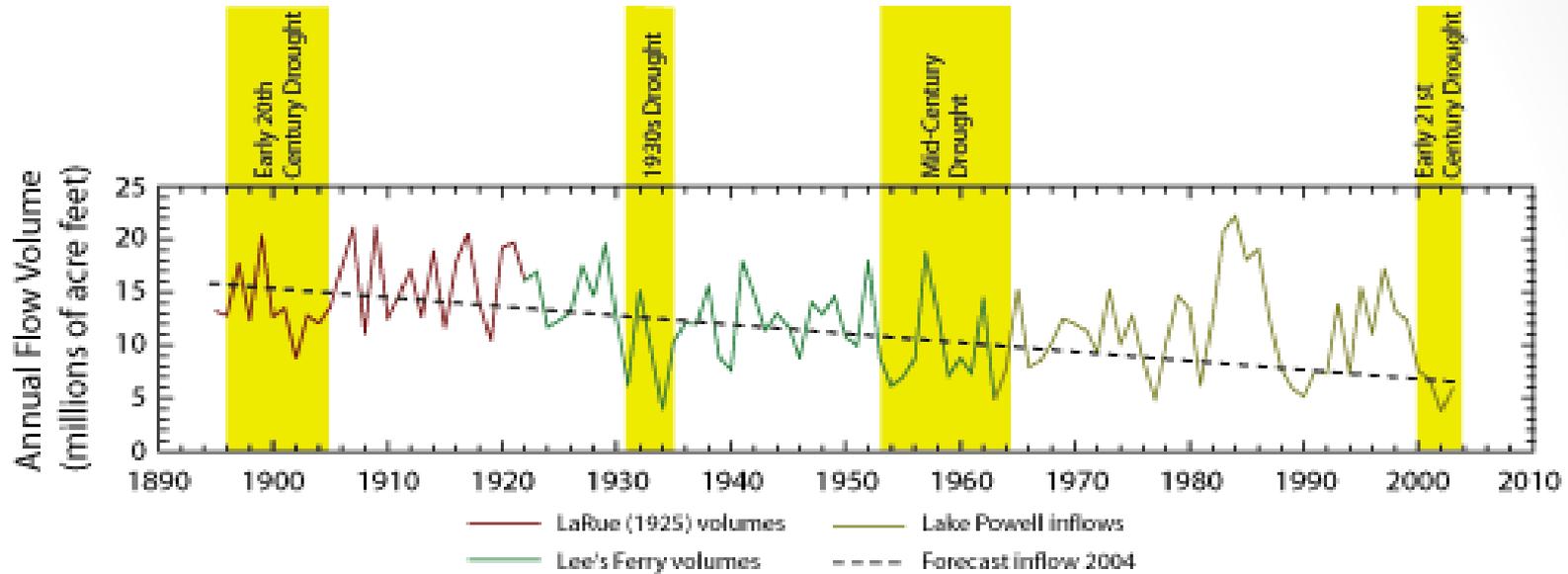


Rio Grande



Colorado

A General Trend



Issues and Approaches-Jordan (Israel, Jordan, Palestinian Authority)

Issues

- Intensification of prolonged droughts and increase in population
- The diversion of water upstream of the Jordan Basin (including storage in Syria)

Approaches

- **Infrastructure, institutions, issue linkage, second-order resource strategies, supply side solutions, demand side solutions, and inter-basin (upper-lower) linkages**
 - The 1994 Treaty did not account for major drought events but It established mechanisms to deal with them jointly should they arise
 - Infrastructure (reuse of treated wastewater, desalination of ocean water)
 - Inter-basin linkages to deal with water scarcity and cost sharing
 - The two states implemented new water pricing policies

Issues and Approaches-Ganges at Farakka (India, Bangladesh)

Issues

- Dry season flow to Bangladesh creates economic and environmental problems in the downstream country

Approaches

- **Inter-basin linkages and institutions**
 - The 1996 treaty offers flexible allocation schemes that address variability and critical low water flow in the dry season. Allocation is in percentage of flow rather than absolute flow
 - It calls for augmenting the flow at Farakka (from other sources) in the dry season
 - The treaty established an institution for monitoring and addressing extreme flow situations (floods and droughts)

Issues and Approaches-Syr

Darya (Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan)

Issues

- Conflict over timing of release of water from upstream reservoir for use in irrigated agriculture rather than energy production, especially under extreme winter conditions

Approaches

- **Second-order resources strategies, infrastructure (reservoir/hydropower facilities)**
 - Barter agreement (Bishkek) of energy for water
 - Because it is not confined to a set of regulatory institutions, the execution is subject to difficulties arising from political and economic disparities and climatic conditions
 - The agreement creates tensions among the riparians, based on their unequal per-unit payment rates for different energy sources

Issues and Approaches-Tagos (Spain and Portugal)

Issues

- Considerable variability in inter-annual rainfall and recurring droughts which leads to economic and environmental losses

Approaches

- **Infrastructure and institutions**
 - 1998 Albufeira Convention established flexible flow regimes that take into account needs and storage capacity
 - It allows close coordination of actions to ensure the sustainable use of surface and ground water
 - provides a basis for joint action via contributions towards the mitigation of water scarcity
 - An 2008 amendment revised the allocation scheme from annual coefficients to quarterly and weekly coefficients, which introduced much more flexibility to the scheme

Issues and Approaches-Rio Grande and Colorado (United States and Mexico)

Issues

- Prolonged droughts and variability of water supply (Mexico accrued a water debt...)

Approaches

- **Infrastructure, institutions, issue linkage, inter-basin linkages**
 - The 1944 Treaty (Harmon rule) was revised in 2013
 - The revision calls on the riparian states to support investments in improved water use efficiency
 - The revision allows Mexico to store water in reservoirs in the US during years of abundance
 - It introduces changes to the way the water debt of Mexico to the US is calculated
 - allowing Mexico to hold water debt between the 5 years of the water cycle, but punishing Mexico if such debt exceeds the 5-year cycle.

What Can be Concluded From this Work?

- Our book serves a dual purpose:
 1. It is a collection of the more recent works investigating the relationship between scarcity, variability, conflict and cooperation over shared waters
 2. It adds to the extant literature challenging water wars predictions
- Our work suggests that there is indeed an inverse U-shape relationship between water scarcity or increased variability and cooperation.
 - It recognizes the need for additional mechanisms for stable agreements:
 - policies, incentives, strategies, and diplomatic instruments

General Conclusions from Global Analyses

- Conflict and cooperation are explained by variables other than scarcity and variability
 - **Power:** little support for the claim that power asymmetry facilitates international cooperation
 - **Incentives:** use of financial incentives provide a better means for fostering international cooperation between asymmetric parties
 - **Trade and diplomatic relations:** are also important determinants of cooperation through which they can indirectly exchange [virtual] water
 - **Effective institutions and good governance:** enable states to better address scarcity and variability
 - **Geography:** Surprising, but geography of the river may not be important in explaining the level of cooperation

Lessons for California

- California – a micro cosmos of the world's water problem, so what can California learn?
- Develop a system that allows conjunctive use of surface water, groundwater and wastewater
- Encourage less transaction-cost burdened water trade among regions
- Extend rights system to include not only water rights but also
 - Storage rights in surface reservoirs
 - Storage rights in shared aquifers
- Agriculture is the major user of water: encourage a more advanced monitoring of soil wetness and soil salinity
- Desalination is not an ugly proposal. It was found very effective in severe drought years
- Promote frequent open regional dialogue among conflicting groups
- Identify ways to enhance investment in infrastructure, improving institutions, second-order resource strategies (land), new supply side and demand side solutions, and more inter-basin transfers