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From Hydroclimatic Prediction to Negotiated and Risk Managed Water Allocation and Reservoir Operation

Upmanu Lall
Columbia University

An almost traditional view

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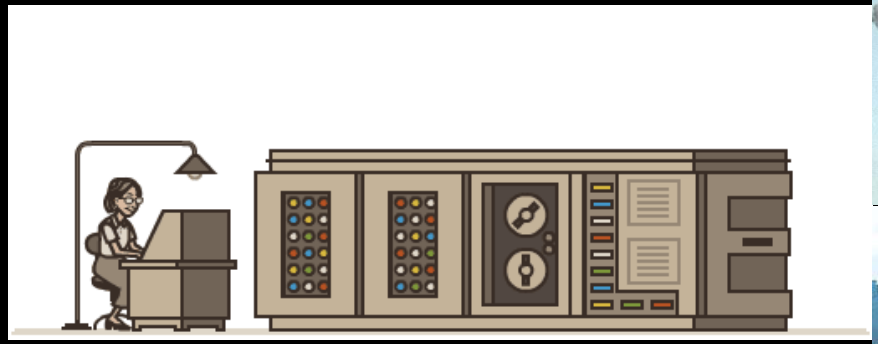
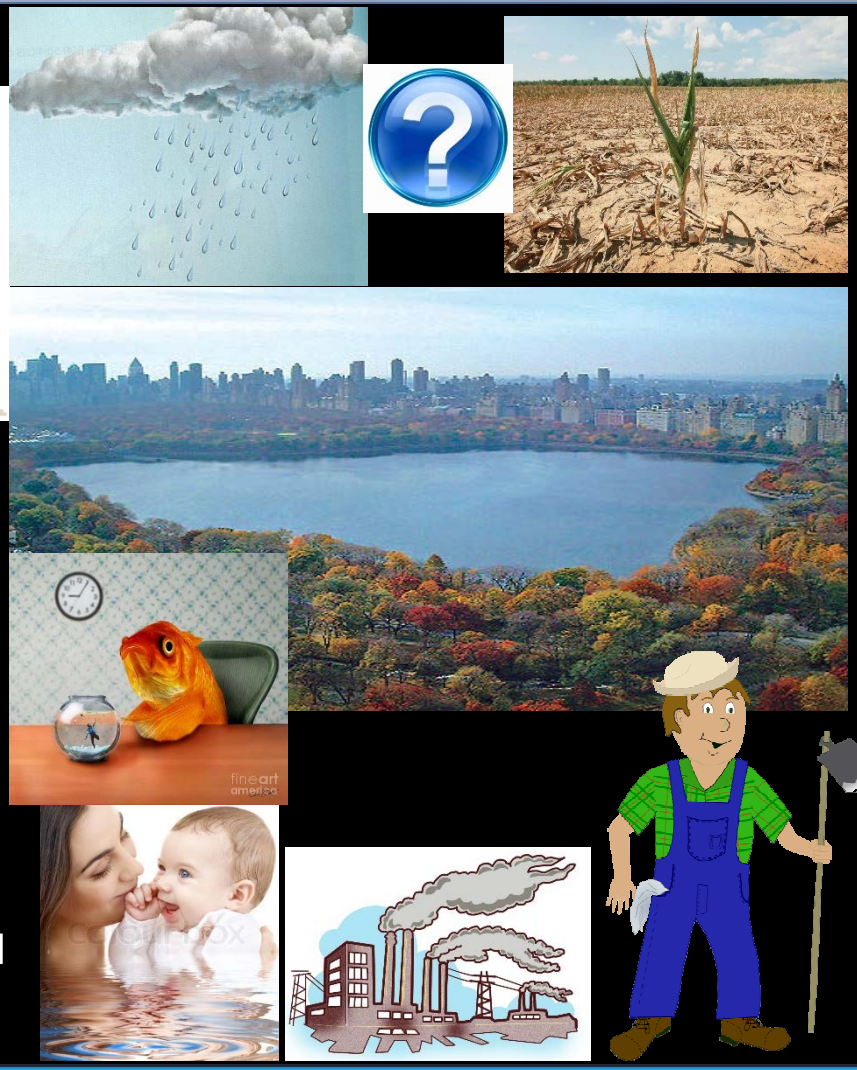
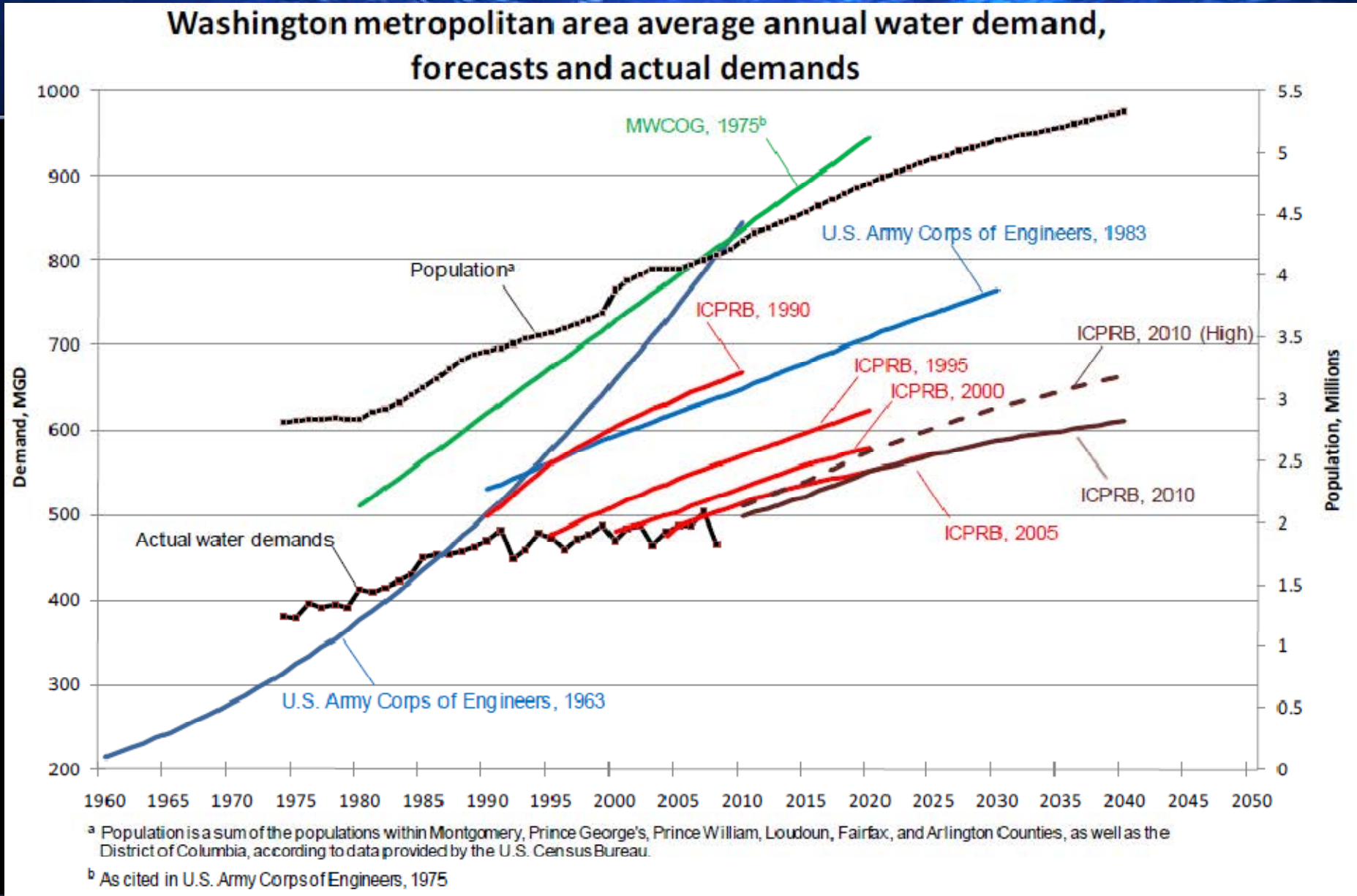




- Central Planner optimizes resource
  - Water Rights & Allocations
  - Prediction and control systems for infrastructure design/operation
- Primary challenge: supply uncertainty
  - Use Seasonal and longer forecasts to improve system reliability to meet specified demand targets
  - Supply side? Demand Management? Financial impacts, equity?

Alan Roberson, AWWA



New York City

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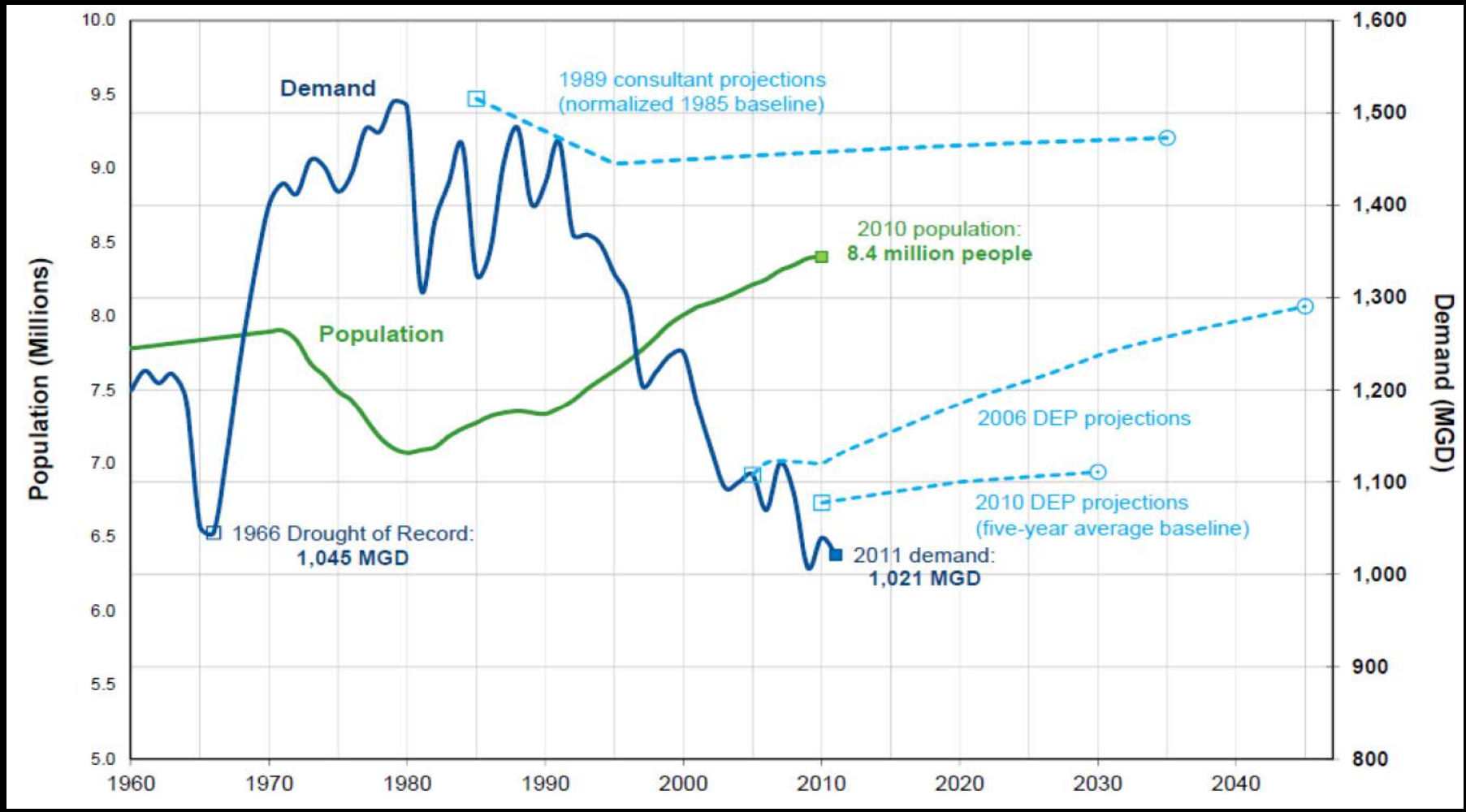

Sectoral Demand?

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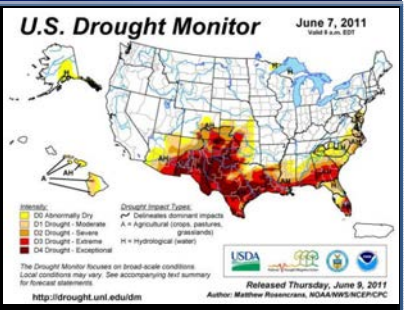
NM farmers selling water to oil and gas developers

Drought-Stricken New Mexico Farmers Drain Aquifer To Sell Water For Fracking



With a scant agriculture water supply due to the prolonged drought, some farmers in Eddy County with supplemental wells are keeping bill collectors at bay by selling their water to the booming oil and gas industry.

Davis said he sees no problem selling water to the industry, but the current drought conditions are having an impact on the amount of water that is being sold. He believes there has to be some personal accountability on how much is pumped out of the aquifer.

Davis alleges that some well owners are finding ways to apply for a commercial permit that allows them to pump up to 9 acre-feet for the year without advertising their change of use and advertising it in the legal section of the newspaper.

Mitigating Corporate Water Risk

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www.water-alternatives.org

Larson, W.M.; Freedman, P.L.; Passinsky, V.; Grubb, E. and Adriaens, P. 2012. Mitigating corporate water risk: Financial market tools and supply management strategies. Water Alternatives 5(3): 582-602

Response	
	Hedge using commodity derivatives for water
	Insure against adverse weather events that cause water scarcity
	Buy or trade water rights and physical quantities of water
	Reduce water use in the value chain and **Reuse** wastewater
	Enhance supply in the value chain

Derivatives/hedging

Insurance

Water trading and water rights

Reduce, recycle, and reuse

Enhance supply

www.water-alternatives.org

Larson, W.M.; Freedman, P.L.; Passinsky, V.; Grubb, E. and Adriaens, P. 2012. Mitigating corporate water risk: Financial market tools and supply management strategies. Water Alternatives 5(3): 582-602

RISK-RESPONSE DECISION FRAMEWORK

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	Identify	Evaluate	Respond
Objective	**Identify water-scarcity risks**	**Determine the value at risk**	**Select a strategic risk-mitigation response**
Criteria	• **Physical risk** water use in operations • **Regulatory risk** local water pricing policy • **Reputational risk** impact of water use on the local community	• **Likelihood of risk** based on watershed data, climate trends and other indicators • **Magnitude of impact** economic loss suffered	• **Cost** of implementation • **Effectiveness** how much risk is negated • **Feasibility** (difficulty) • **Time** implementation timeline for response

The Emerging World

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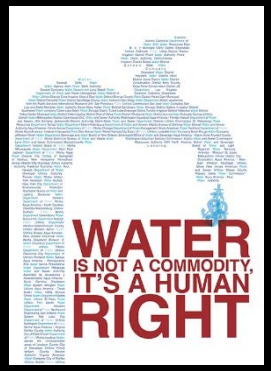
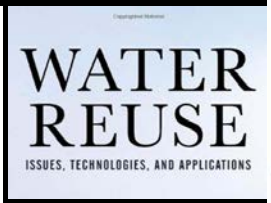
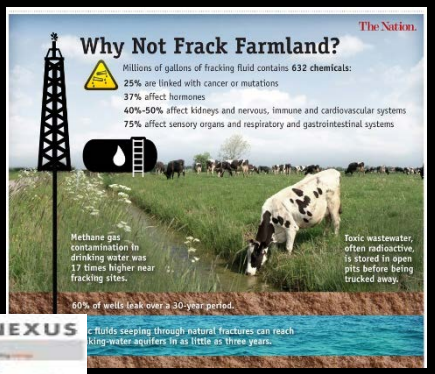
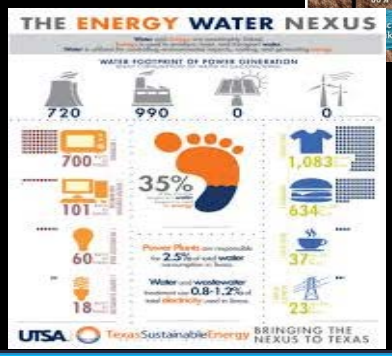
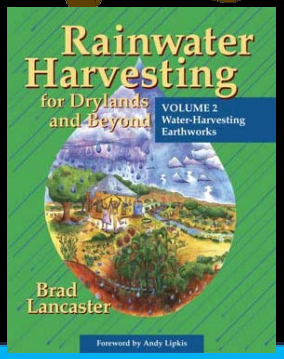






- Public or Private
- Market or Monopoly
- Transactions





Enter the Hydrologist

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- Is water the currency of climate or a bit more?

Actor\Period	Season/Year	5 years
Farmer	**Crop Choices**	**Water Infrastructure Investments**
Agro Corporation	**Sourcing Strategy**	**Sourcing & Stock Strategy**
City Manager	**Drought Pricing Acquire Rights**	**Capacity Expansion Acquire Rights**
Household	**Conservation**	
Energy Producer	**Acquire Rights**	
Manufacturer	**Insurance**	**Water Reuse facility**
Hedge Fund		
Insurance		
Investor		

Actors influence actions of other actors

Collective actions predict local, regional and global demand shifts

Some are climate related

Operator Predictability ?

Application

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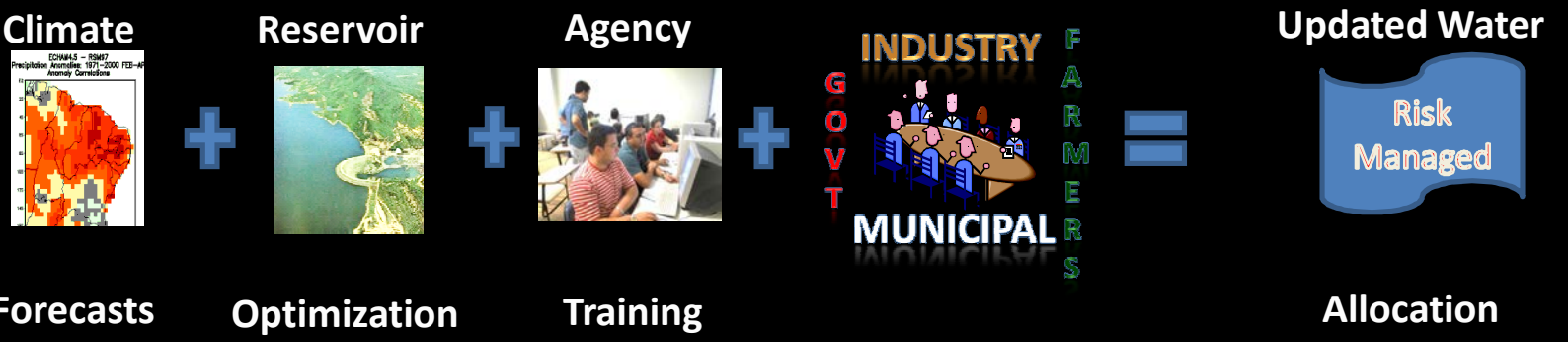
Reservoir/Water Management



- Provision of stochastic inflow forecasts and current reservoir levels
  - Skill information disclosure = assurance of credible intervals, not mean
- Insured Contracts with reliability and deficit control
  - Insurer validates analysis and process reducing risk premium
- Iterated, dynamic process for negotiated convergence for multi-time period contracts across sectors/players
  - Demand and Price Discovery relative to projected reliability and shortage
- Public Agency as facilitator & regulator, supported by fast optimization model to evaluate market contracts
  - Institutional & Technical Support + Enforcement essential. Recover Transaction costs

Questions

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- Subsidies: How is access to water for the poor managed under such a system?
  - Direct cash subsidy + per unit charge?
  - Base access guarantee?
  - Tradability of access/right at market values?
  - Potential of exit from agriculture?
- Does reduction in uncertainty through climate & agricultural forecasts help stabilize or aggravate such a market based system?
  - Does the market process introduce volatility in drought /wet years?
  - Do coalitions form ex ante or ex poste to distort results?
  - How to manage trade-offs between short/long term contracts
- Does the increased sophistication called for operations lead to increased transactions costs?
  - Better science training and data collection/sensors?
  - Infrastructure operating cost recovery – increased re-use reduces revenue?
  - New strategies to allocate carry over and current storage?
  - Post allocation trades and delivery assurance?

Summary

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- It's the anthropocene
  - The challenge is to understand, (predict) and manage processes that define the redistribution of the resource
  - Climate change is just one element of significant structural changes in the offing
  - Gaining experience with new instruments is essential to provide social balance and resource investment incentives
  - Emergence of new needs for hydrologic information
- A new era dawns for the applications of hydrologic science, as the value of a most precious resource on earth emerges through competition and local constraints

  - We need soft and hard technologies, but most of all understanding of the changing context in which we operate

Friday *11:40 AM - 11:55 AM*	*H52G-06. Multi-time scale Climate Informed Stochastic Hybrid Simulation-Optimization Model (McISH model) for Multi-Purpose Reservoir*