



Presentation from  
**2015 World Water  
Week in Stockholm**

[www.worldwaterweek.org](http://www.worldwaterweek.org)

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# Tools for the New Era of Water

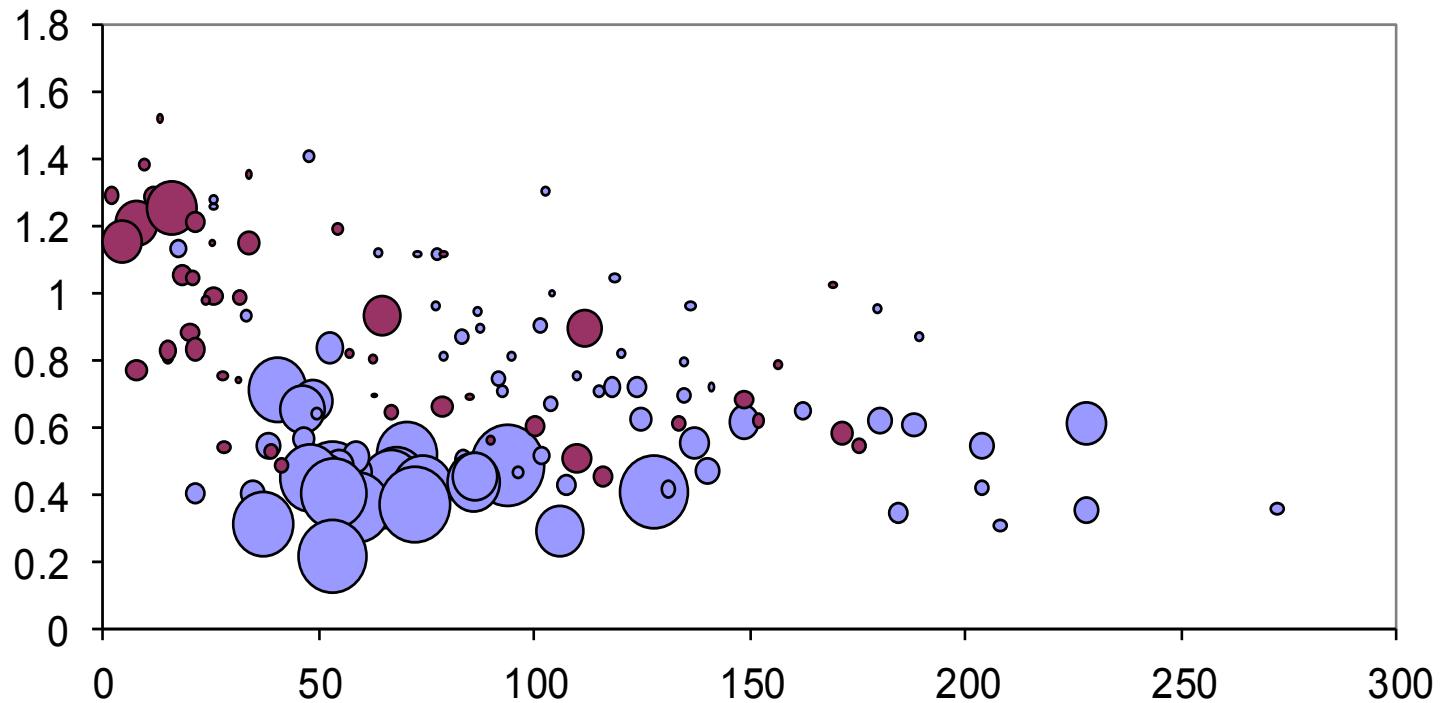
**Casey Brown**

*Associate Professor of Civil and Environmental Engineering  
University of Massachusetts*

# Rainfall Variability and GDP

**Bubble Size = GDP per capita**  
**(Blue = low interannual variability of rainfall)**

**Monthly  
Rainfall  
Variability**



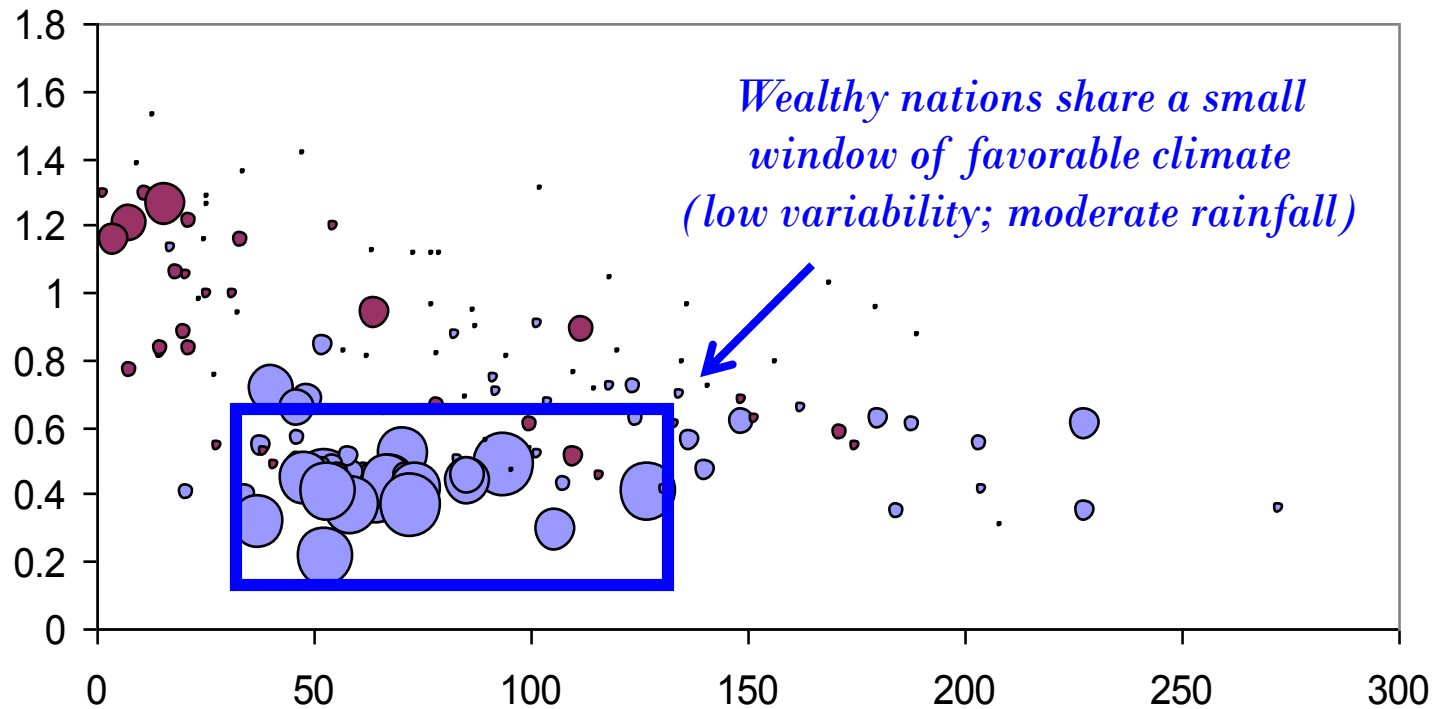
**Mean Annual Rainfall**

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**Mean Annual Rainfall**



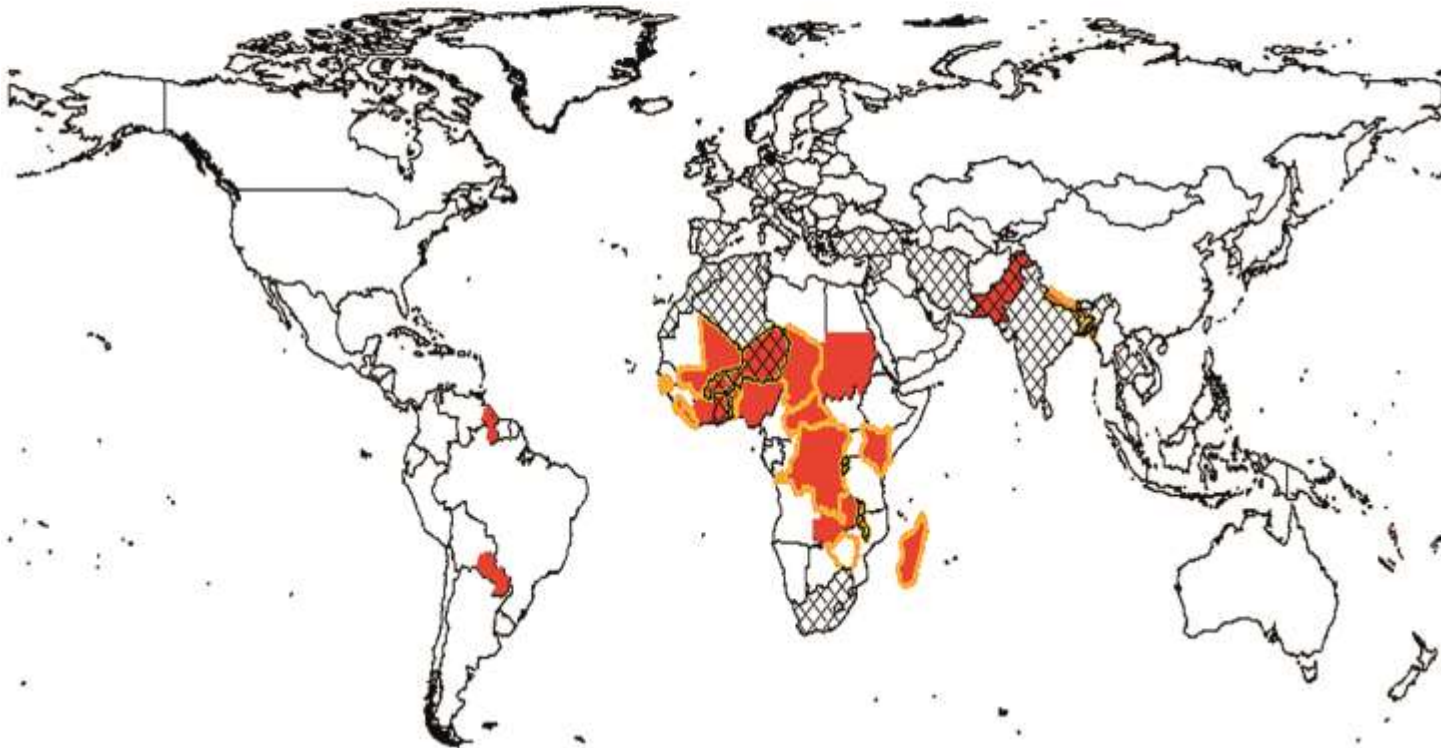
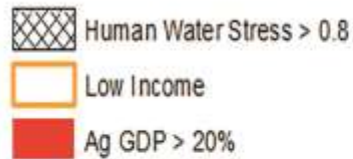
# SECURING WATER, SUSTAINING GROWTH

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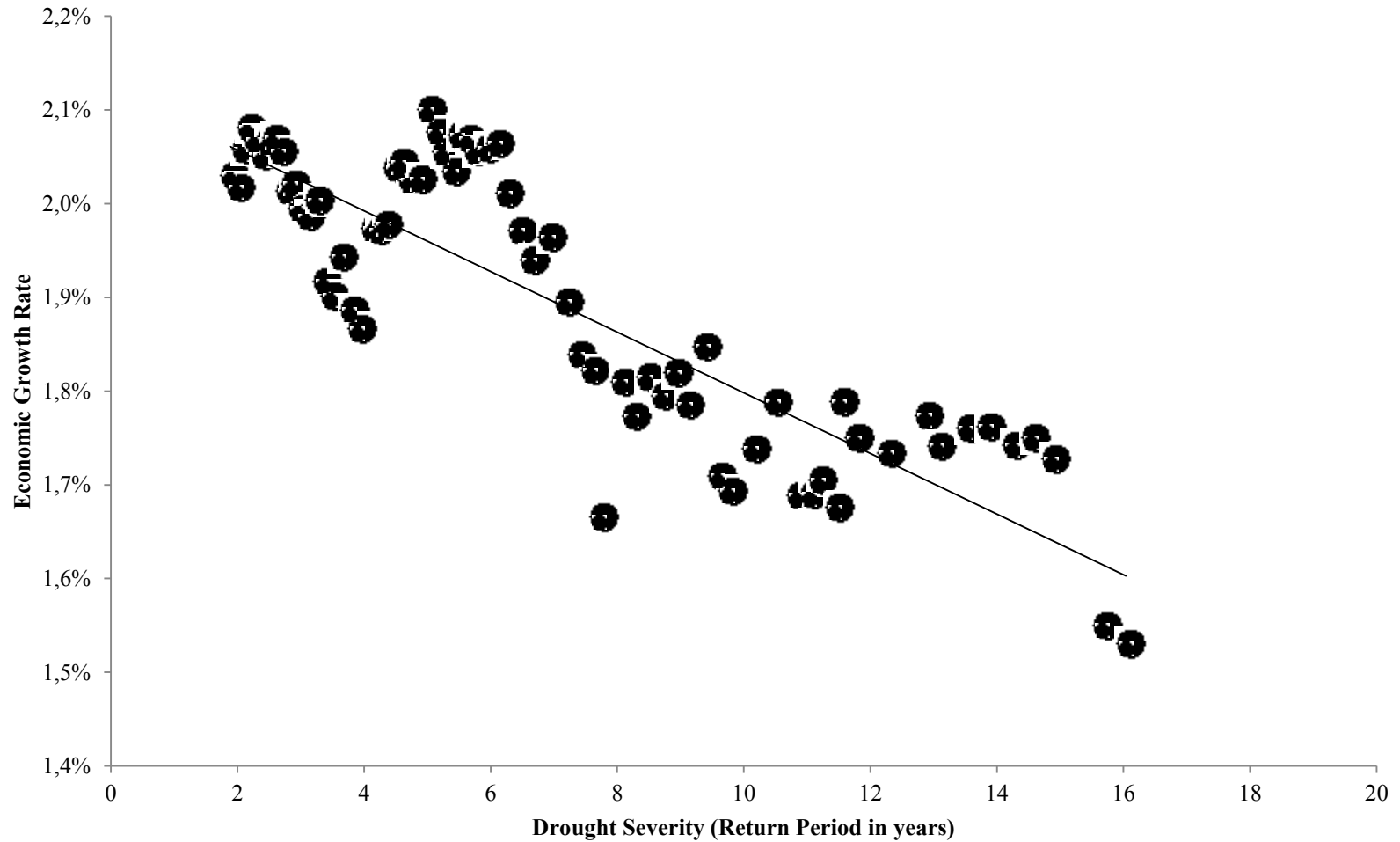
**Findings of the GWP/OECD Task  
Force on**

**Water Security and  
Sustainable Growth**

***“water-related hazards have a statistically significant, causal effect on economic growth”***

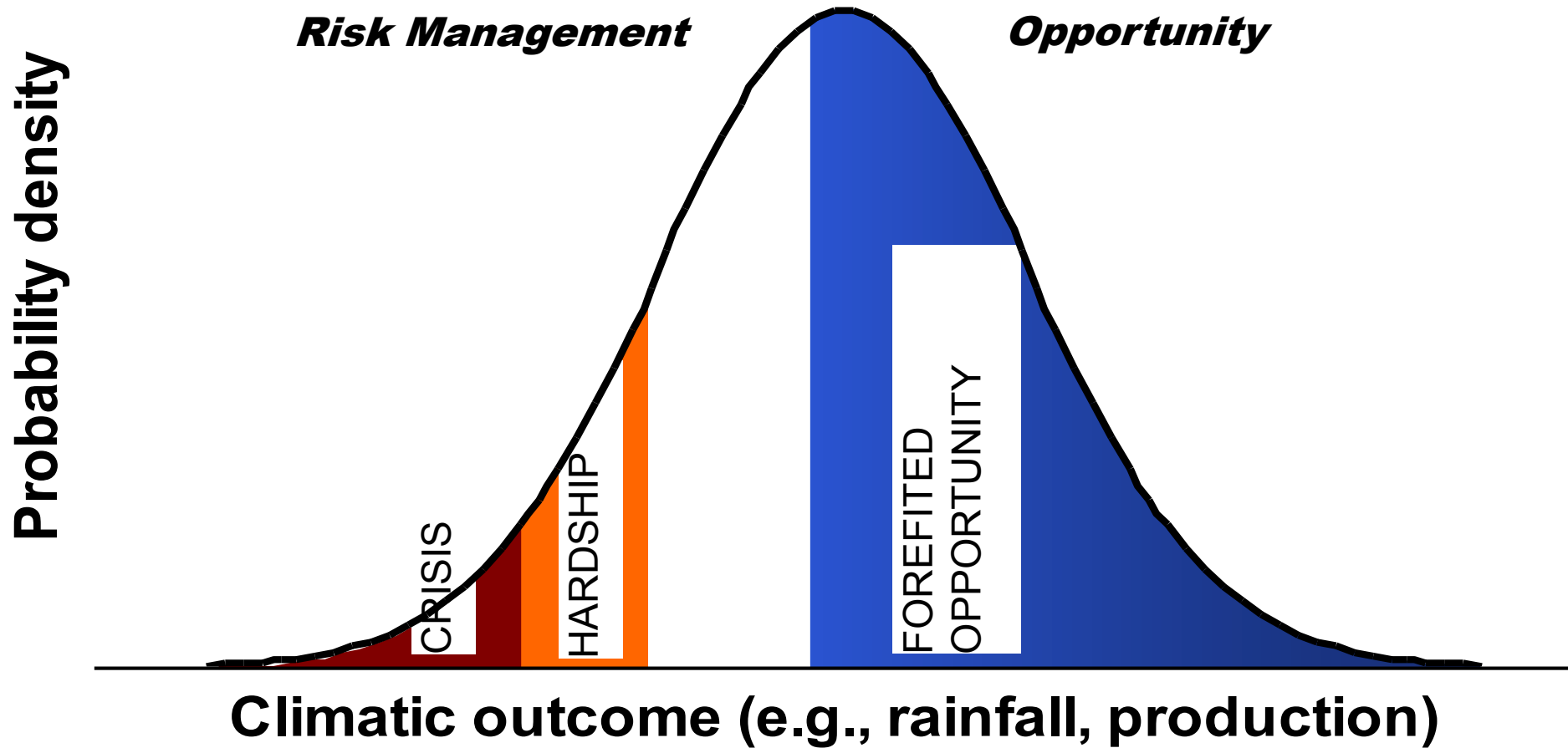


## Drought Effect on Economic Growth Rate



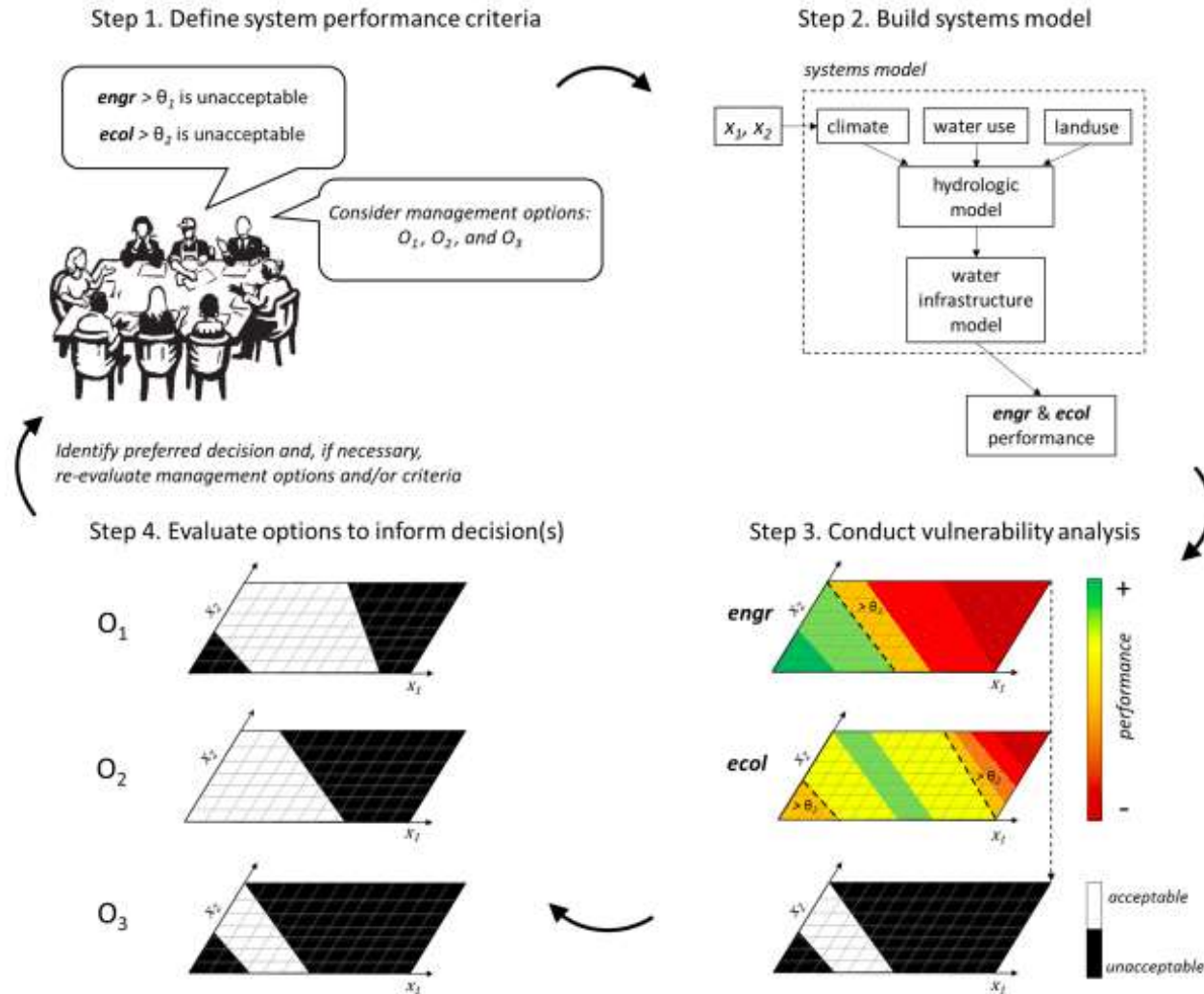
# Uncertainty Management

(de Neufville et al., 2004)





# “Eco-engineering decision scaling for sustainable water management under future hydrologic uncertainty”



# Conclusion

- Climate variability has real, negative effect on economic growth
- Identifying resilient and robust solutions requires new approaches to investment planning and development
- Need for evidence of the performance of water security investments
- Unique opportunity to develop and demonstrate green approaches to water security

# Hydroclimate risk to economic growth in sub-Saharan Africa

Casey Brown · Robyn Meeks · Kenneth Hunu · Winston Yu  
*Climactic Change 2011*

- **Hydroclimate variability** is the dominant and negative climate effect on economic growth
- **10% increase** in drought area causes a **40% reduction** in annual growth in SSA

## An Empirical Analysis of the Effects of Climate Variables on National Level Economic Growth

Casey Brown<sup>1\*</sup>, Robyn Meeks<sup>2</sup>, Yonas Ghile<sup>1</sup>, Kenneth Hunu<sup>1</sup>

- Globally, **10% increase** in drought area causes a **30% reduction** in annual growth

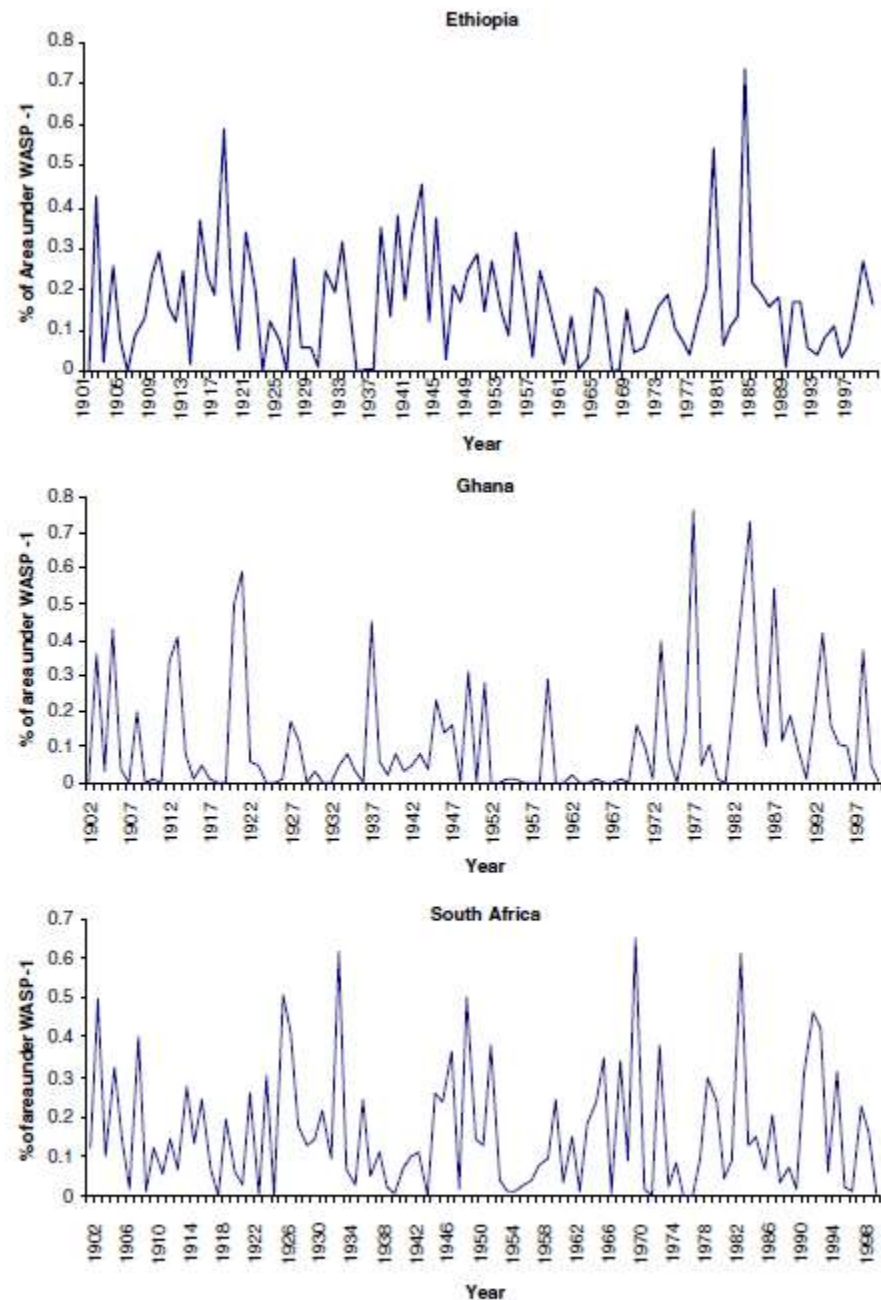
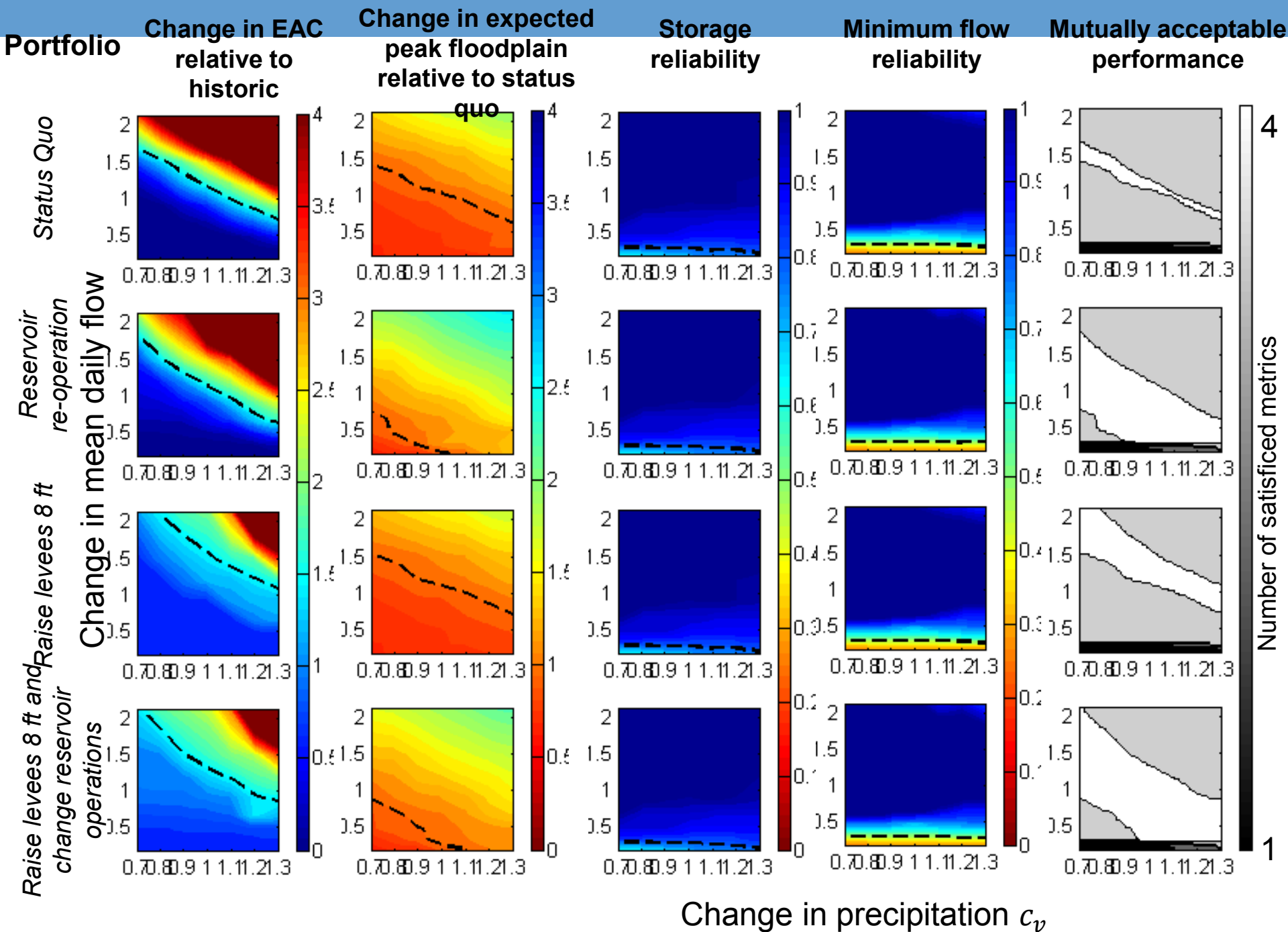


Fig. 1 Timeseries of the WASP (-1) for a Ethiopia, b Ghana, and c South Africa which are generally indicative for east, west and southern Africa. The values represent the percentage of the country with a WASP value of -1 or less for each year. This is representative of the percentage of a country



# Further Reading

- Brown, C. and R. L. Wilby (2012), [An alternate approach to assessing climate risks](#), *Eos Trans. AGU*, 93(41), 401, doi:10.1029/2012EO410001.
- Moody, P. and C. Brown (2012), Modeling stakeholder-defined climate risk on the Upper Great Lakes, *Water Resources Research*, 48, W10524, doi:10.1029/2012WR012497.
- Brown, C., Y. Ghile, M. A. Lavery, and K. Li (2012), [Decision scaling: Linking bottom-up vulnerability analysis with climate projections in the water sector](#), *Water Resour. Res.*, doi:10.1029/2011WR011212.
- Brown, C., Werick, W., Fay, D., and Leger, W. (2011) “[A Decision Analytic Approach to Managing Climate Risks - Application to the Upper Great Lakes](#)” *Journal of the American Water Resources Association*, 47, 3, doi/10.1111/j.1752-1688.2011.00552.x.
- Hallegatte, S., Shah, A., Lempert, R., Brown, C., and S. Gill (2012) "Investment Decision Making under Deep Uncertainty: Application to Climate Change. [World Bank Policy Research Working Paper #6193](#).
- Brown, C. (2011) “Decision-scaling for robust planning and policy under climate uncertainty.” *World Resources Report*, Washington DC. Available online at <http://www.worldresourcesreport.org>



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DIRECTIONS IN DEVELOPMENT  
Countries and Regions

# The Indus Basin of Pakistan

*The Impacts of Climate Risks  
on Water and Agriculture*

Winston Yu, Yi-Chen Yang, Andre Savitsky,  
Donald Alford, Casey Brown, James Wescoat,  
Dario Debowicz, and Sherman Robinson



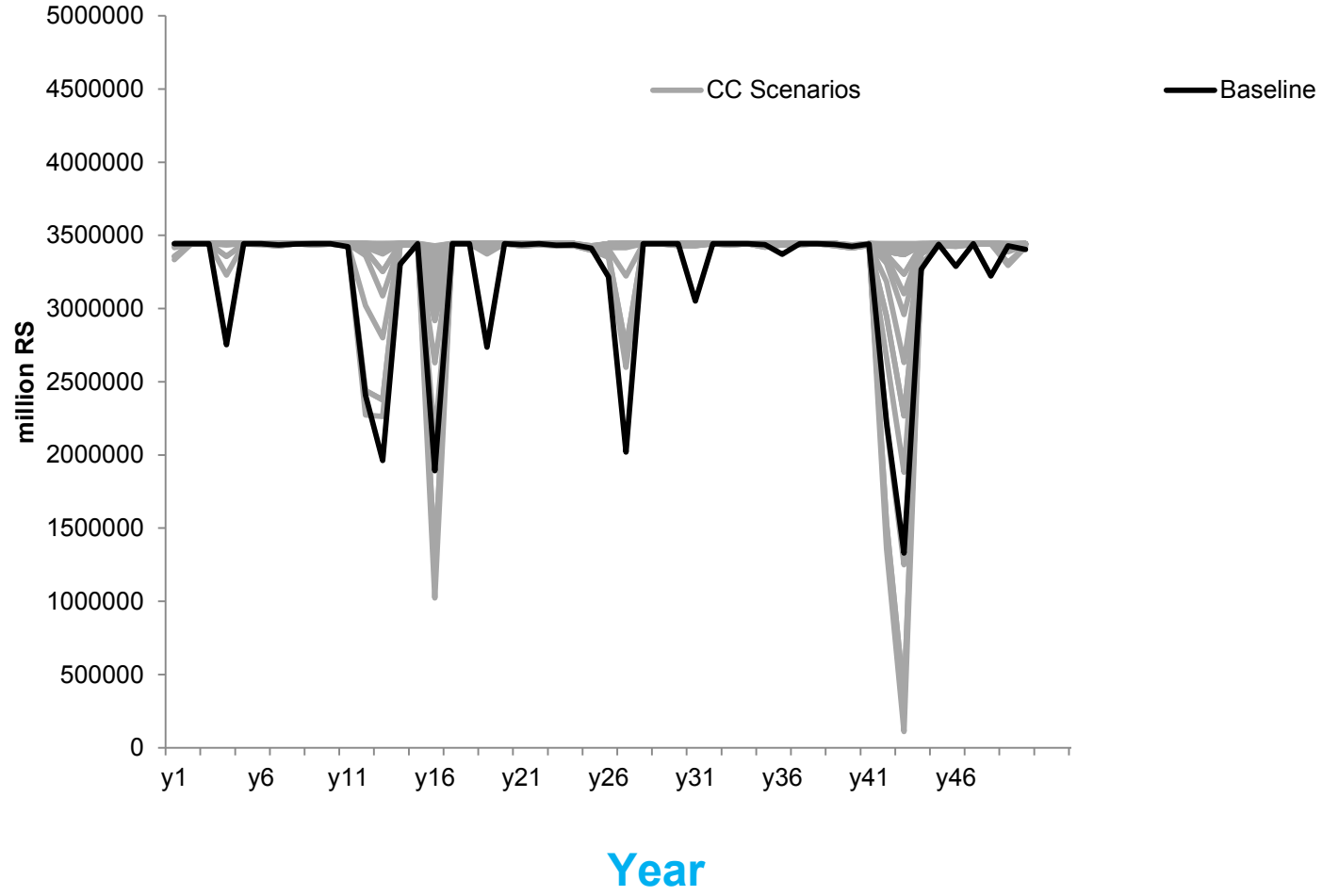
THE WORLD BANK

- 3 major multi-purpose storage reservoirs, 19 barrages
- 12 inter-river link canals
- 43 major irrigation canal commands (covering over 14 million hectares)
- Over 120,000 watercourses
- Total length of the canals is about 60,000 km



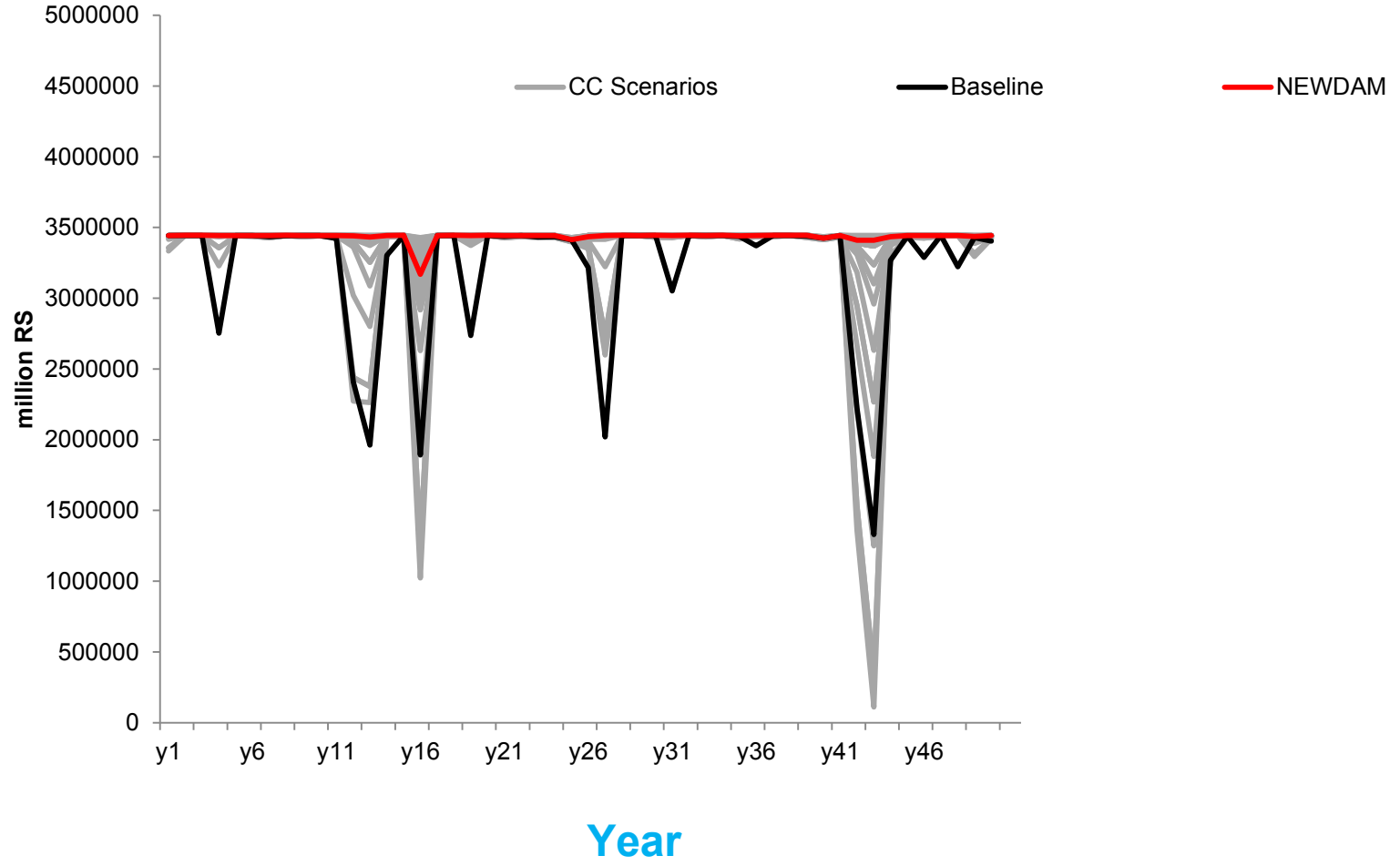
# Indus River Basin Adaptation – New Dam?

## Economic



# Indus River Basin Adaptation – New Dam?

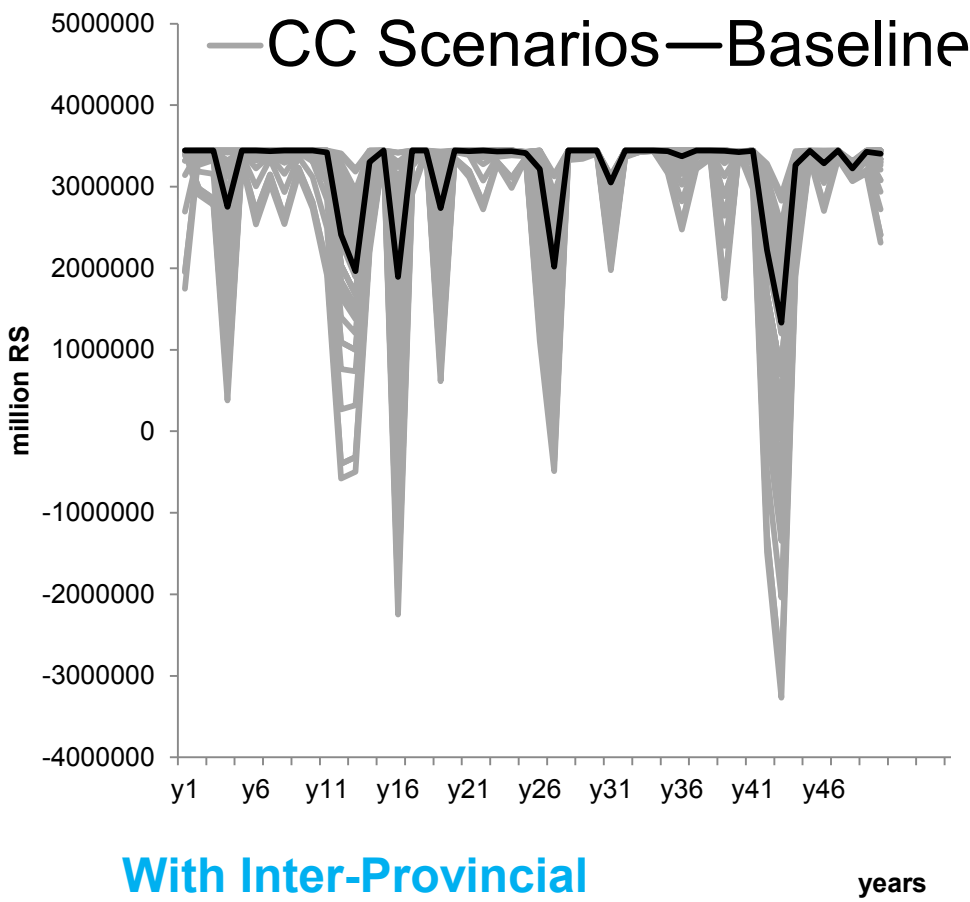
## Economic





# Indus River Basin – Economic Allocation?

## Economic Production



With Inter-Provincial

years