Water and Economics
水和经济学

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Overview 概览

- Why use an economic approach? 为什么遵循经济的途径？
- Are water markets the answer? 水市场是有效的方法吗？
- Role for economic analysis 经济分析的作用
- Application of economics in the Middle East 水经济学在中东的应用
- Conclusions 结论

Why economics?

Water is scarce

- Water use has been growing at more than twice the rate of population increase in the last century
- An increasing number of regions are chronically short of water
- By 2025, 1.8 million people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions
- The situation will be exacerbated as rapidly growing urban areas place heavy pressure on neighboring water resources

What defines scarcity?

- Imbalances between availability (supply) and demand
- Degradation of groundwater and surface water quality
- Inter-sectoral competition
- Interregional and international conflicts

Economics

- Economics is the science of allocation of scarce resources and the examination of tradeoffs
- Markets can be an efficient way to allocate scarce resources
- Are water markets therefore the answer?

Are markets the answer?

- It is often true that the efficient way to allocate resources is through a free market.
- But that is not always true. That result requires:
  - Markets to be competitive – many small sellers and buyers
  - All social benefits and costs to be private benefits and costs
- These requirements are not met in the case of water

Role for economic analysis

Rationale

- Even with these limitations, economics still has a major role to play in water planning and management
- Economic tools can incorporate social and ecological values and externalities
- The impact of imposing these values using an economic framework can then be calculated and factored into policy making

How do you apply economic theory?

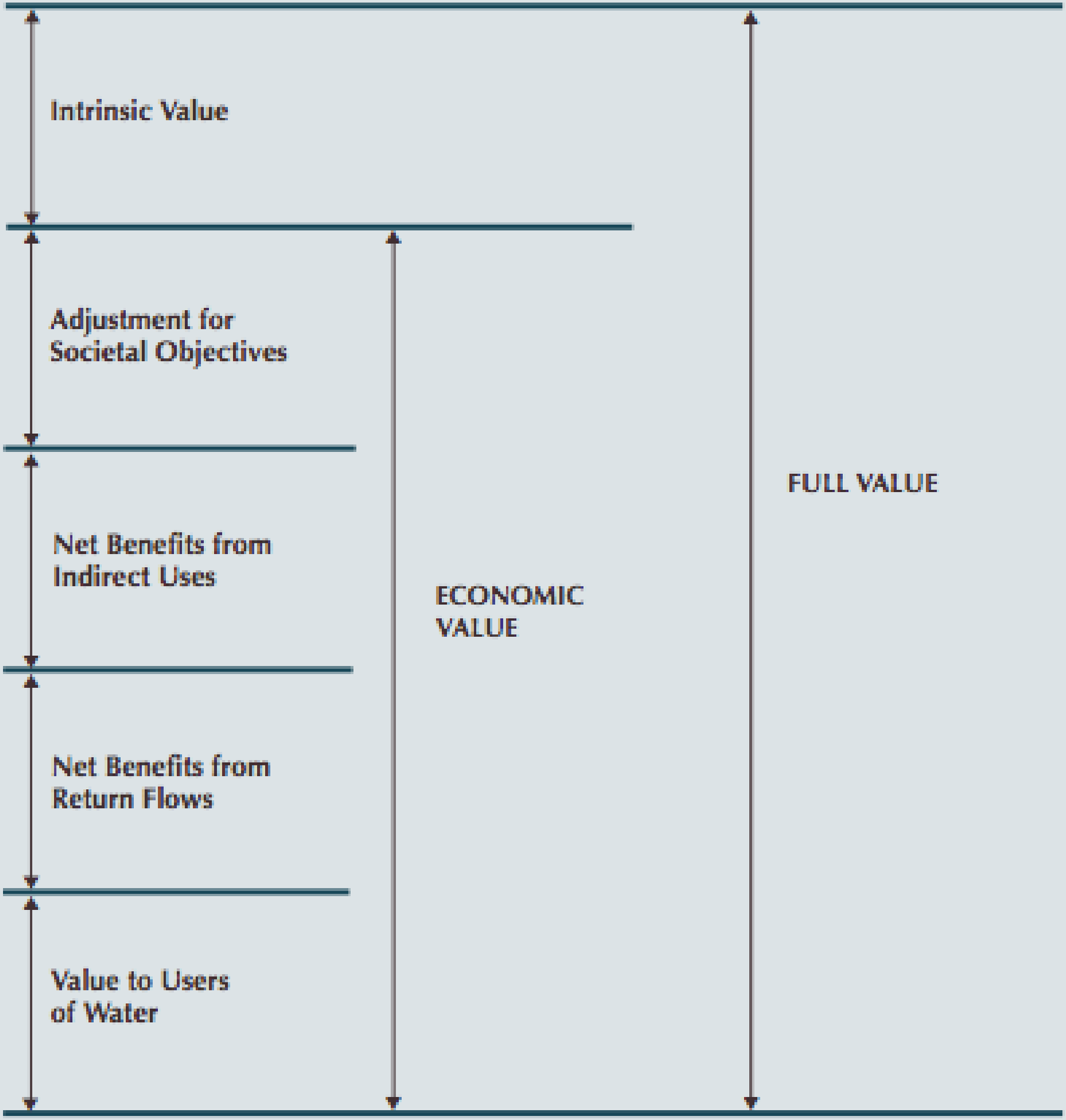
Fundamentals

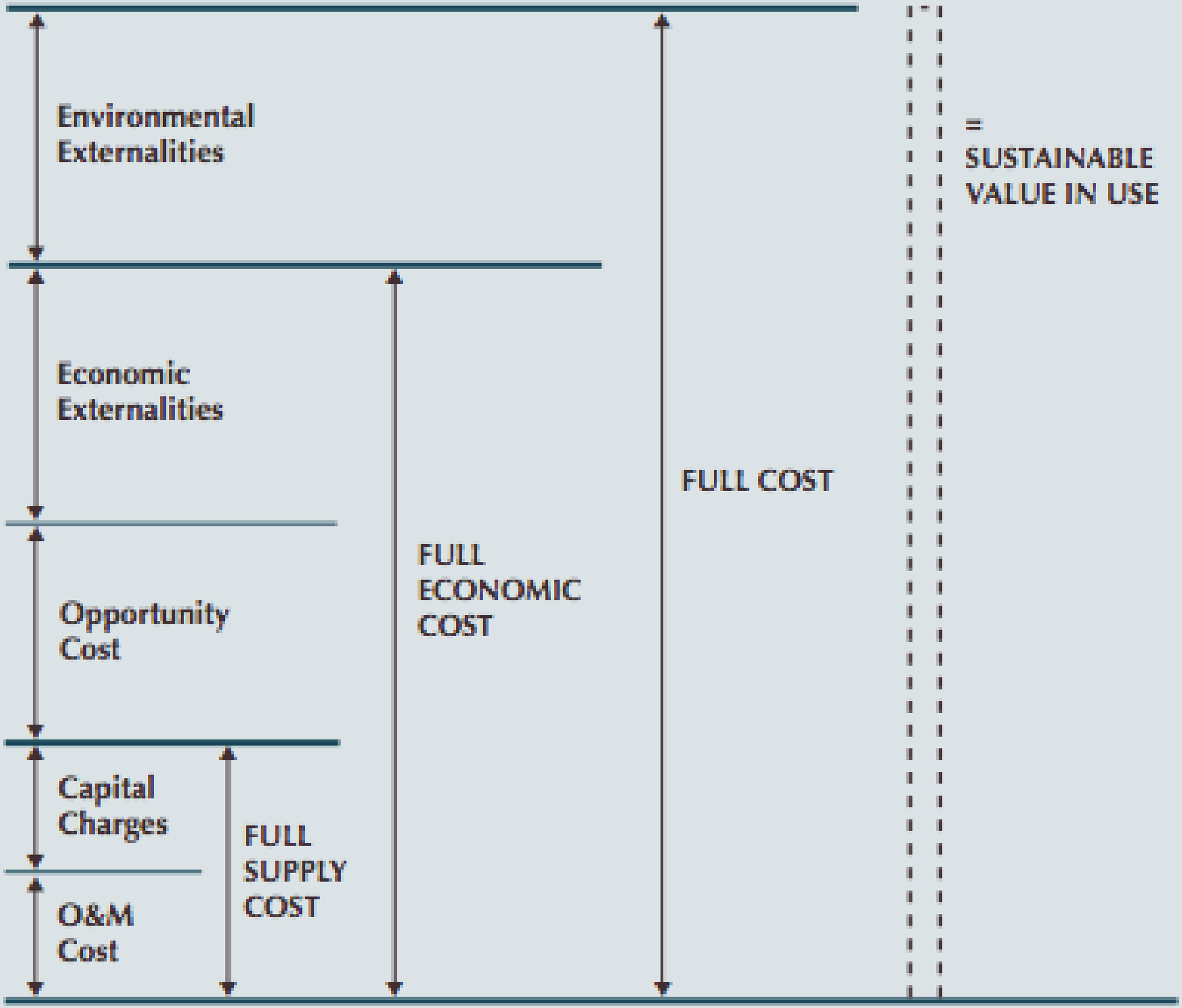
- Full Costs
  - direct
  - indirect, including externalities

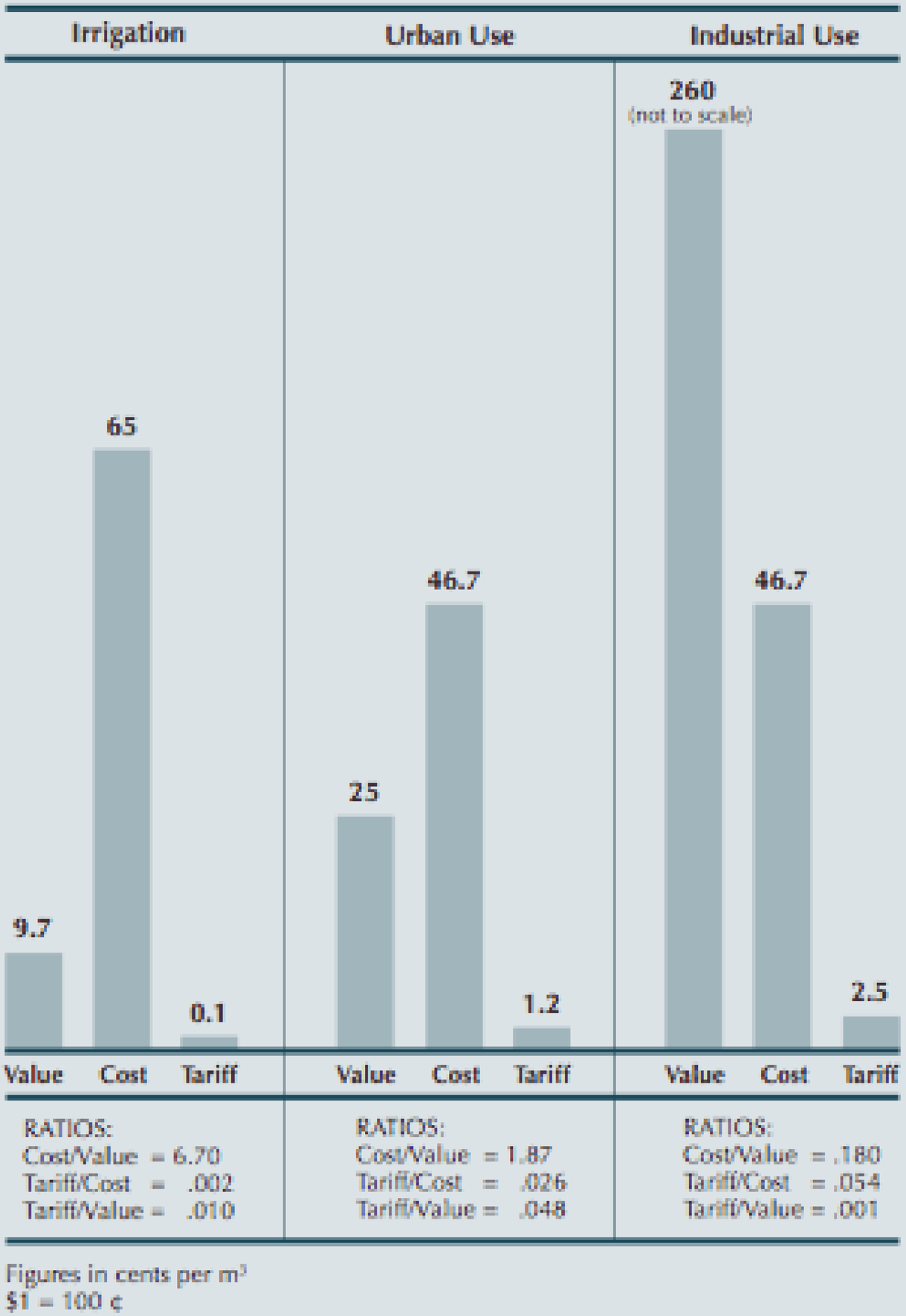
- Full Values
  - to users
  - indirect

Two General approaches

- Make an accounting of the various components of costs and values and compare with tariffs, or,
- Model the entire systems of demands, supplies, along with social and ecological values in a mathematical economic model


Intrinsic Value
Adjustment for Societal Objectives
Net Benefits from Indirect Uses
Net Benefits from Return Flows
Value to Users of Water
ECONOMIC VALUE
FULL VALUE


Environmental
Externalities
Economic
Externalities
Opportunity
Cost
Capital
Charges
O&M
Cost
FULL
SUPPLY
COST
FULL
ECONOMIC
COST
FULL COST
=
SUSTAINABLE
VALUE IN USE



Comparison of value in use, cost and tariffs in a river basin in India

System-wide economic analysis

- Modeling an entire water system for a basin, nation or region is possible
- Involves collecting demand and supply data as well as societal goals and preferences, and examining how things may change over time

Figure 1 Gross Benefits from Water

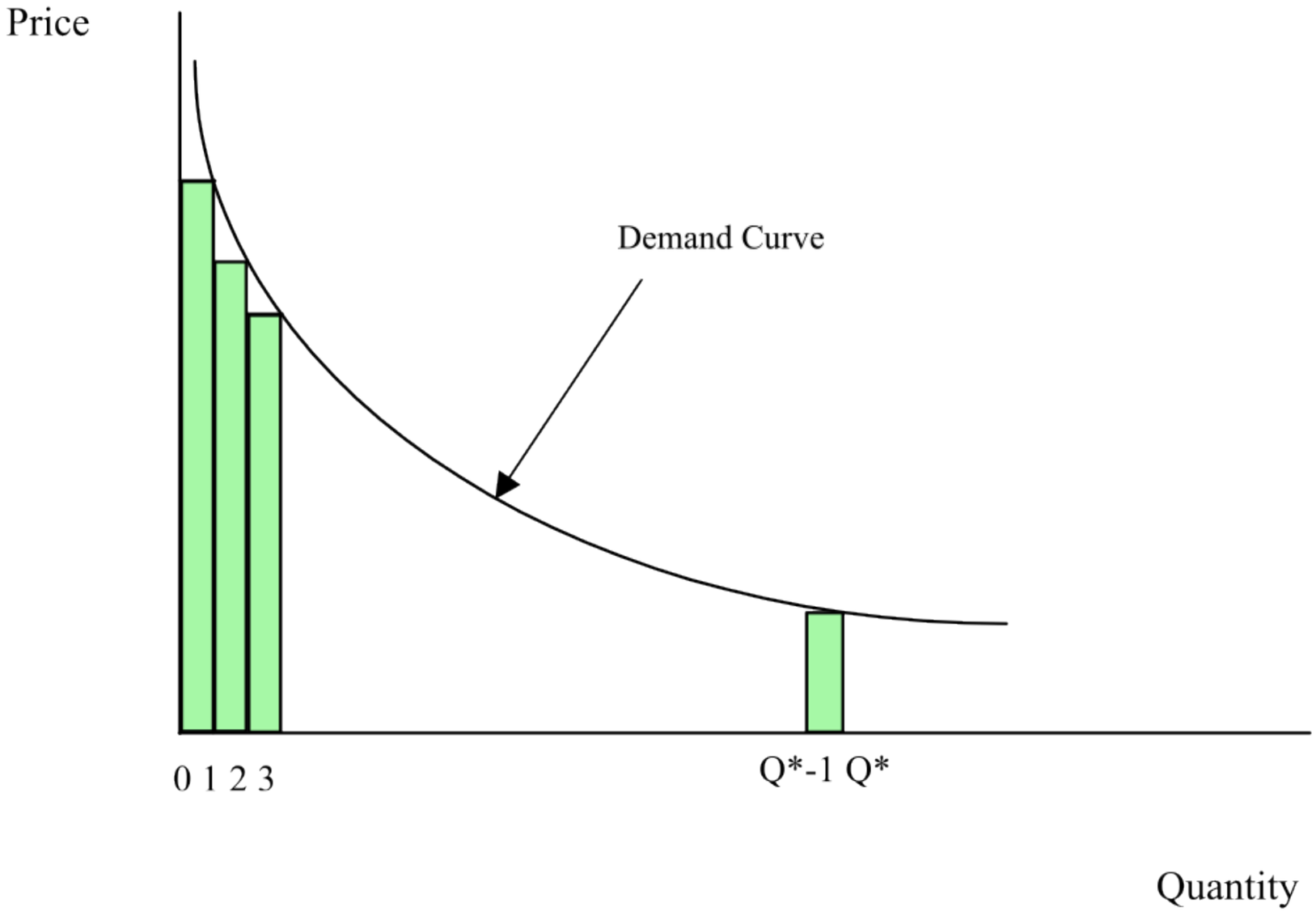
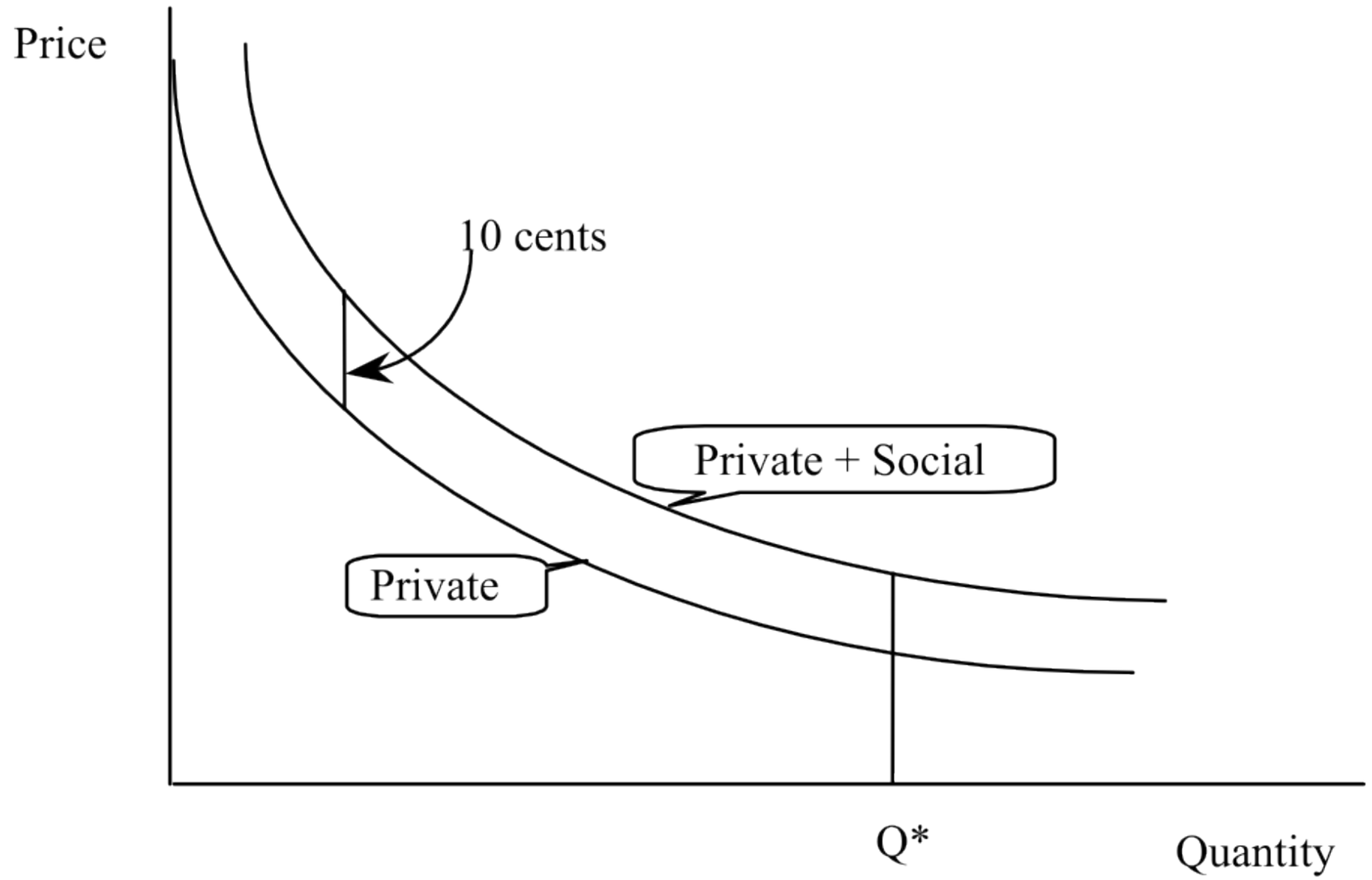


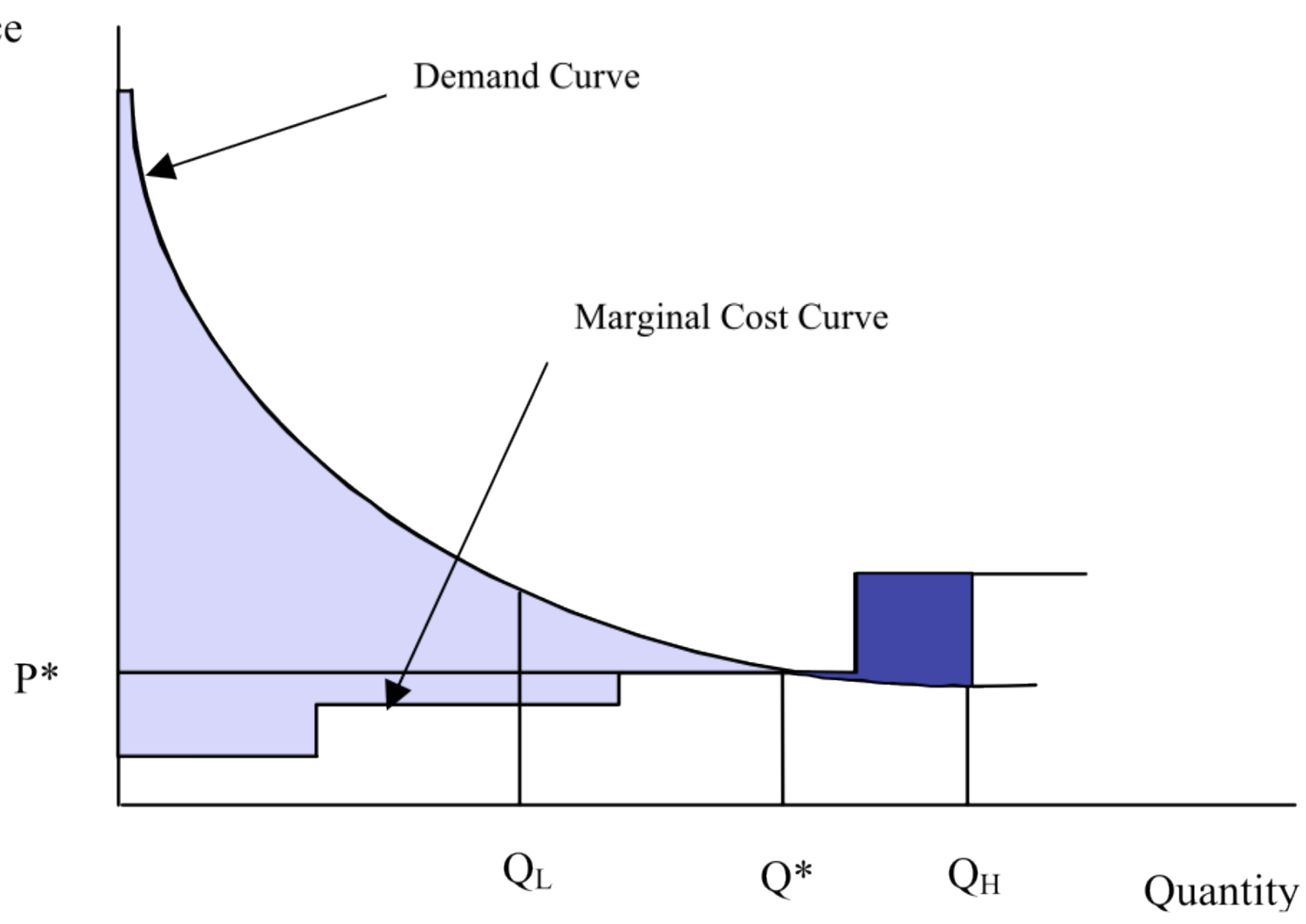
Figure 3. Social Value of Water as Revealed by a Subsidy



Economic optimization

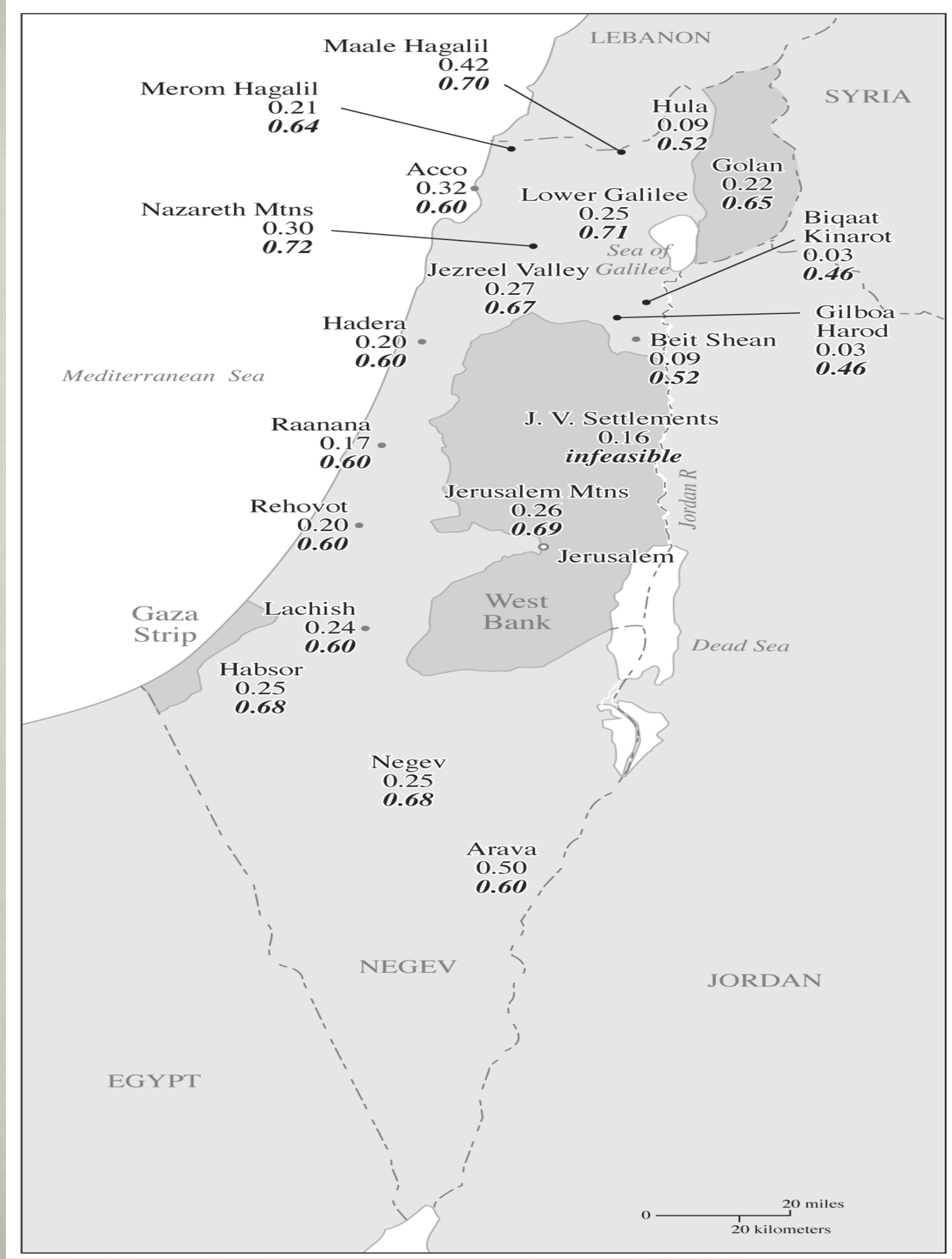
- A country or region can be divided into districts or other units that capture the distribution of demands and supplies
- When so described, the optimal allocation of water is achieved - one that maximizes net social welfare

Figure 2 Net Benefits from Water



Shadow values and scarcity rent

- Approach 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
- The “scarcity rent” of a water source is the shadow value at the source – the value (system-wide) of an additional cm there

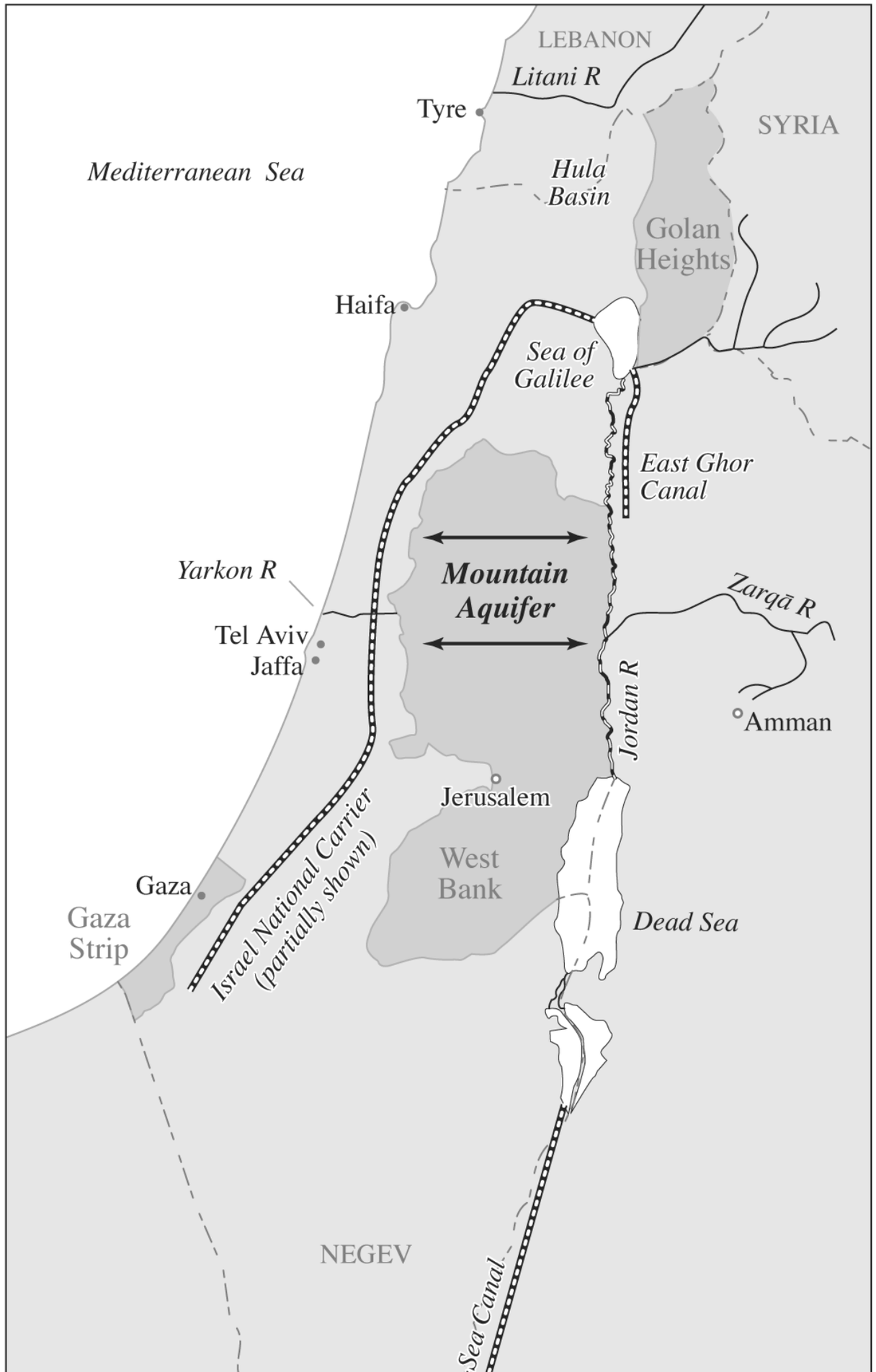


2010 Shadow Values with Desalination: Normal Hydrology vs. 30% Reduction in Naturally Occurring Fresh Water Sources; Fixed-Price Policies in Effect

Example water economic tool

Water allocation system

- Developed by Water Economics Project
- Applied to the water economy of Jordan, Palestine and Israel
- Users specify future conditions, price policies, ecological or economic conditions, and other social values



Water in dispute

Mountain aquifer, shared by israel and Palestine
and
Jordan River, shared by the three countries and Syria and lebanon

Current situation

- Water is managed by the three countries independently
- Very limited cooperation between Israel and Jordan
- Water is seen as a major obstacle to peace in the region

Model description

- Region is divided into 45 districts
- Each district’s supplies are specified
- Each district has three types of demands: agriculture, urban and industrial

Example results

- The example is for 2020
- It is first assumed that Palestine owns 20% of the Mountain Aquifer (roughly what it is now permitted to pump)
- Then this is doubled to 40%

Jordan River division

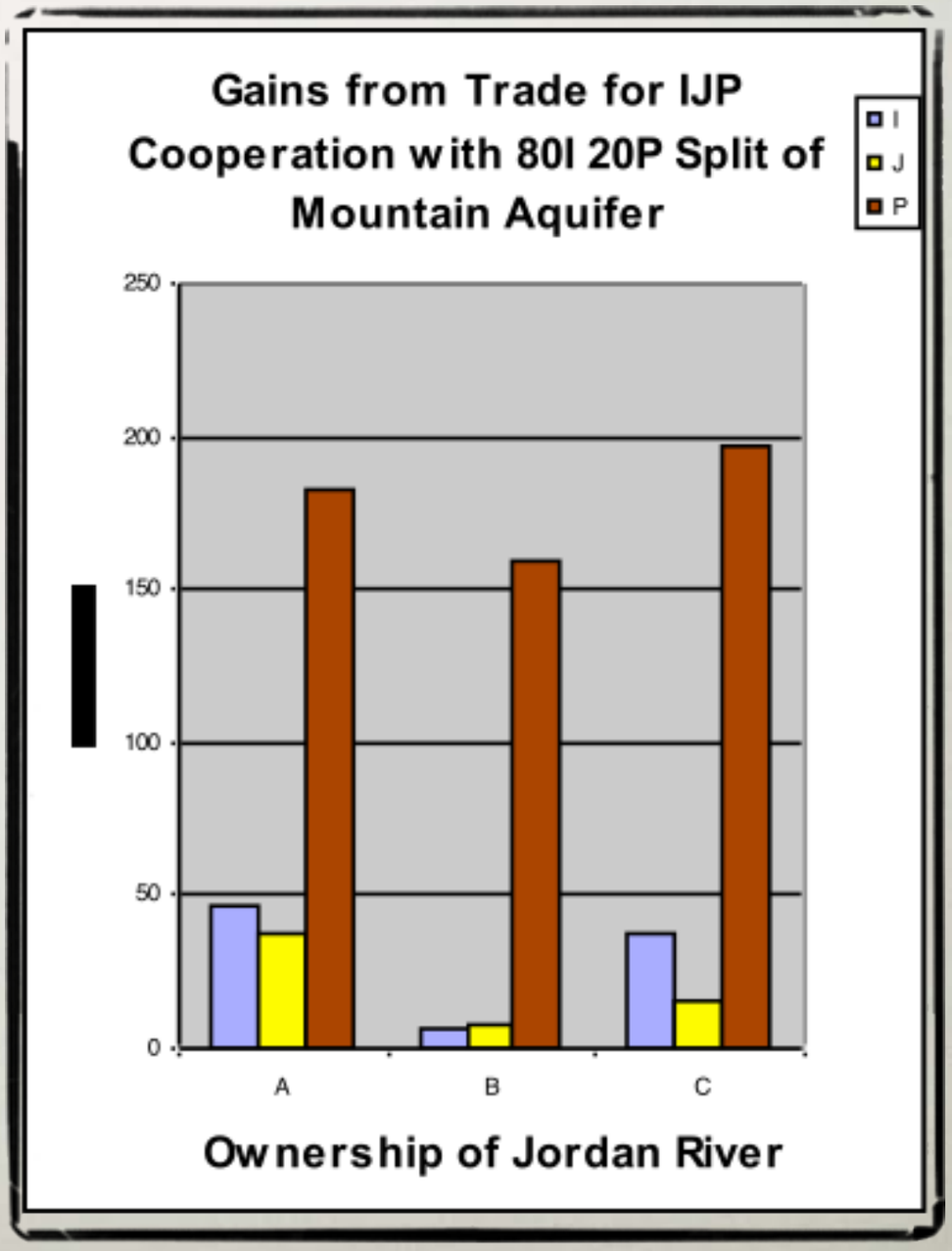
- Three cases for the Jordan River are examined:
  - Israel 92%, Jordan 8%; Palestine 0. (This is approximately the existing situation.)
  - Israel 66%; Jordan 17%; Palestine 17%.
  - Israel 33.3%; Jordan 33.3%; Palestine 33.3%.

Regional vs. individual management

- In the following Figures, Palestine is represented in red, Israel in blue, and Jordan in yellow.
- The heights of the columns show the gains (measured in millions of dollars) to the respective countries from regional versus individual management

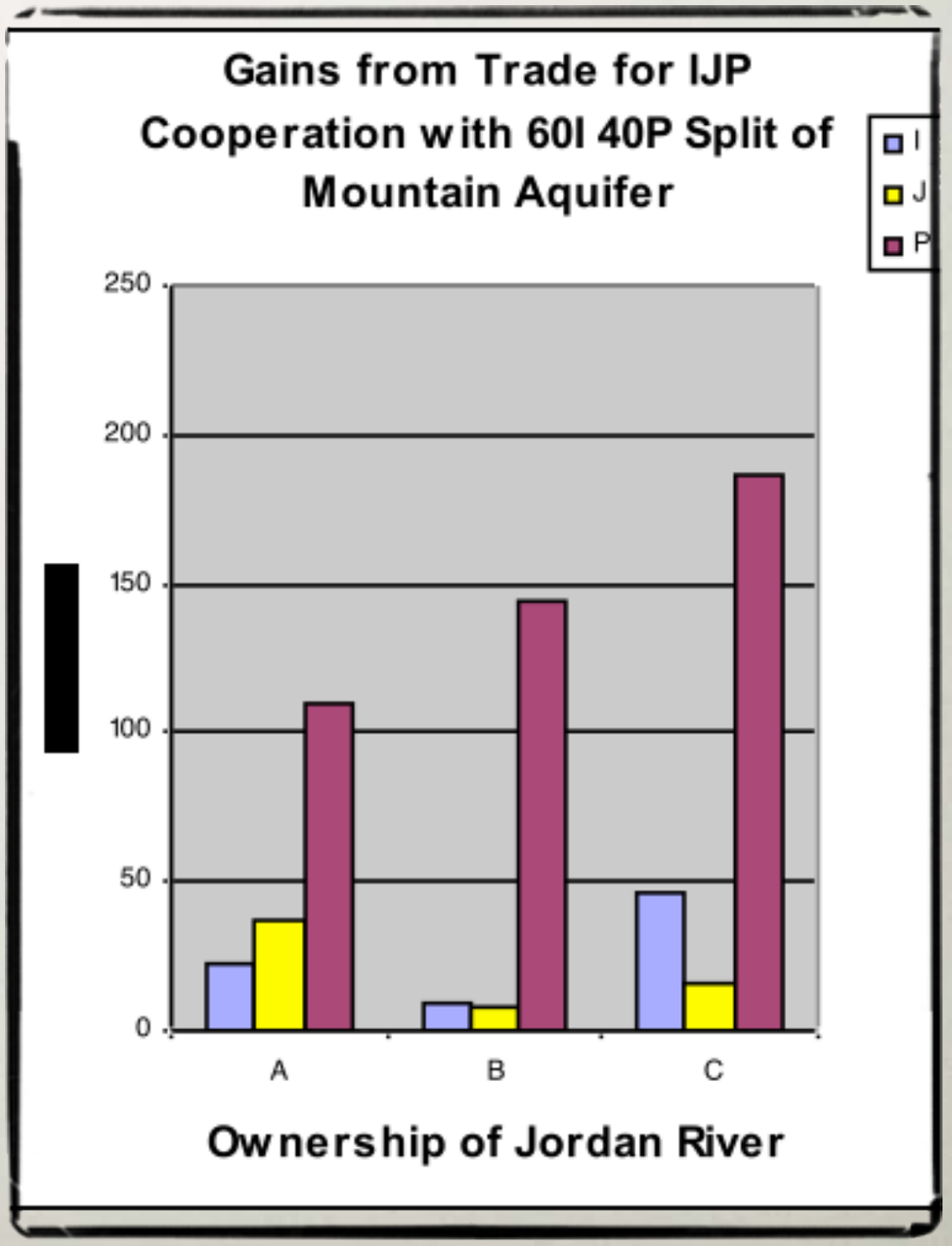
Gains from Trilateral Cooperation in 2020:MA 80-20

- In this picture, at the left, Palestine has roughly the water it has now.
- It gains from regional management by acquiring water from Israel.
- Those gains decrease in the middle where Palestine has more Jordan River water.
- But they increase again at the right where Palestine gains as a seller, selling Jordan River water to Israel



Gains from Trilateral Cooperation in 2020:MA 60-40

- In this picture, Palestine has so much Mountain Aquifer water that it always gains as a seller, selling more and more Jordan River water to Israel



Results

- These are not special cases. In all cases, all parties gain, and that is not an accident
- In fact, the gains from regional management typically exceed the gains from large amounts of additional ownership

WAS summary

- WAS in effect produces an efficient solution that a real market would reach if it could deal with the problems associated with non-economic values
- In particular, WAS permits the user to impose conditions on the optimization that reflect the user’s own values and policies and see the system-wide effects

Summary - part 2

- 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.
- Water ownership and water usage are important but analytically separate questions.

Conclusions

结论

Economics of water 水经济学

- An examination of values and costs more broadly will support better and more adaptive planning 一个更广泛的价值和成本分析将会支持更好适应性更强的规划
- Can use optimization techniques to understand the nature of tradeoffs 可以使用复合的优化去了解权衡的性质
- Economic approaches can find win-win opportunities 遵循经济的途径可以找到双赢的机会

Economics is essential for managing and planning for water that meets societal goals of sustainability, equity and resilience

经济学在管理和规划水资源以满足可持续发展、公平和持久力的社会目标中必不可少