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Urmia Lake Restoration: Some Economic Insights

Hamed Ghoddusi
Assistant Professor
School of Business

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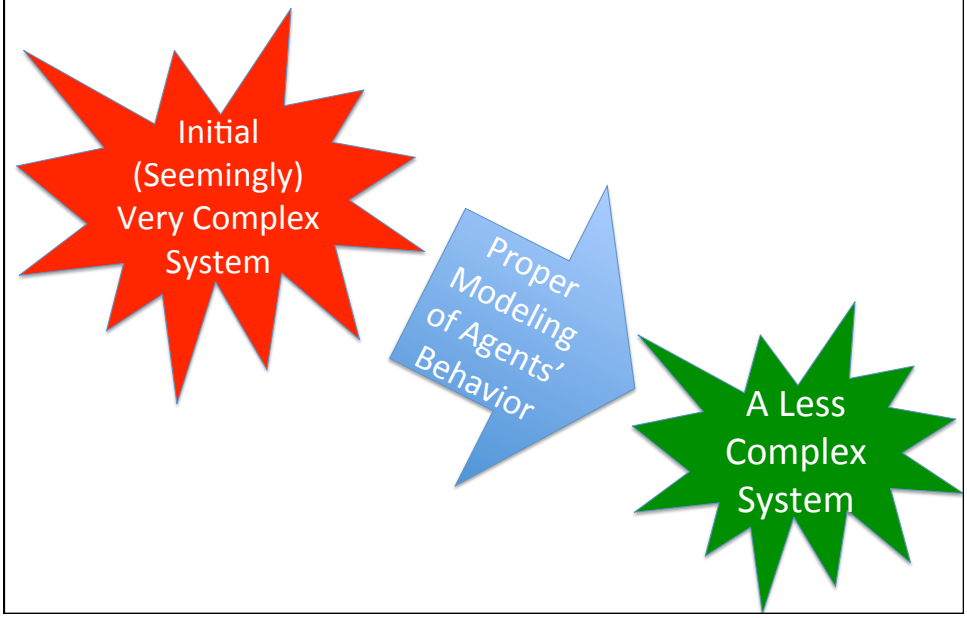
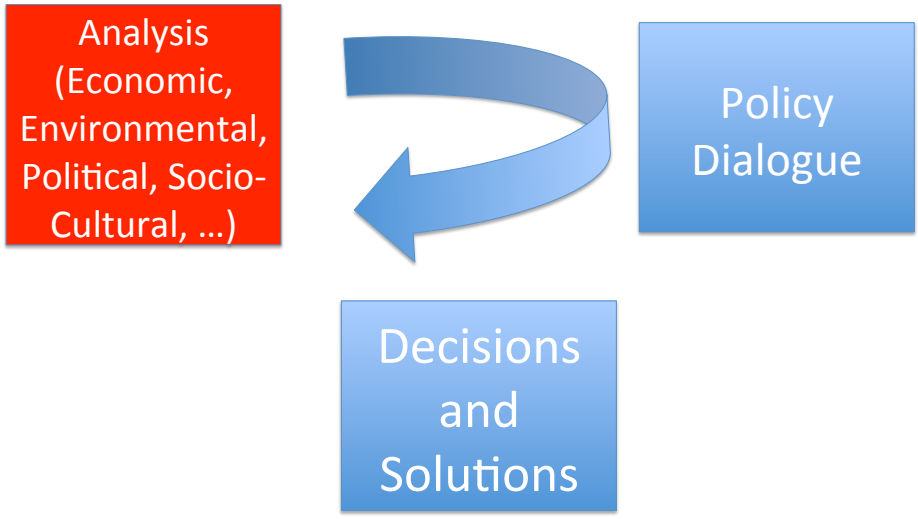
My Personal View on Complex Systems



Starting Point: Some Econ 101 Principles

- Trade-offs: resources are limited.
- People respond to incentives.
- Relative prices are important.
- Institutions and property rights matter.

Decision Making Cycle

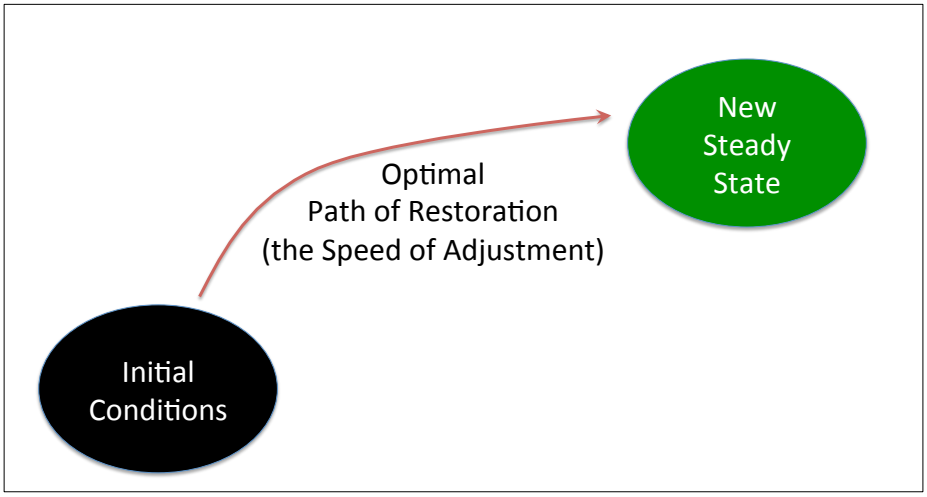


Ecosystem Restoration =

1) Reallocation of resources:
   Cost / benefit analysis

2) Redistribution of costs/benefits:
   Winners/losers analysis

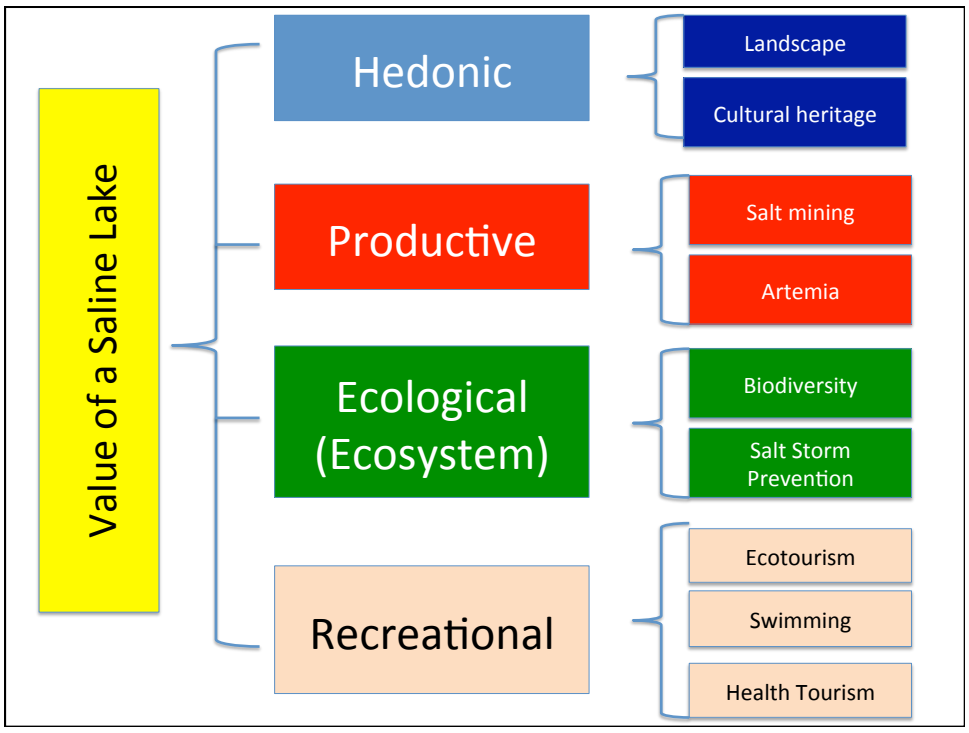
An Optimal Control Problem with a Free Terminal Point



The Optimal Size of the Restored Lake

Trade-off:

- The value of a saline lake
  - Size-dependent components
  - Size-independent components
- The value of alternative uses (i.e. the outside option of no restoration)
- The cost schedule of water supply

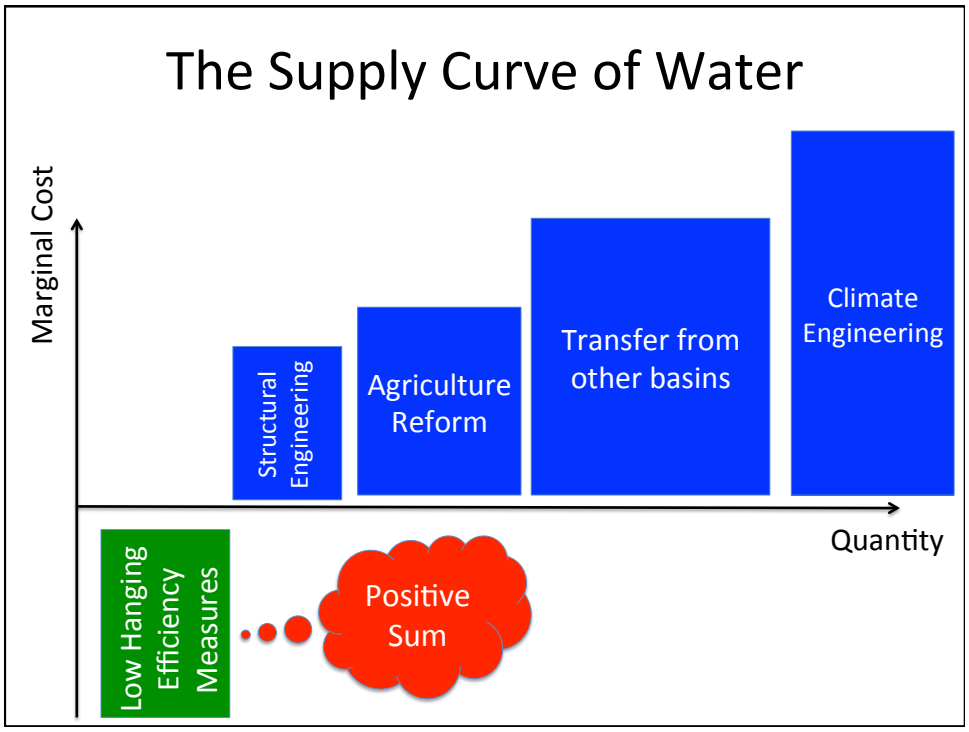


Valuation Challenges

- Consequences distributed over large temporal spatial scales
- Lack of sufficient knowledge
  - Tipping points
  - Unknown consequences
  - Option value (possible uses in future)
- Adjustment for the ambiguity effect

Mapping Values to UL's Stakeholders

- Local community
- Farmers
- Local tourism industry
- Regional businesses
- Local politicians
- Iranian citizens
- Iranian government
- Neighbor countries
- Global environmentally concern citizens
- International institutions (e.g. UNESCO)



Background Information on the UL Basin

Key Regional Economic Indicators

	East Azerbayjan	West Azerbayjan	National Average
Unemployment Rate (%)	8.1	9.8	10.5
Share of agriculture in regional GDP (%)	11.8	19.1	11.9
Share of agriculture in the local employment (%)	20	30	19.6
Rural Household Income (m R)	112	143	108
Urban Household Income (m R)	155	148	164

Agriculture Activities in the Basin

- Number of farmers: 500,000
- Average farmer income: 13000 USD (minimum wage = 3000 USD / Year)
- Cultivated area: 460,000 he (335,000 in 1970s)

Can we easily convince farmers to switch to an alternative plan?

History: Agriculture Transformation

The Economics of Crop Choice

	Wheat	Grape	Apple
Water Footprint (m3/t)	1800	2400	800
Yield (t/h)	6	15	40
Price ($/t)	300-500	300-500	300-500

Should we really abandon (or shrink) apple farming?

A Closer Look at Proposed Strategies for Water Savings from the Agriculture Sector

Agriculture Sector Reforms

- Water Efficiency
- Land Conversion
- Aggregate Water Use
- Crop Change

Initiative 1: Water Efficiency

- Diffusion and adoption of new irrigation technologies
  - Land size
- Concern of the rebound effect

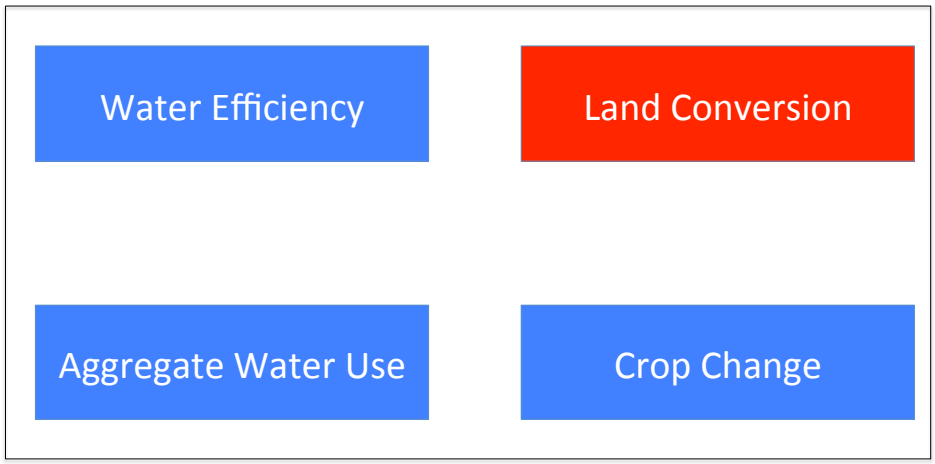
Channels of the Rebound Effect

- Expansion of cultivated area (land use)
- Plantation pattern: rainfed to irrigated
- Crop choice: more water-intensive crops
- Double (multiple) cropping

Addressing Possible Rebound Effects

- Enforcement at the:
  - Land level: limiting the area of cultivated land
  - Crop level: constraints on crop choice
  - Aggregate water use level
  - Water pricing schemes

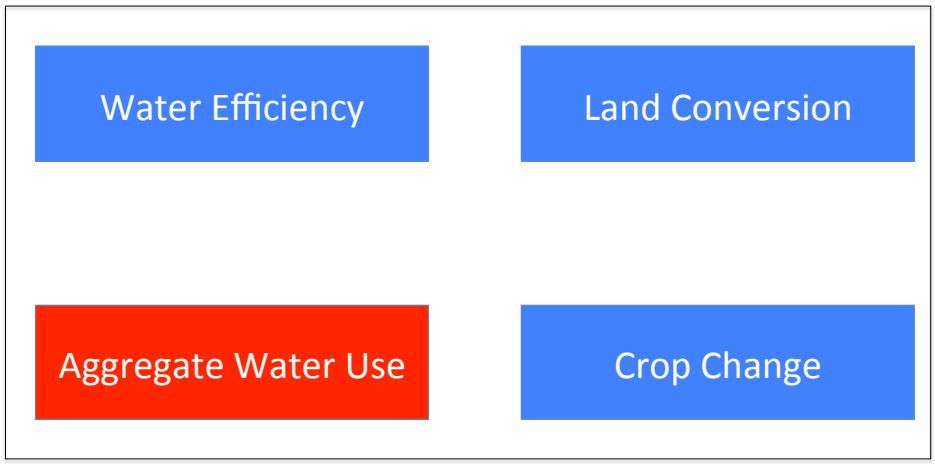
Agriculture Sector Reforms



Initiative 2: Land Conversation

- "No Cultivation" initiative (*Nakasht* project)
- Features to consider:
  - Sustainability: government commitment
  - Outside option for labor
  - Valuation challenges
  - Annual, perennial, and trees
    - Irreversibility and the option value

Agriculture Sector Reforms



Initiative 3: Water Use Management

- A de facto "Prior Appropriation Water Right" system
- Transformation to a system with "priced" or "capped" irrigation water
- Prerequisite: water extraction monitoring technologies
- Challenge: small size and large number of farmers (free riding problem)

Technological Solutions for Water Extraction/Use Monitoring

Method and device for measuring and controlling the amount of flow/volume of liquid pumped/transferred by an electro-pump

US 7734441 B2

ABSTRACT

Disclosed is a method and system for measuring and controlling an amount of flow and volume of liquid fluid and/or electrical energy consumed by an electro-pump. The method and system obtains a plurality of values for electrical parameters of the electro-pump including voltage value, currents value and active/reactive energy value; calculates the plurality values; and determines and controls the amount of instant flow and volume of said liquid fluid based on said calculated values. The system/method gathers these two measuring and controlling features (i.e. measuring and controlling the volume of liquid and amount of energy) in one casing, thereby, where applicable, provides a secure reference for policy making of both two parameters at the same time (e.g. for underground water resources).

Publication number	US7734441 B2
Publication type	Grant
Application number	US 12/241,085
Publication date	Jun 8, 2010
Filing date	Sep 30, 2008
Priority date	Sep 30, 2008
Fee status	Lapsed
Also published as	US20090099700
Inventors	Mohsen Taravat, Amin Moazedi, Hossein Nazarboland Jahromi
Original Assignee	Mohsen Taravat, Amin Moazedi, Hossein Nazarboland Jahromi
Export Citation	BiBTeX, EndNote, RefMan

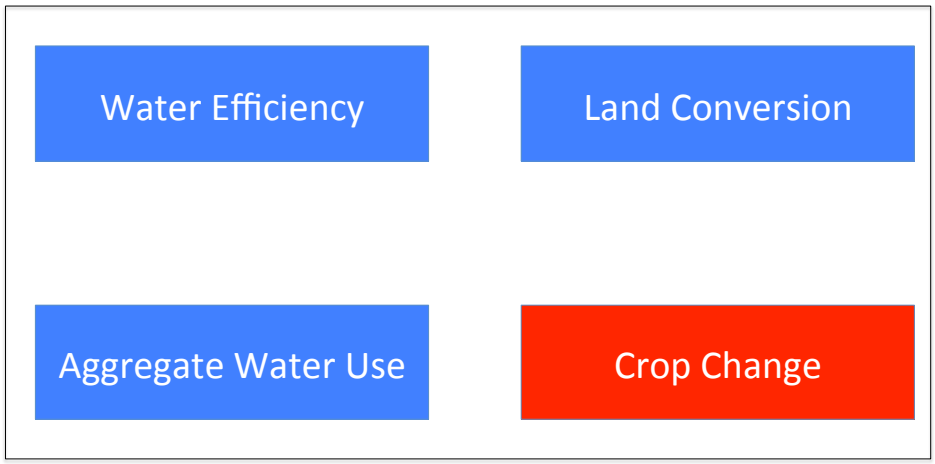
Patent Citations (3), Referenced by (4), Classifications (26), Legal Events (3)

External Links: USPTO, USPTO Assignment, Espacenet

Initiative 3: Irrigation Water Reforms

- Cap and trade (with a land-attached grandfathering of quotas)
- Crop-based water taxes
- Revenue recycling schemes: linking payment to farmers to the lake level
- Water tenure reforms

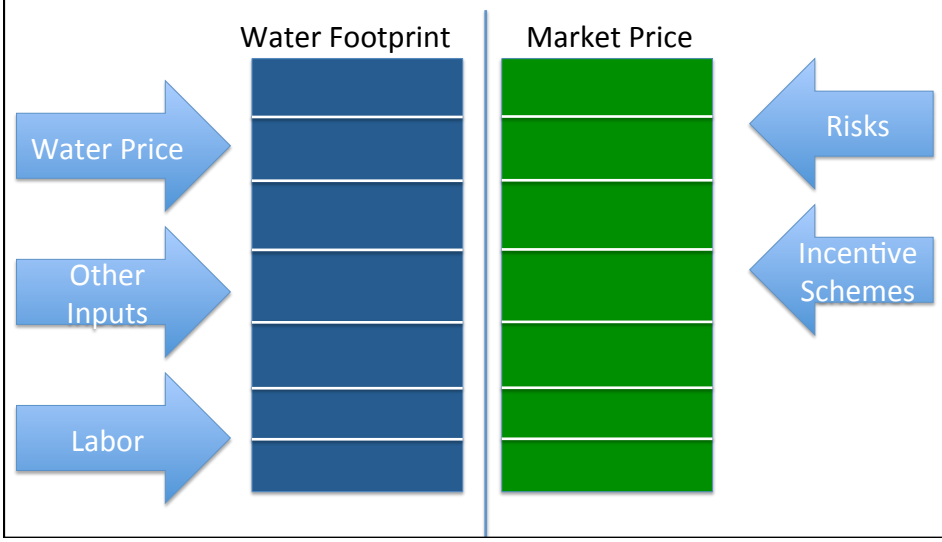
Agriculture Sector Reforms



Initiative 4: Crop Change

- Tax and credit schemes for crop switching
  - Feasibility: apple to ?
- Financial and technological assistances
- Lumpy versus continued government support
  - Credibility problem
- Enforcement problems

Crop Choice by Farmers



Some Implementation Considerations

Modeling Requirements

- Micro-founded integrated models of agriculture and water:
  - Soil quality
  - Precipitation pattern
  - Temperature
  - Crop markets and trade
  - …

Financial Engineering Solutions

Investment Initiative	Possible Sources
Agriculture sector reforms	Agriculture investment companies Public funds Bank loans Tax credits Public Private Partnerships (PPP)
Water transfer projects	UL restoration bonds (tax-exempt) International donors Local businesses
Water inflow improvements	Public funds
Salt storm prevention	Local taxes, voluntary contributions, irrigation water taxes, public funds

Political Economy of Restoration

- Long-term project: political cycles
- Visible physical outcomes and intangible economic impact
- Rent seeking and market distortions
- Common pool problem

Conclusion

- Optimal size of the restored lake
- Agriculture and irrigation water reforms
- Modeling requirements
- Financial engineering
- Political economy