Understanding and Managing Water Demand in Agriculture

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Understanding Demand Management

• Conceptual Foundation
• A Working Definition
• Goals and Approaches
• An Example: Broadview Water District
• Pricing Design and Irrigation Responses
• Summary
Conceptual Foundation

Starting with a Production Function

![Graph showing the relationship between water (m³ per ha) and yield (tonnes per ha).](image-url)
Conceptual Foundation

Converting to a Revenue Function

![Graph showing the relationship between Revenue ($ per ha) and Water (m3 per ha).]
Conceptual Foundation

Deriving the Incremental Revenue Function

Incremental Revenue ($ per m3)

“Demand Curve” for water

Water (m3 per ha)
Conceptual Foundation

Demand: A schedule of prices and amounts

Incremental Revenue ($ per m3)

“Demand Curve” for water

P

W

Water (m3 per ha)
A Working Definition of Water Demand Management

Water Demand Management involves efforts to:

A. Move farmers along the water demand curve, and
B. Shift the water demand curve inward.
Goals and Approaches

• Goal A: Moving Farmers Along the Curve
  – Adjusting Water Prices
  – Adjusting other input prices
  – Imposing Water Allocations

• Goal B: Shifting the Water Demand Curve
  – Through improvements in technology
  – Through improvements in productivity
  – By correcting market distortions
Goals and Approaches

Movement Along the Curve via Prices

Incremental Revenue ($ per m3)

“Demand Curve” for water

P2

P1

W2

W1

Water (m3 per ha)
Goals and Approaches

Movement Along the Curve via Allocations

Incremental Revenue ($ per m³)

Water Allocation at W2

“Demand Curve” for water

W2  W1  Water (m³ per ha)
Shifting the Water Demand Function

Water Demand is a function of many variables, some of which are shifters in price-quantity space.

\[ W = W(\text{water price} \mid \text{irrigation technology, crop production technology, crop prices, other input prices, climate}) \]
Goals and Approaches

Consider the role of irrigation technology.

![Graph showing demand curves for water with Incremental Revenue ($ per m3) on the y-axis and Water (m3 per ha) on the x-axis, comparing original and improved irrigation technology.](image)
Goals and Approaches

At any price, a smaller quantity is demanded.
Additional Considerations Regarding Water Demand Function Shifters

• **Shifting the Demand Curve Inward**
  – Improving irrigation technology
  – Correcting input price distortions
  – Correcting output price distortions

• **Shifting the Demand Curve Outward**
  – Improvements in crop productivity
  – Increases in crop prices
  – Possible implications of climate change
An Example of Water Demand Management: 
The Broadview Water District

Location: San Joaquin Valley of California

Area: 4,000 hectares

Crops: Cotton, Tomatoes, Melons, Sugarbeets, Wheat

Water Supply: Surface water in a federal canal project

Established: 1955
Irrigation and Drainage Problems at BWD

- Excessive irrigation
- Limited drainage water discharge
- Salinity build-up in soils
- Selenium in drainage water
- Improvements needed in water management
- Implemented increase block-rate pricing
Increasing Block-Rate Prices

Price per acre-foot ($ / A.F.)

“Water Supply”

Demand Curve

Irrig. Water (A.F. / Acre)
Examples of Irrigation Responses

• “Low technology,” management solutions
  – Reducing furrow lengths and set times
  – Hiring additional irrigators
  – Training and motivating irrigators

• “High technology” solutions
  – Microsprinklers and drip systems
  – Laser leveling
  – Soil moisture monitoring
  – Shallow groundwater monitoring
Water Deliveries, Per Acre, in the Broadview Water District, 1986 to 2002
Estimated aggregate irrigation efficiencies in the Broadview Water District, 1986 to 2002
Summary

• Demand is a function; not a number.
• Many dimensions require attention.
• We can shift the demand curve or …
• Encourage farmers to move along the curve.
• Technology is available and affordable.
• Farm-level training and technical assistance enhance demand management programs.
Thank you very much for the opportunity to participate in this important colloquium.