

**WATER ALLOCATION SYSTEM (WAS):
Opportunities in Jordan, Israel, Palestine
(and Lebanon)**

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Outline

- History of WAS
- Basic concepts, theory and structure
- Application in Palestine, Jordan and Israel
- Current status of the Water Economics Project and MYWAS
- Possibilities for collaboration and further research

**THE WATER ECONOMICS
PROJECT (WEP) and WAS**

History of WEP

- Founded at Harvard University in mid-1990s
- Funded by the Dutch government to develop the Water Allocation System (WAS) to represent the water economies of Jordan, Palestine and Israel and to promote cooperation in water
- Active until 2000, when political circumstances prevented discussions of cooperation
- Some work in Lebanon and Syria 2002-2003

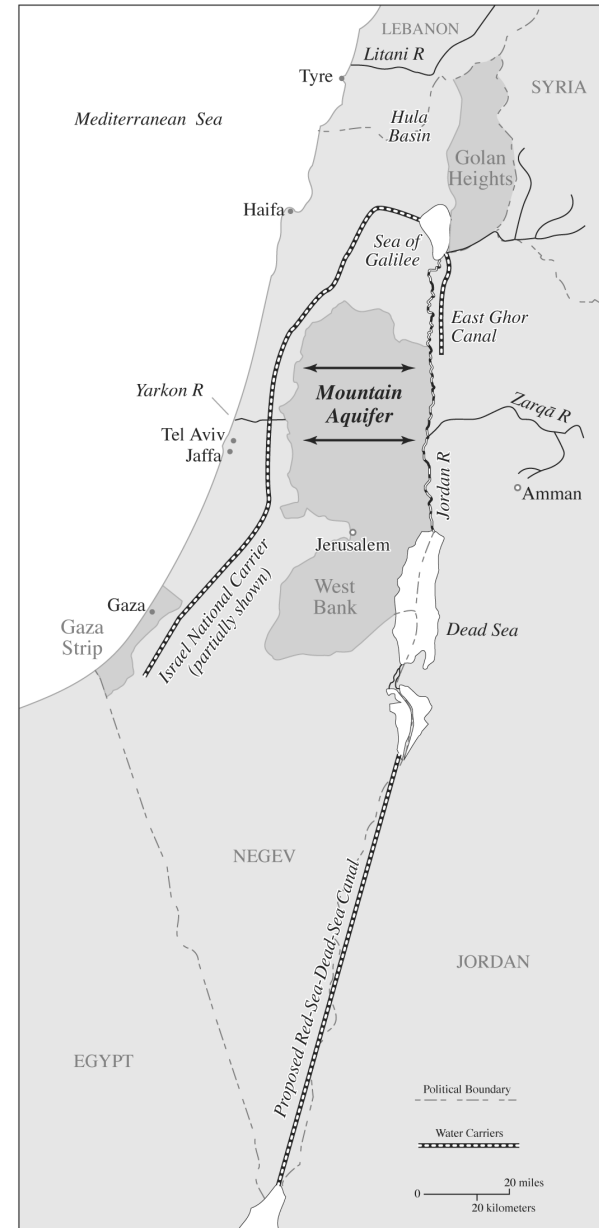
Goals of the WEP

- To promote a new way of thinking about water and thus to help resolve water disputes;
- To provide a powerful tool for optimal water management and infrastructure decisions, based on **economic and social values**;
- To show how that tool can be used in negotiations;
- To promote regional cooperation in water, turning what appears to be a “zero-sum game” into a “win-win” situation for the benefit of all.

**Thinking about Water:
Water Values, not Water Quantities**

Fishelson's Example

“Water is a scarce resource. Scarce resources have value. And the value of the water in dispute is bounded above by the replacement cost given by desalination, with that upper bound not very high.”



What does WAS do?

Structure

- System is divided into districts/units, to a degree of resolution appropriate for considered infrastructure and policies
- For previous modeling of Israel, Jordan and Palestine, 37 districts
- Supplies, demands, infrastructure - existing and potential future - are represented
- System is solved to maximize social welfare via non-linear optimization
- How is social welfare represented? and social values?

Figure 1. Gross Benefits from Water

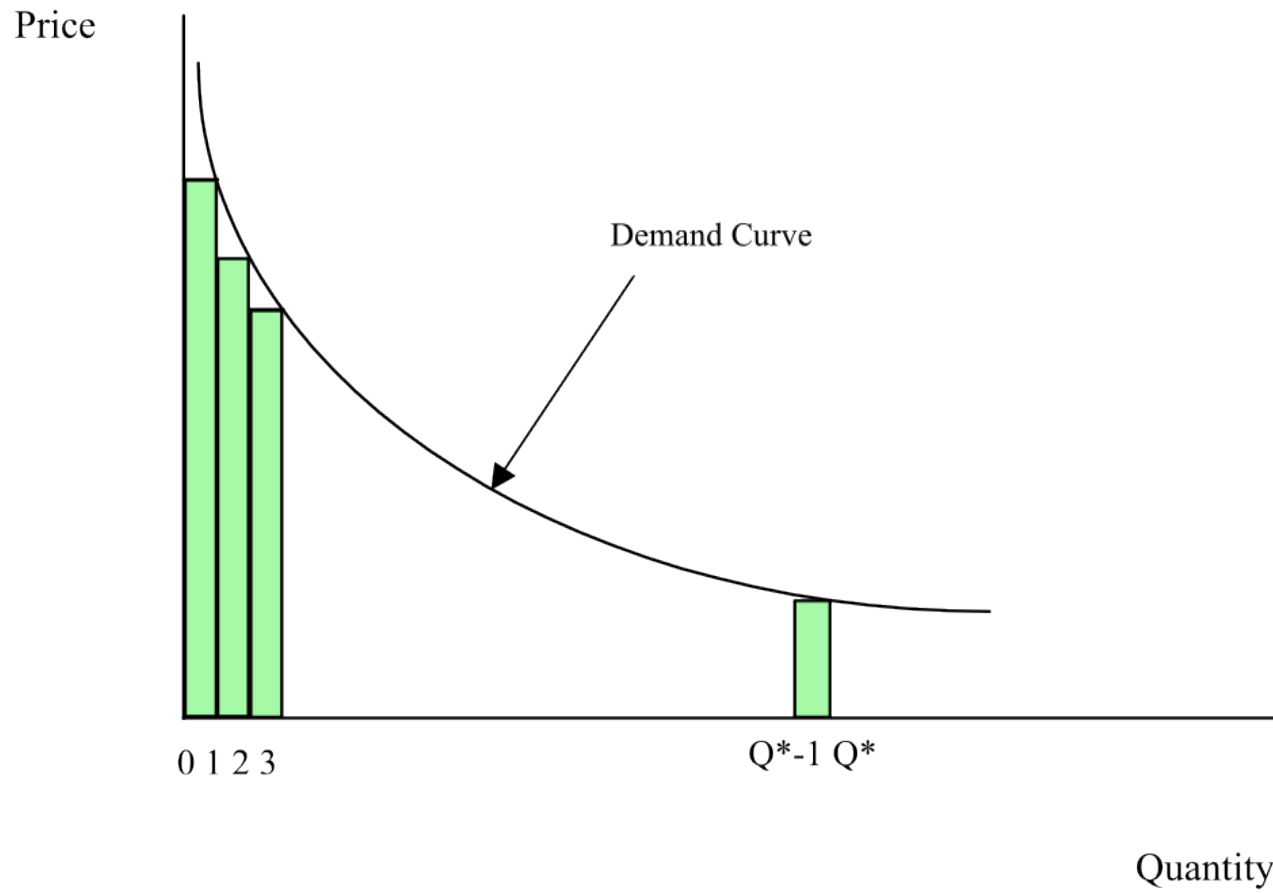


Figure 2. Net Benefits from Water

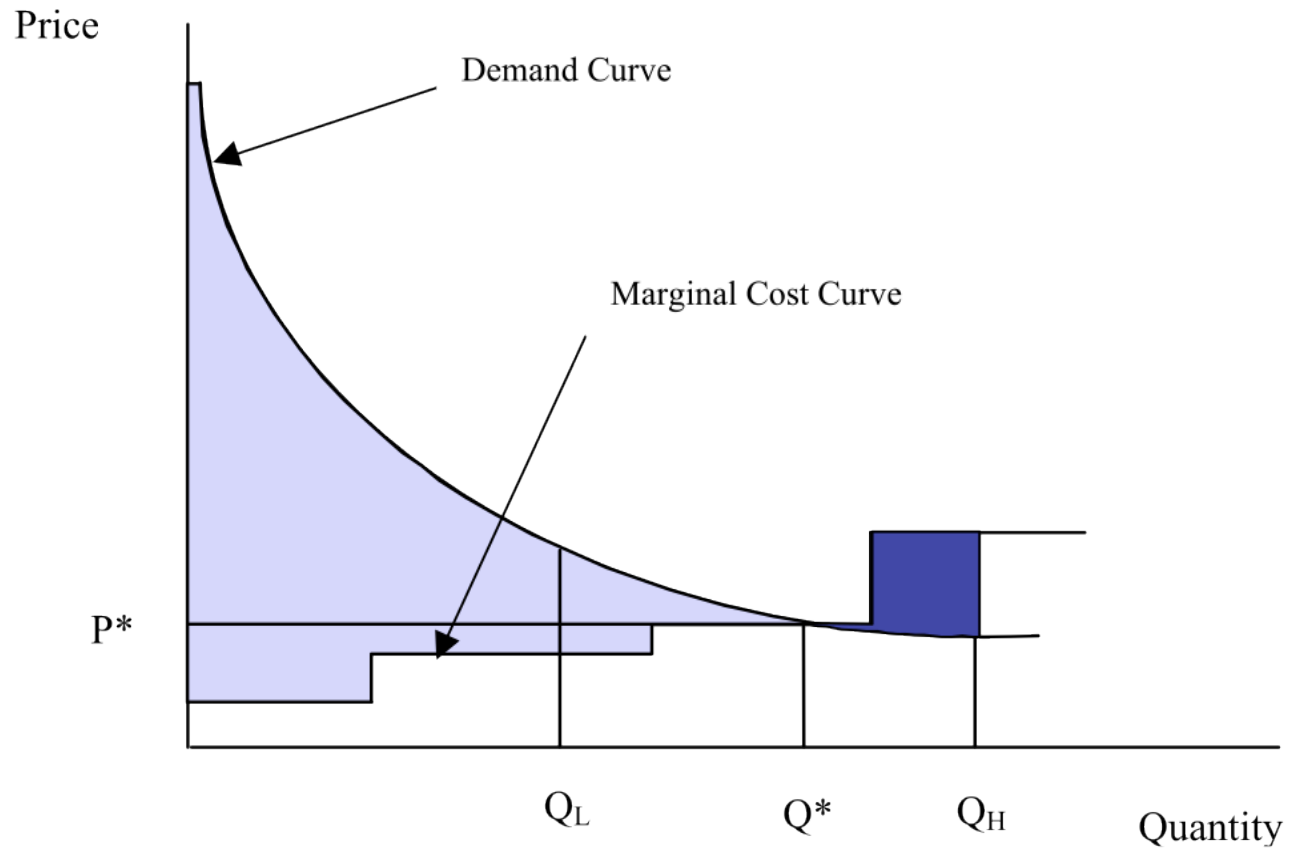
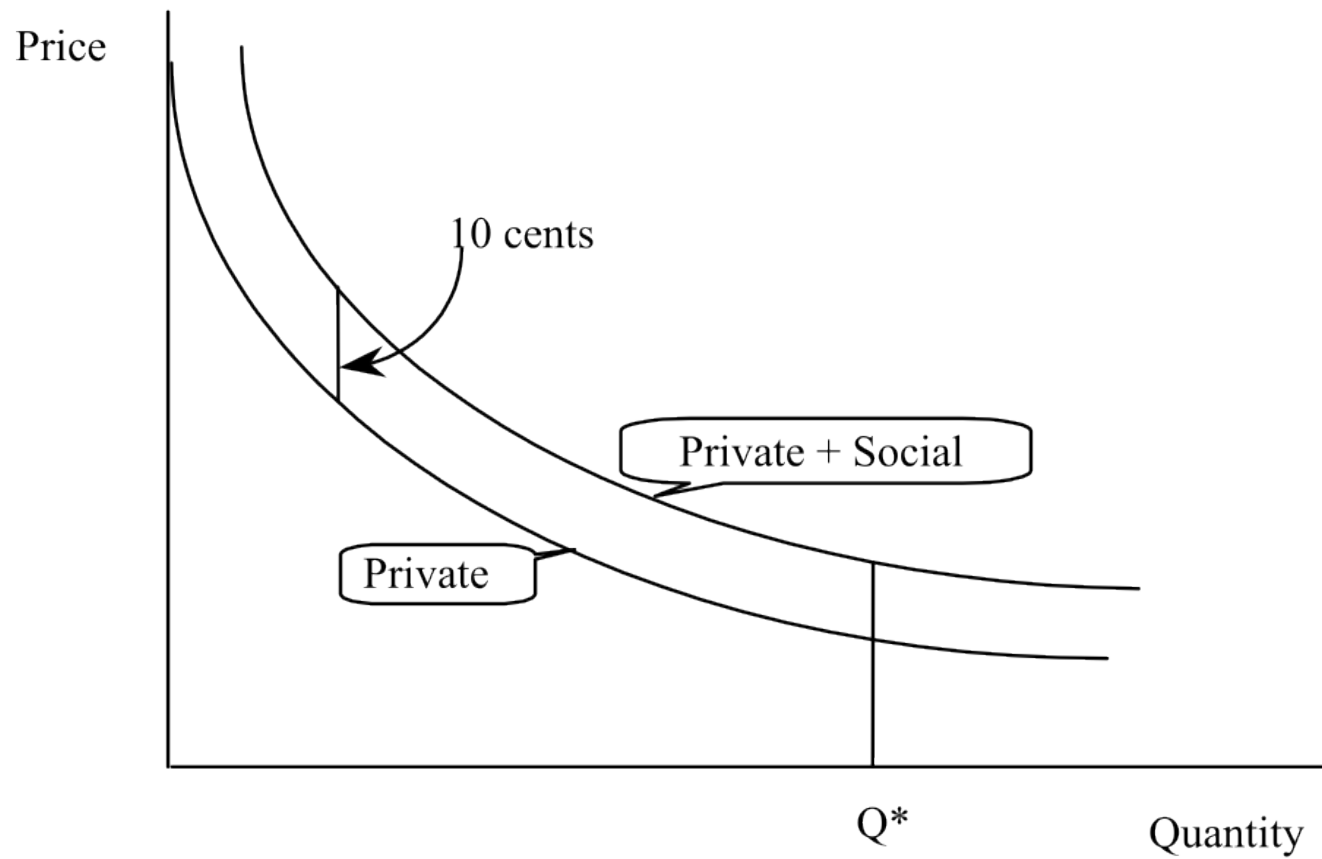
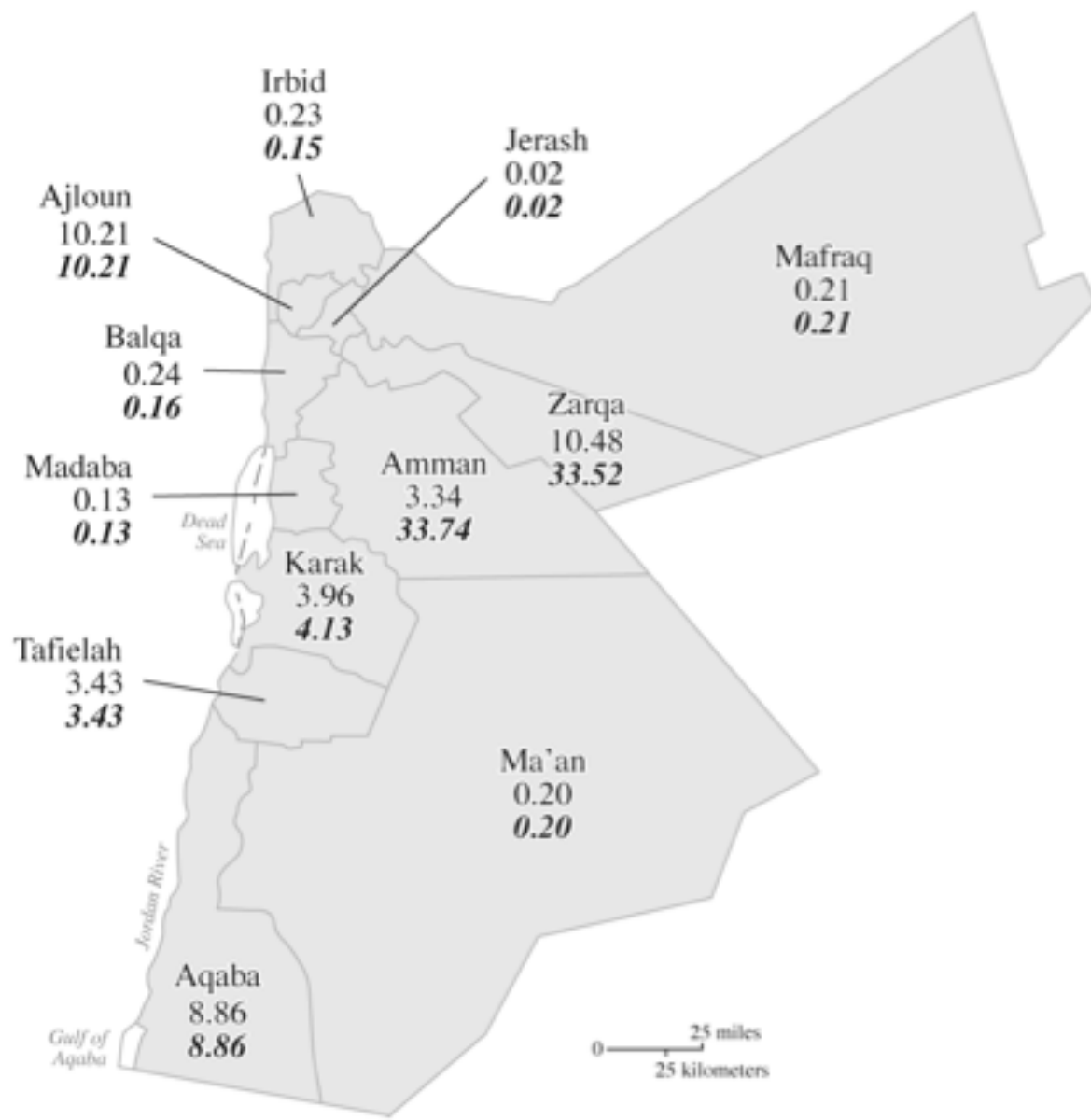


Figure 3. Social Value of Water as Revealed by a Subsidy



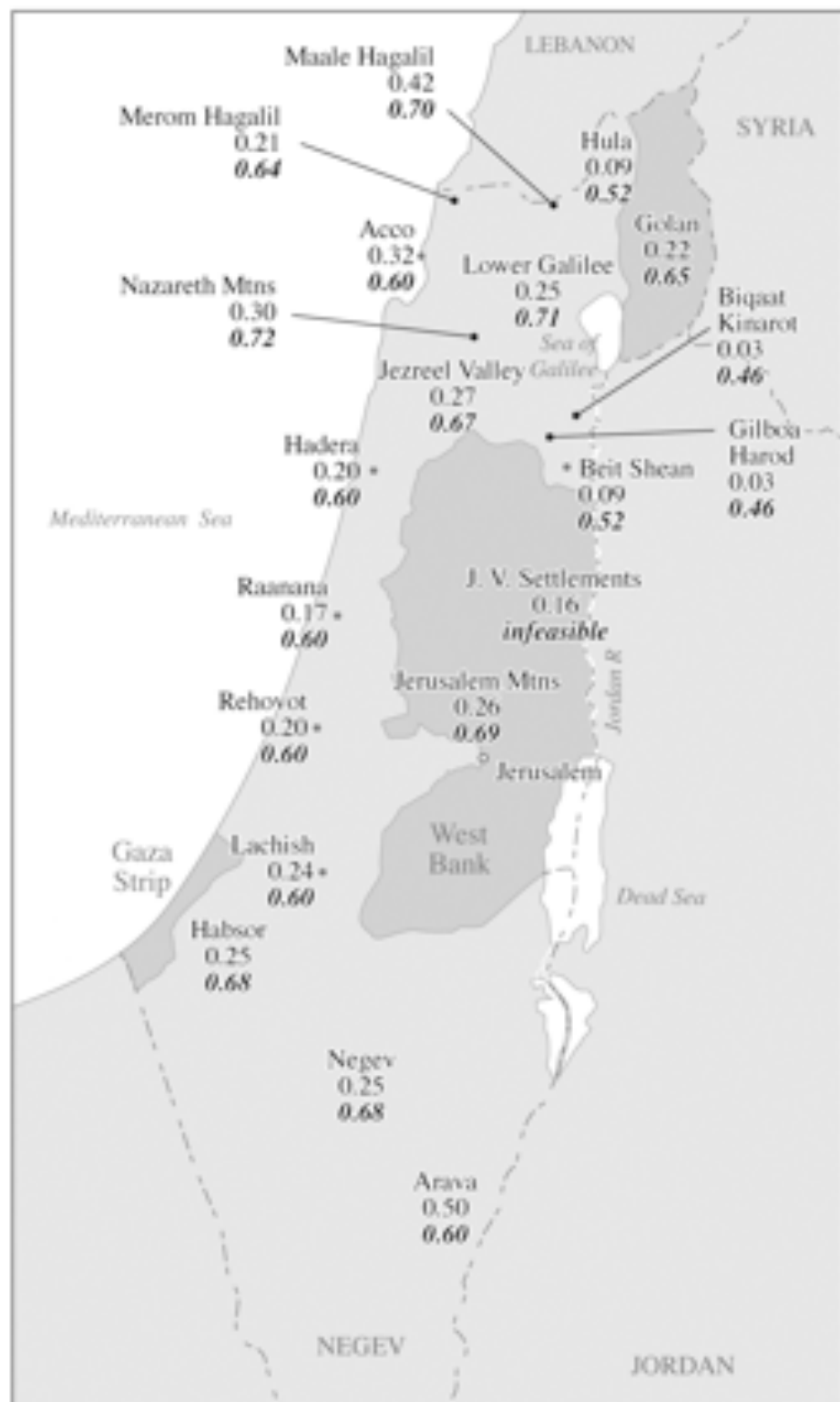
Shadow Values and Scarcity Rents

- WAS provides a system of “shadow values” for water in different locations.
- Such a shadow value is the amount by which system-wide benefits would increase if there were an additional cubic meter of water available free in the corresponding district. It is the value of additional water there.
- These shadow values take into account social and economic values



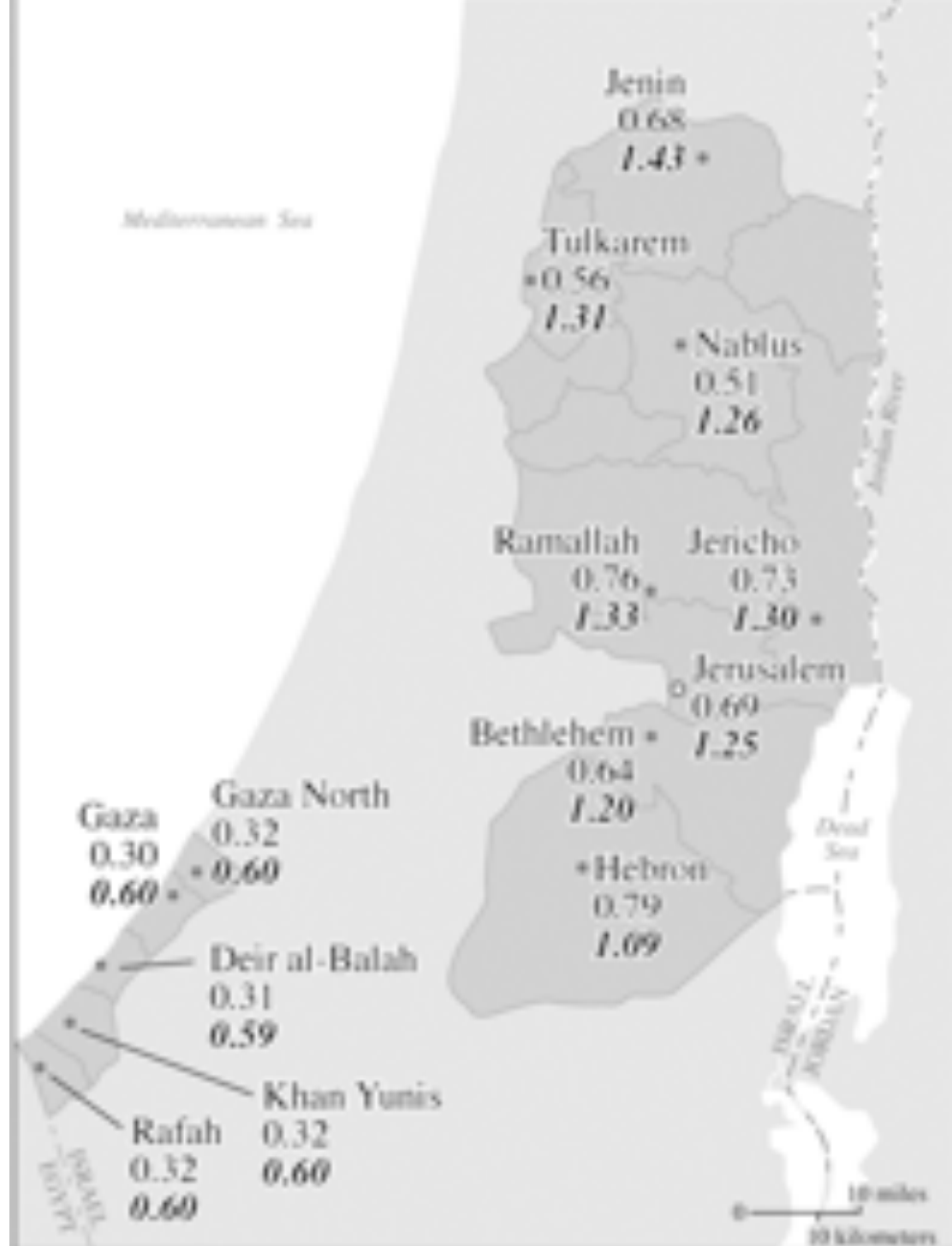
Shadow Values and Scarcity Rents

- The “scarcity rent” of a particular source of water is the shadow value of the water at that source. It is the additional system-wide benefit that would be gained if the source yielded an additional cubic meter of water at no cost.
- *It is the scarcity of water and not merely its importance for existence that gives water its value. Where water is not scarce, it is not valuable.*



Infrastructure Analysis

- WAS provides a powerful tool for the cost-benefit analysis of infrastructure projects.
- For example, by running the model with and without a proposed conveyance line, one can find the increase in annual benefits that the line in question would bring. The present discounted value of such increases should be compared with the capital cost of the project.
- Note that such calculations take into account the system-wide effects that result from the projected infrastructure.



WAS, Conflict Resolution, and Cooperation

Basic Concepts

- Water ownership is a property right entitling the owner to the economic value of the water.
- All water users are effectively buyers whether or not they own the water
- Disputes over water ownership can be translated into disputes over the right to monetary compensation for the water involved, taking into account social and environmental values.
- This may assist in resolving them.
- Water ownership and water usage are important but analytically separate questions.

In other words...

- *Every country with a seacoast can have as much water as it wants if it chooses to spend the money to do so.*
- *Hence, so far as water is concerned, every country with a seacoast can be self-sufficient in its food supply if it is willing to incur the costs of acquiring the necessary water.*
- *Disputes over water among such countries are merely disputes over costs, not over life and death.*

Application to Israel, Jordan and Palestine

Ownership Assumptions

- We analyze gains for varying assumptions about ownership of the Jordan River and the Mountain Aquifer.
- *It must be emphasized that such assumptions are not meant as a political statement. They are illustrative only.*

Jordan River Assumptions

A: Israel 92%; Jordan 8; Palestine 0
(roughly current situation)

B: Israel 66%; Jordan 17%; Palestine 17%.

C: Israel 33.3%; Jordan 33.3%; Palestine 33.3%.

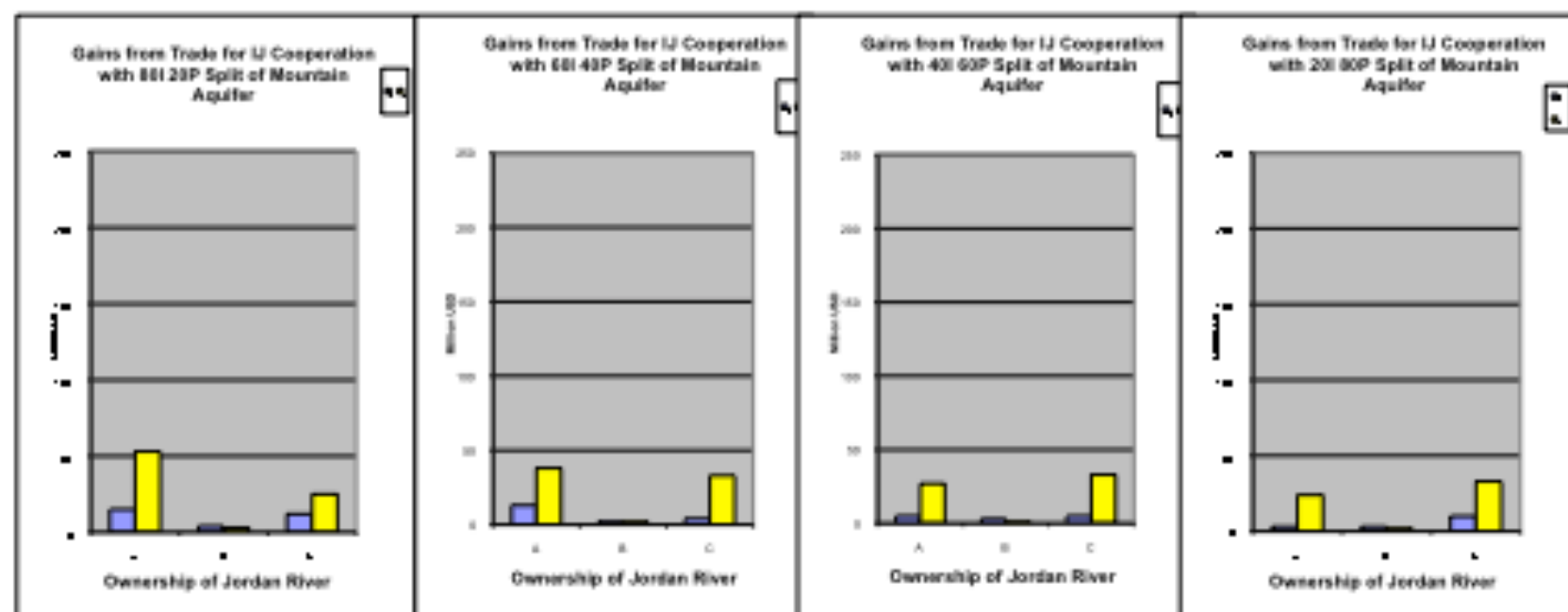
Mountain Aquifer Assumptions

- The Mountain Aquifer is not claimed by Jordan.
- We start with Israel 80% - Palestine 20% (roughly current situation) and then shift ownership to Palestine in 20% tranches.
- We end with Israel 20% - Palestine 80%

Israel-Jordan Bilateral Cooperation

- In what follows, Jordan is in yellow, Israel in blue, and (later) Palestine in red.
- We begin with Israel-Jordan bilateral cooperation, with results for 2020, then Jordan and Palestine.

Gains from Bilateral Cooperation: Israel and Jordan, 2020



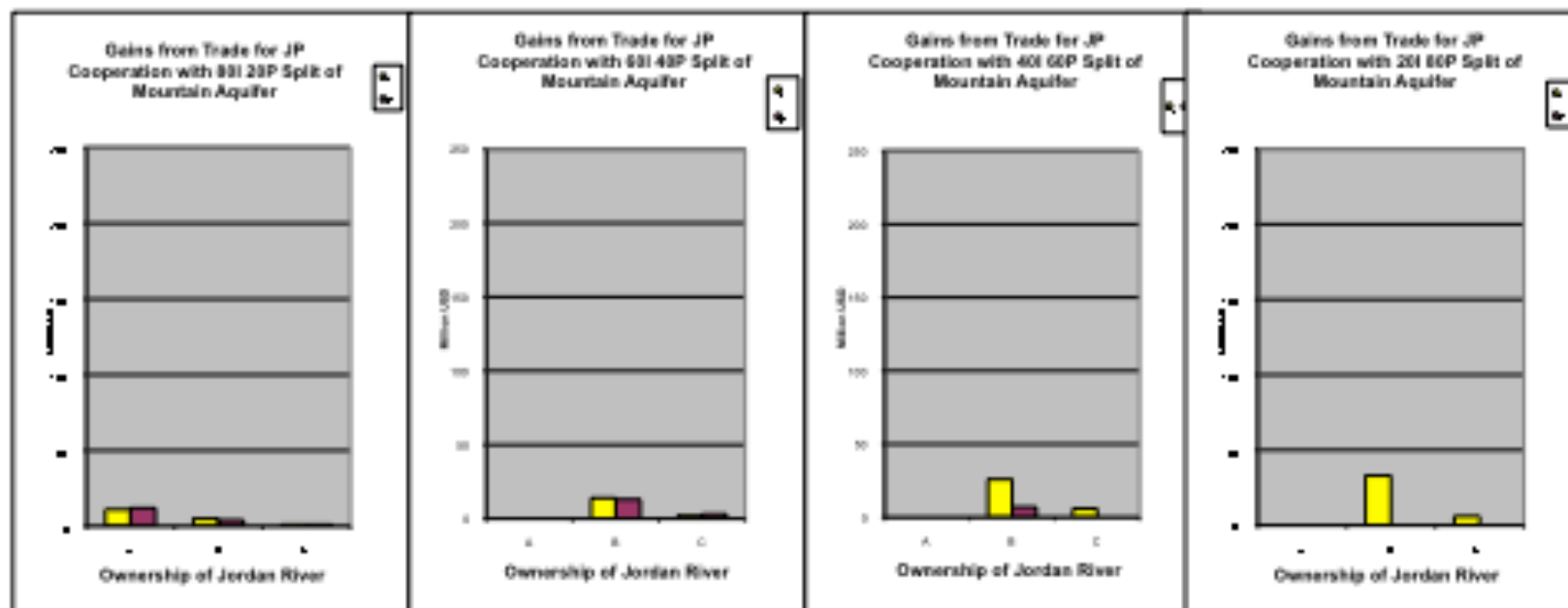
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Gains from Bilateral Cooperation: Jordan and Palestine, 2020



I

II

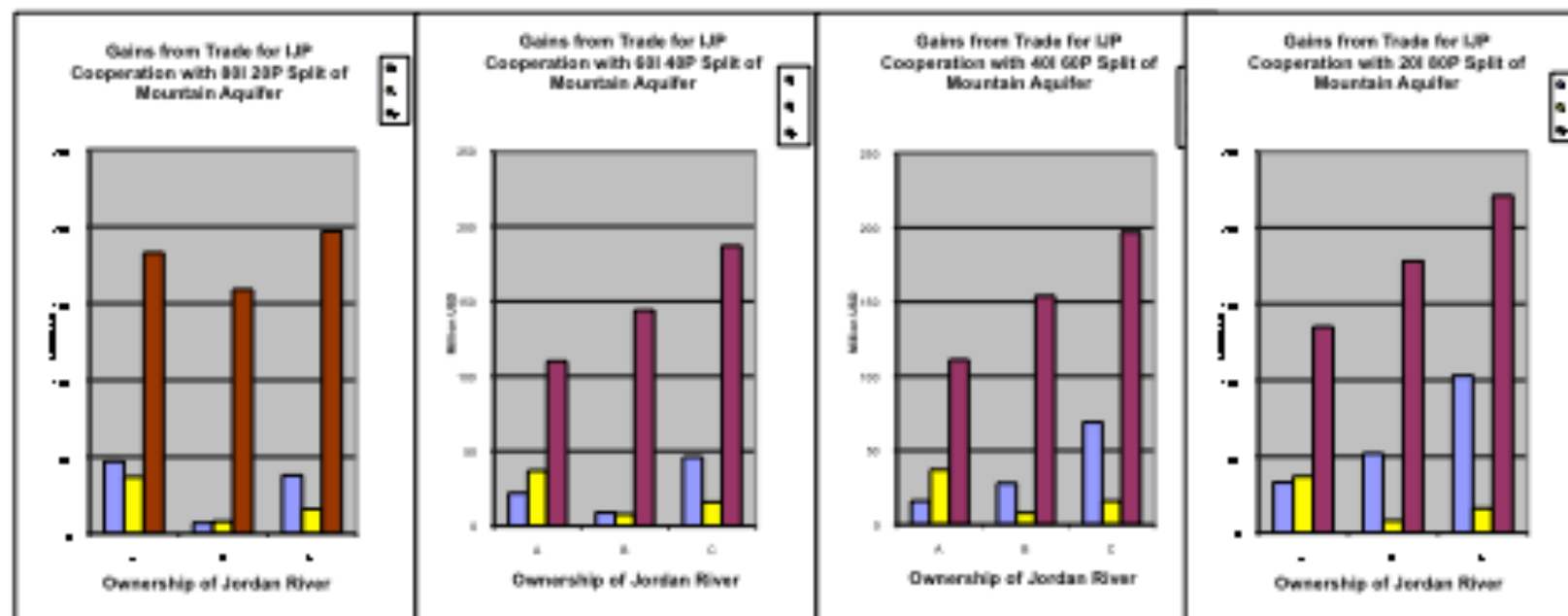
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Trilateral Cooperation

- The following slide shows that all three parties gain from cooperation.
- Jordan usually gains the least, and Palestine usually the most, but the gains are non-negligible for all parties, especially in 2020.

Gains from Trilateral Cooperation: Israel, Jordan, and Palestine, 2020



I

II

III

IV

Is Cooperation Worth It?

- Of course there are some security issues not presented here, but other papers cover this in detail.
- Agreement on water is only a part of a general peace arrangement, and the kind of arrangement that is proposed requires a willingness to cooperate. **But there is a real opportunity here to remove water as an obstacle to peace.**
- That applies not only in this region but to water disputes around the globe.

Current status

Technical improvements

- Multi-year version of WAS (MYWAS), which optimizes the present discounted value of benefits over a time period and at a discount rate chosen by the user for selection of “optimal infrastructure” and timing
- System-wide effects of different tariff structures can be evaluated, both in time and in space

Involvement with Tufts

- Currently two MS students and committees
- Eric Vaughan - CEE student developing agricultural demand curves and exploring uncertainty and impact on overall system plan
- Simcha Levental - UEP student looking at possibilities of cooperation at municipal scales around wastewater treatment and reuse and equity

Current status

- Currently active in Palestine, since 2009, with funding from Czech Republic for the next 3 years (\$750K) starting in March 2011
- Work should begin in Jordan in fall 2011 with German and EU funding for 1 year (\$150K)
- Funding likely for Israel (3 years total \$450K)
- Funding possible for students/faculty to promote regional collaboration (3 years total \$450K)

Opportunities for collaborative research on water and economics in the Middle East

Ideas for further research

- Link with positive deviance concepts to build on existing successes both in water innovations and trust
- Improve technical capabilities with respect to water aspects, such as ecology, hydrology, climate change, water quality and links to human health
- Strengthen political and legal analysis
- Refine economics, to better represent water demands - especially for ecosystems, tariffs and social values
- Role of models in negotiation
- Equity questions and social values

It takes a university...