Climate change implications for water resources planning in transboundary water systems

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Overview

- Brief Introduction / Justification
- Methodology – A Simulation-Based Framework
- Application – Blue Nile Infrastructure Planning

Justification

"**Vulnerabilities** to climate are strongly correlated with **climate variability**, in particular precipitation variability …are largest in **semi-arid and arid low-income countries**, where precipitation and **streamflow** are **concentrated** over a few months, and where **year-to-year variations** are high."

- IPCC, 2007

Justification (Cont.)

- Traditional framework for water resources project appraisal relies on sophisticated hydrological modeling, followed by limited sensitivity analysis of economic (production and consumption) factors

- There is no existing framework for integrated evaluation of both economic and physical uncertainties in planning applications

- This research aims to develop such a framework, and apply it to a real planning problem

- This is useful for thinking about investments in the context of vulnerability and adaptation

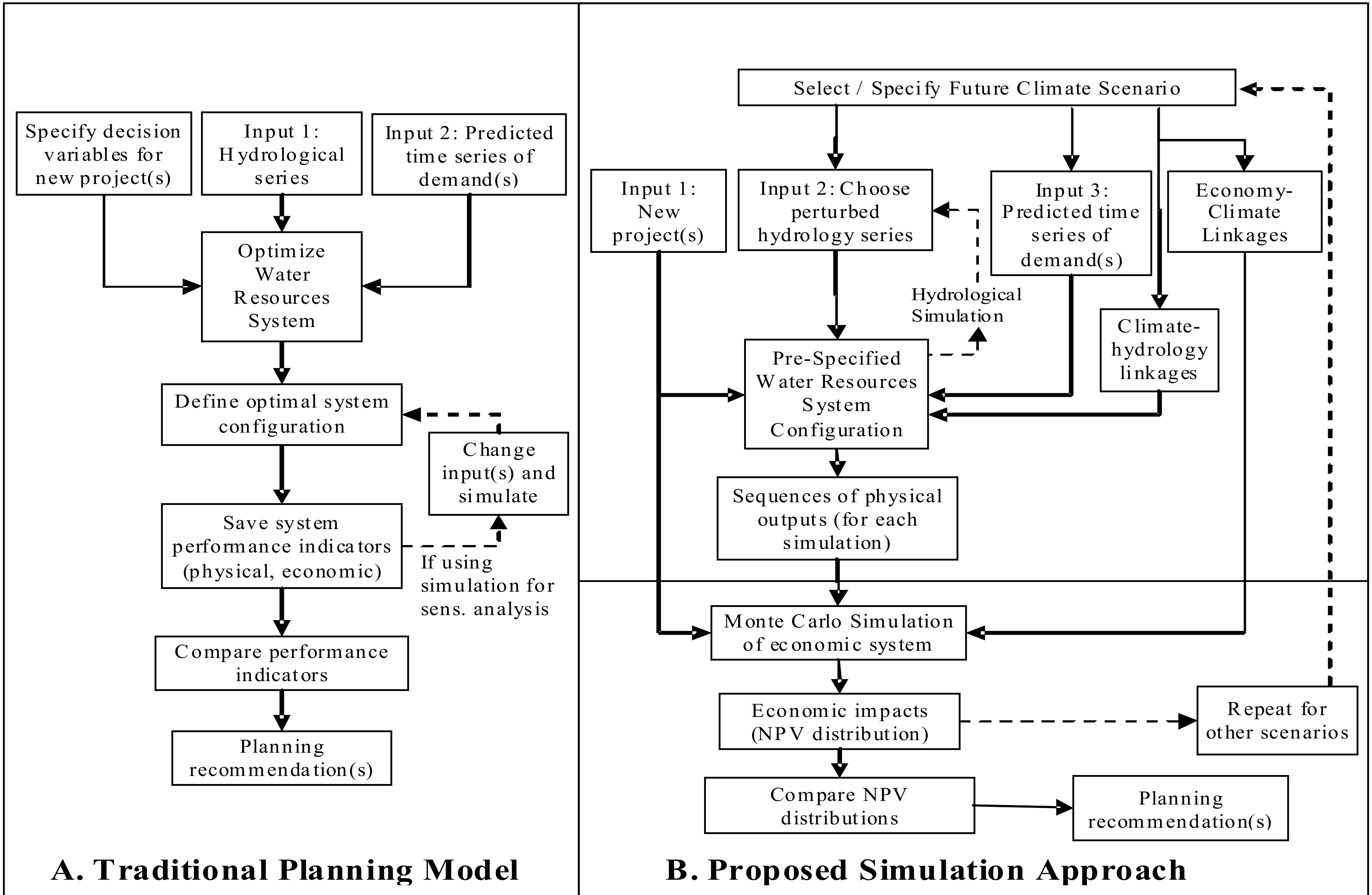
Methodology

- Two levels of simulation
  - Hydrological (routing model with climate-dependent synthetic inflows)
  - Economic (Monte Carlo simulation)
- Inclusion of linkages with climate factors
  - Net evaporation
  - Changes in hydrological routing
  - Increased crop water requirements
  - Changed value of hydrological outputs (hydro, irrigation water, etc.)
  - Value of net carbon offsets

Methodology – Economic Costs & Benefits

Benefits		Costs
Irrigation water demand at dam site		**Capital investment (dam, energy transmission infrastructure, land, etc.)**
Municipal and industrial water demand		**Operation and maintenance**
Hydropower generation		**Opportunity cost of land**
Downstream hydropower and water supply (regularization)		**Reduced water downstream for irrigation, municipal, industrial, hydropower**
Flood control		**Resettlement and rehabilitation**
Decrease in impacts of droughts		**Catastrophic risk**
Creation of fishery in reservoir		Lost river fisheries
Recreational benefits around reservoir		Lost river recreation
Carbon offsets		**Carbon emissions**
Sediment control		Ecological costs
Navigation		Public health costs

Methodology – The Framework



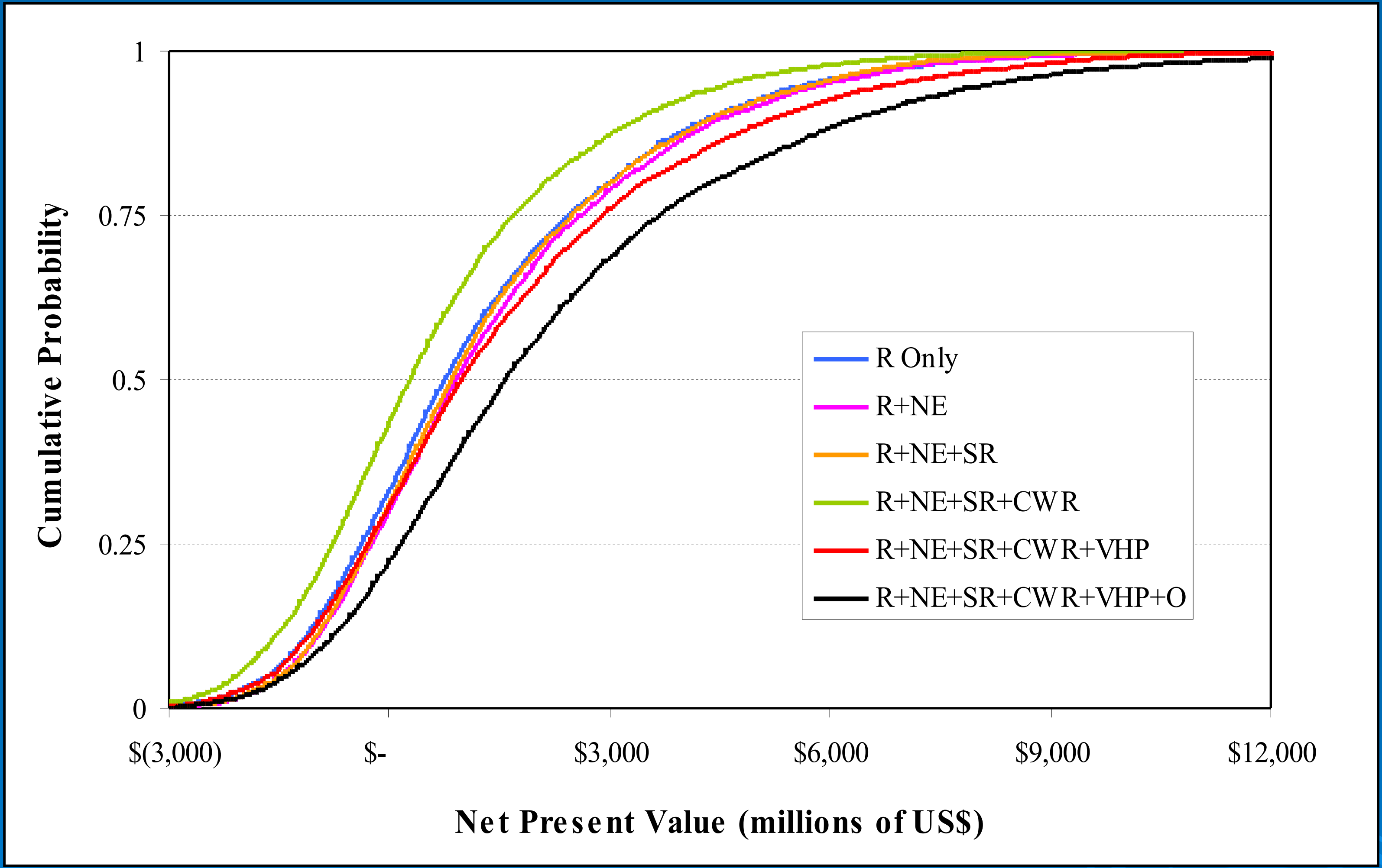
Application - Map

Area of interest:

3-4 Potential sites for large reservoirs

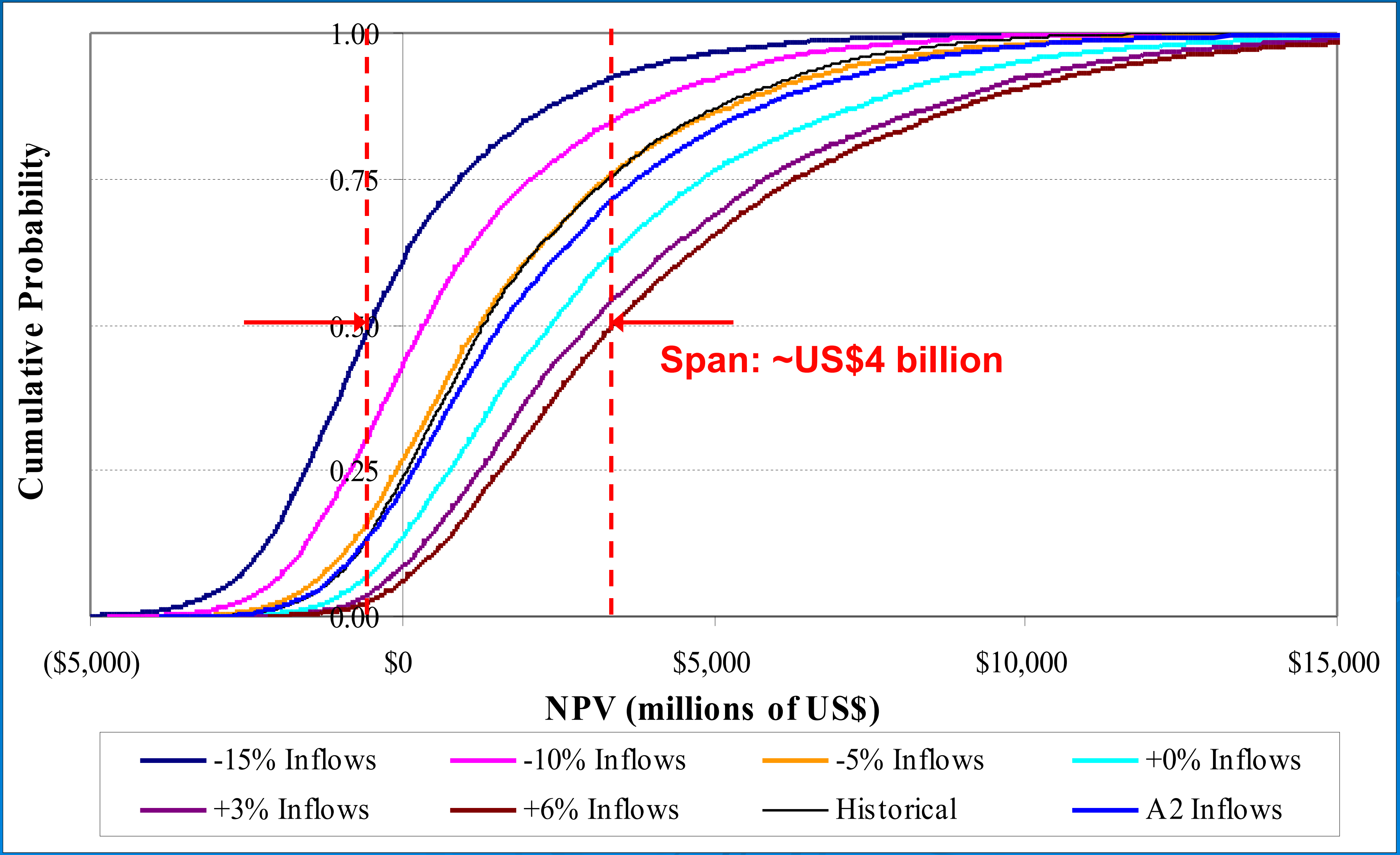
Used A2 ensemble mean projections (from TAR)

Results – The Effect of the Linkages & Adaptation

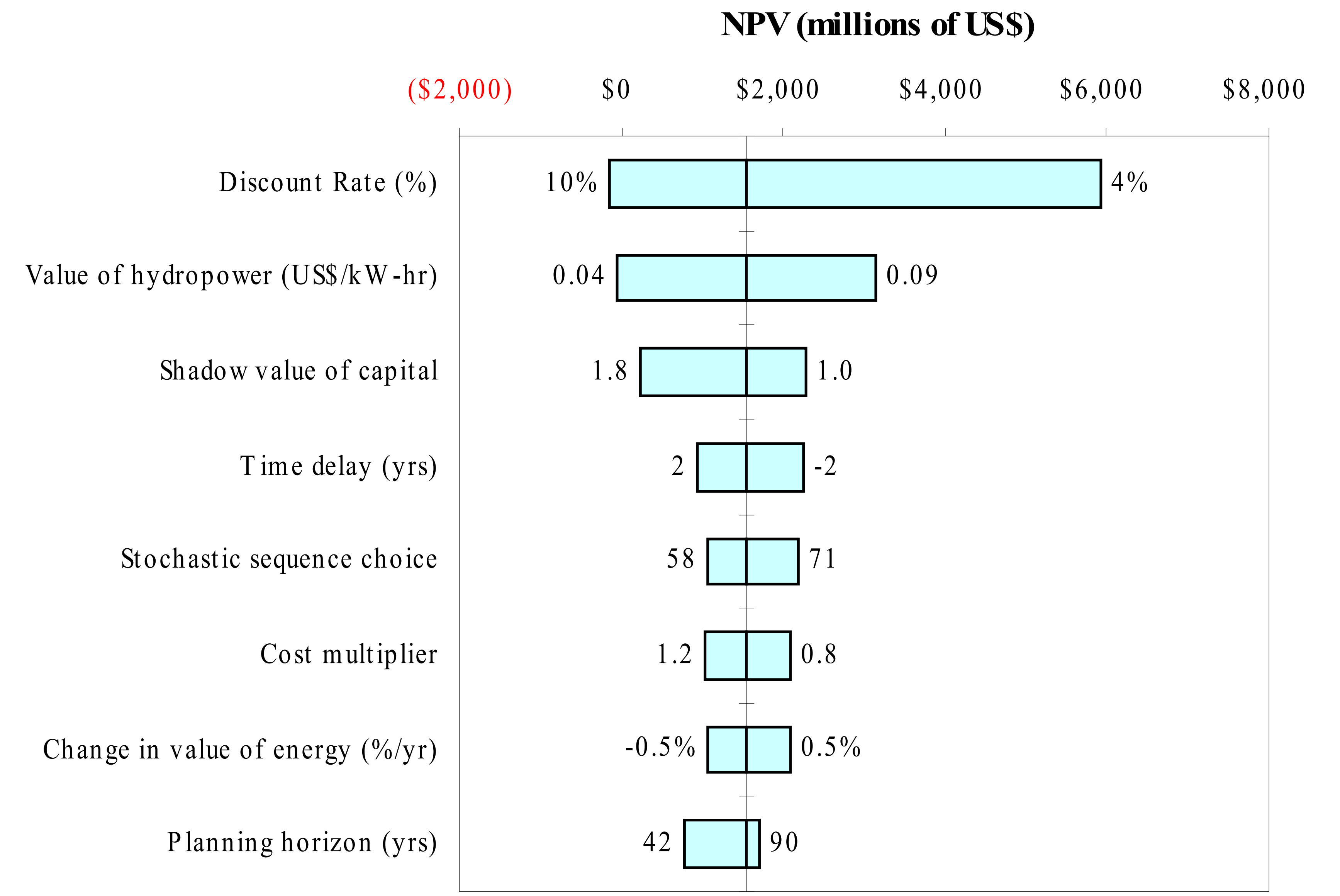


Key: **R** = Runoff only; **NE** = Net Evaporation;
SR = Switching White Nile Hydrology; **CWR** = Crop Water Requirement;
VHP = Time-Increasing Value of Hydropower; **O** = Monetized Offsets

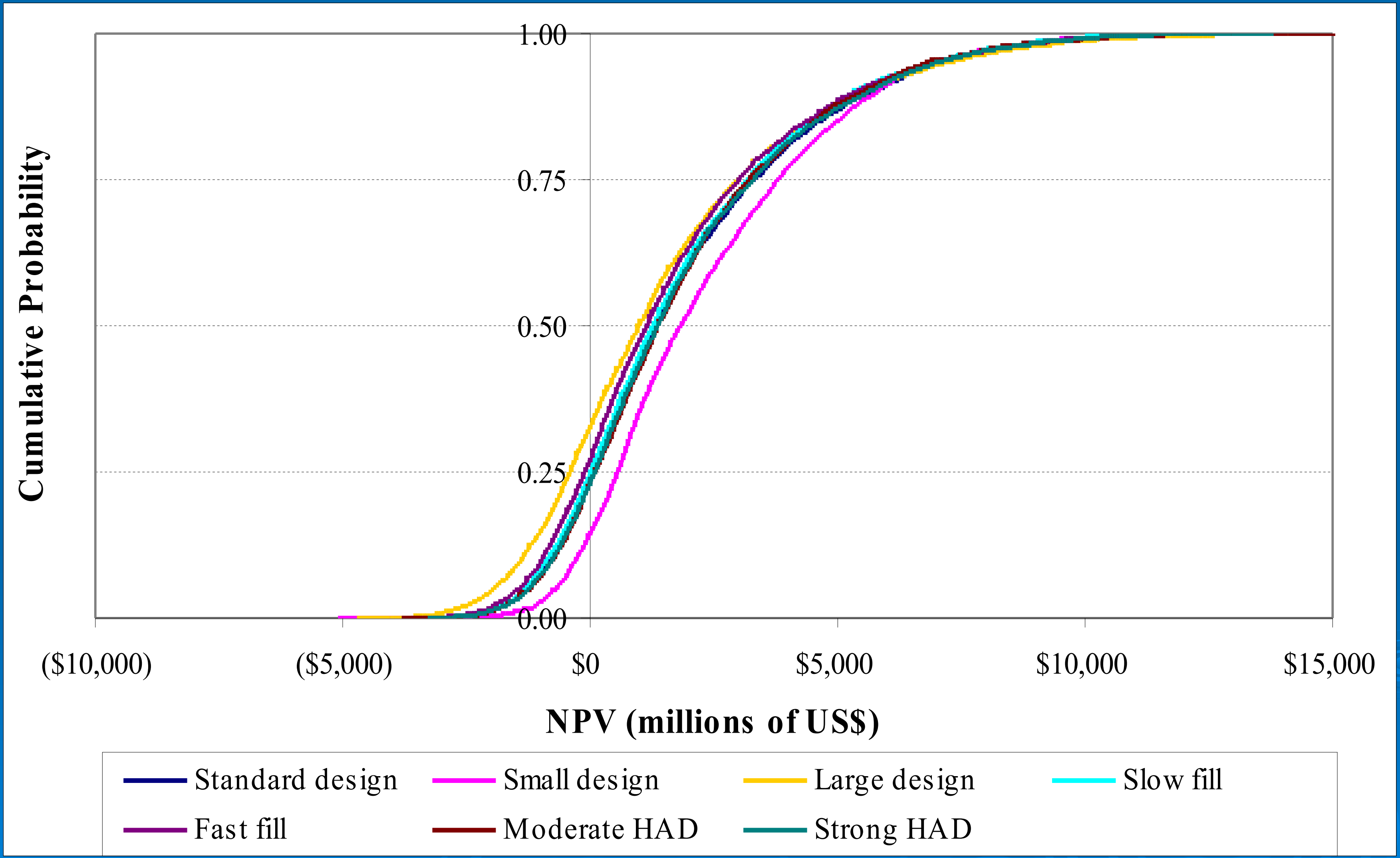
Results – Sensitivity to Inflow Variation & Vulnerability



Results – Sensitivity to Economic Parameters



…And More on Adaptation and Vulnerability



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