

# Water, Development and Vulnerability: Integrated Management in the Context of Vulnerability and Resilience

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USAID “Millennium Plus One: Integrated Water  
Resources Management in the New Century”

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Battelle

# Climate variability and change

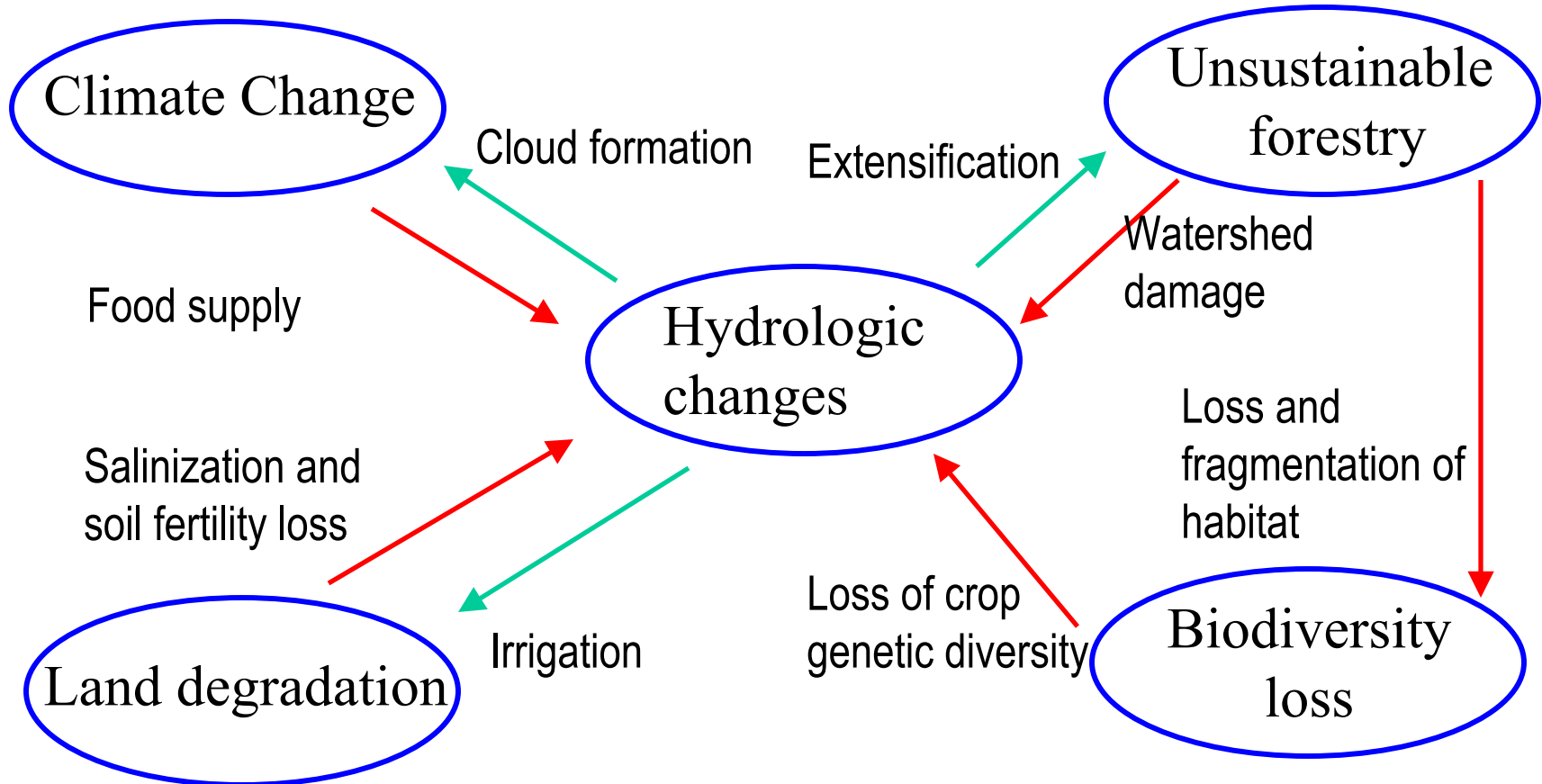
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Integrated water management is already necessary because of increasing population and increasing demand (irrigation, hydro-power, industry, personal consumption).

Climate change will present additional challenges with implications for water supply, timing of supply, food security, tourism, human health, biodiversity, etc.

# Water seeps through to other sectors

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# Vulnerability assessment: a promising framework for analysis

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- Occupies the “middle ground” between economic and biophysical approaches to impacts
- Assesses whether changes lead to harms: includes adaptive capacity
- Extends impact assessment by highlighting *who* is susceptible, *how* susceptible they are, and *why*
- Highlights options for effective adaptation
- Scenario-driven—capability to explore many possible futures

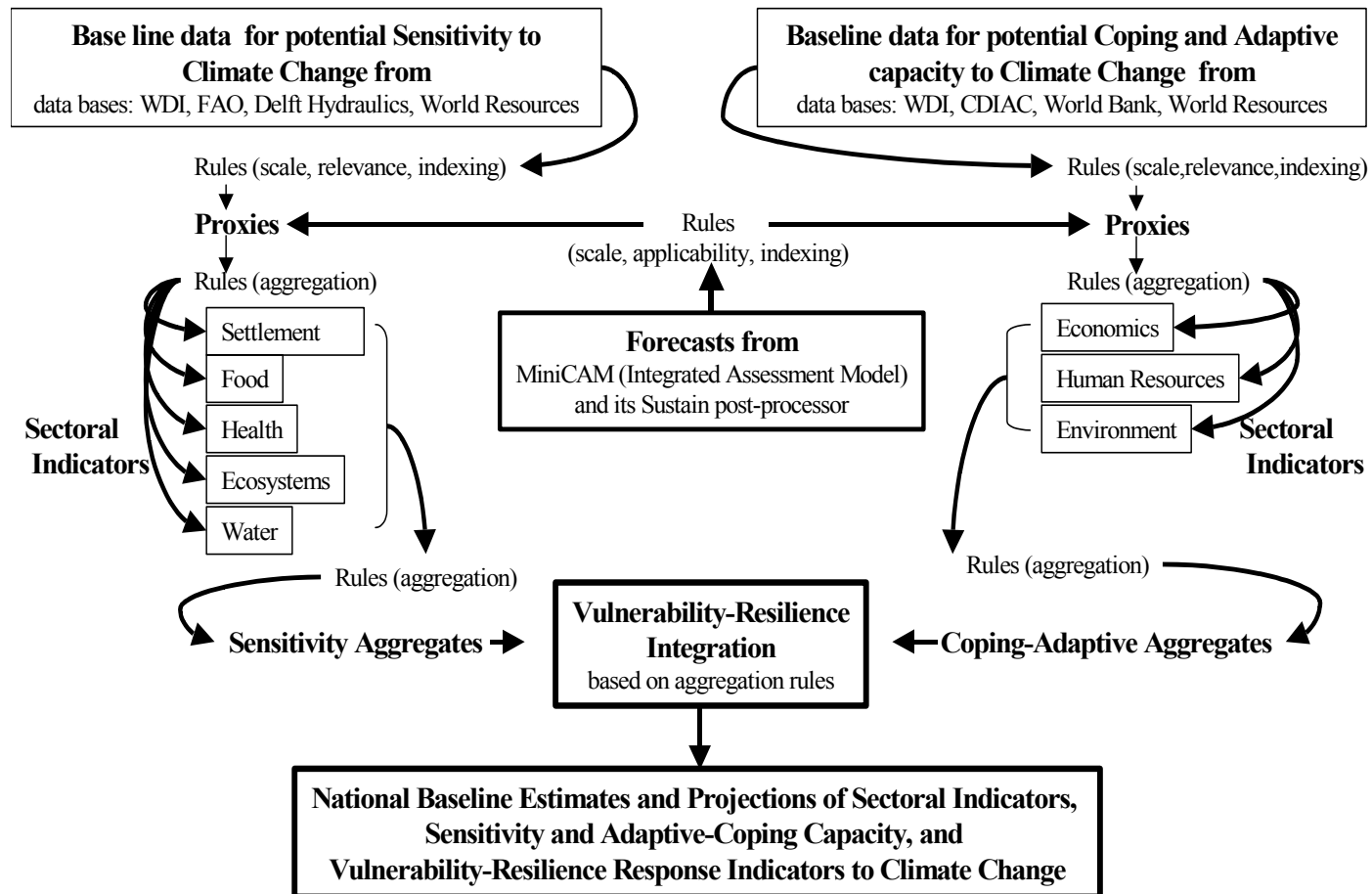
# Important concepts

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- *Vulnerability*: capacity to be harmed; composite of sensitivity, adaptability, and exposure
- *Resilience*: capacity to cope with the hazards
- *Sensitivity*: the degree to which changes and/or variability in climate lead to changes in system attributes
- *Adaptive capacity*: resources available for making adjustments in anticipation of or in response to climate change and/or variability

# Vulnerability: a framework for analysis

## Quantifying Resilience and Vulnerability to Climate Change



# Can vulnerability be measured in a meaningful fashion?

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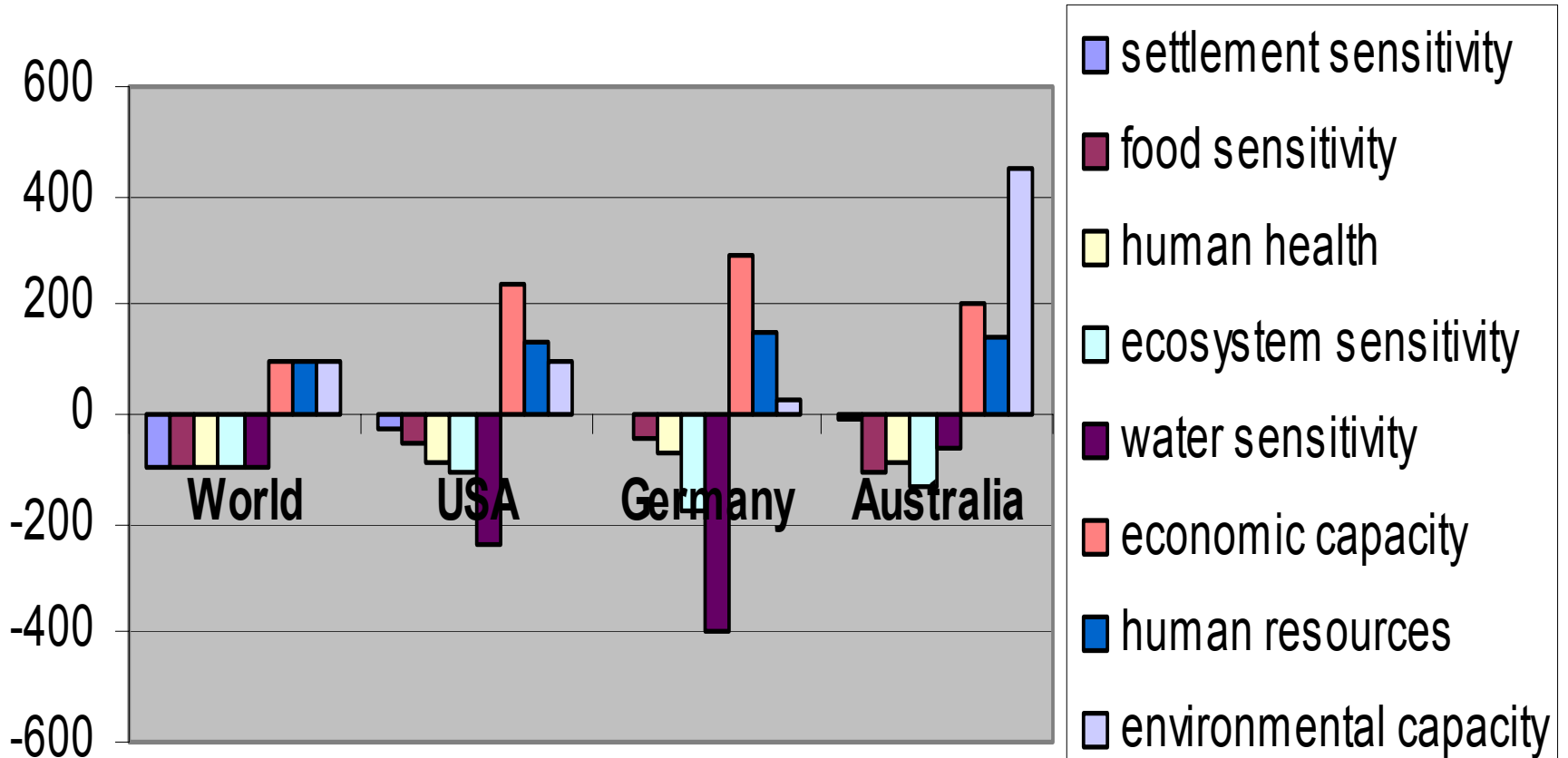
- Experiment with a prototype set of indicators
- Proxies: variables for sensitivity and coping capacity selected on basis of availability of data/projections
- Aggregation: sub-components combined into sector indicators using a geometric mean
- Normalization/scaling: World 1990=100
- Baseline calculations: national data from several sources (FAO, WRI, ...)
- Projections: how does vulnerability evolve under different possible futures? E.g., different patterns and rates of economic growth, population stabilization, ...

# Components of prototype indicator:

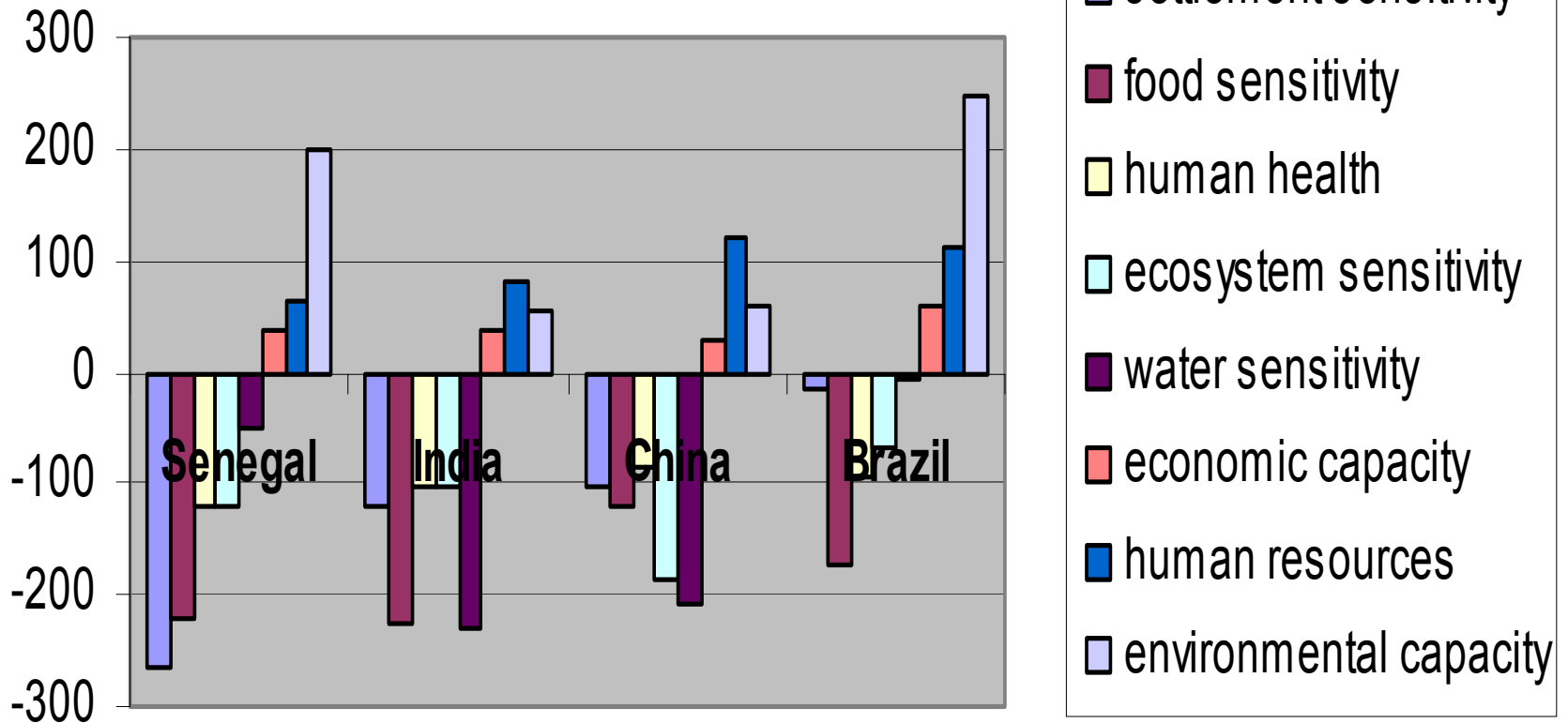
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<b><i>Settlement sensitivity</i></b>	<ul style="list-style-type: none"><li>• Sea level rise resulting in people at risk</li><li>• % population with access to safe water</li><li>• % population with access to sanitation</li></ul>
<b><i>Food sensitivity</i></b>	<ul style="list-style-type: none"><li>• Cereal production/area crop land</li><li>• Animal protein demand per capita</li></ul>
<b><i>Human health sensitivity</i></b>	<ul style="list-style-type: none"><li>• Birth rate</li><li>• Life expectancy</li></ul>
<b><i>Ecosystem sensitivity</i></b>	<ul style="list-style-type: none"><li>• % managed land</li><li>• Fertilizer use/area cropland</li></ul>
<b><i>Water sensitivity</i></b>	<ul style="list-style-type: none"><li>• Water sensitivity, based on availability and consumption</li></ul>
<b><i>Economic capacity</i></b>	<ul style="list-style-type: none"><li>• GDP per capita</li><li>• Income distribution equity (Gini coefficient)</li></ul>
<b><i>Human resource capacity</i></b>	<ul style="list-style-type: none"><li>• % population in the workforce (age dependency)</li><li>• Illiteracy</li></ul>
<b><i>Environmental capacity</i></b>	<ul style="list-style-type: none"><li>• % non-managed land</li><li>• SO<sub>2</sub> emissions</li><li>• Population density</li></ul>

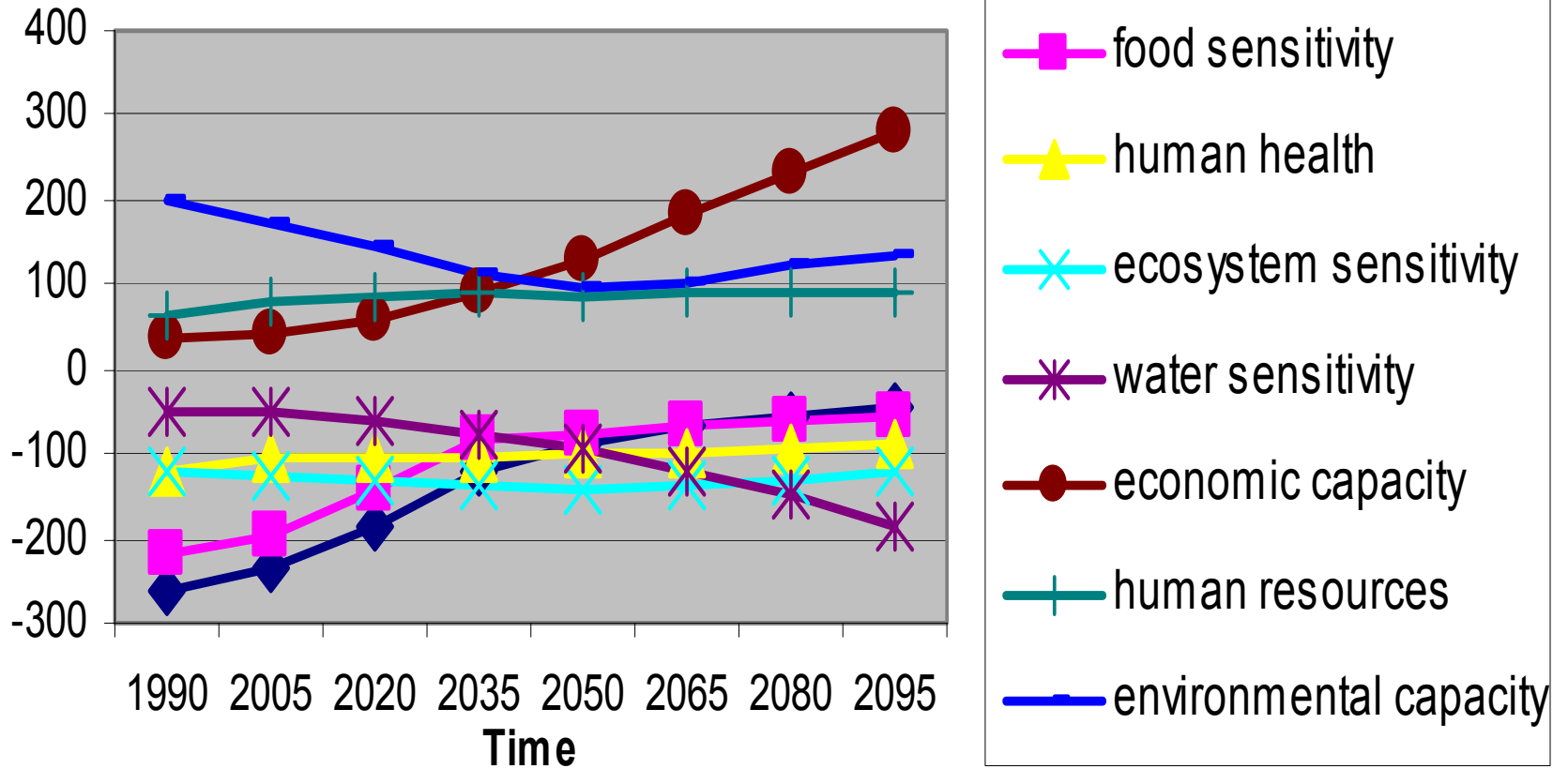
# Sensitivity/Coping-Adaptive Capacity by Sector



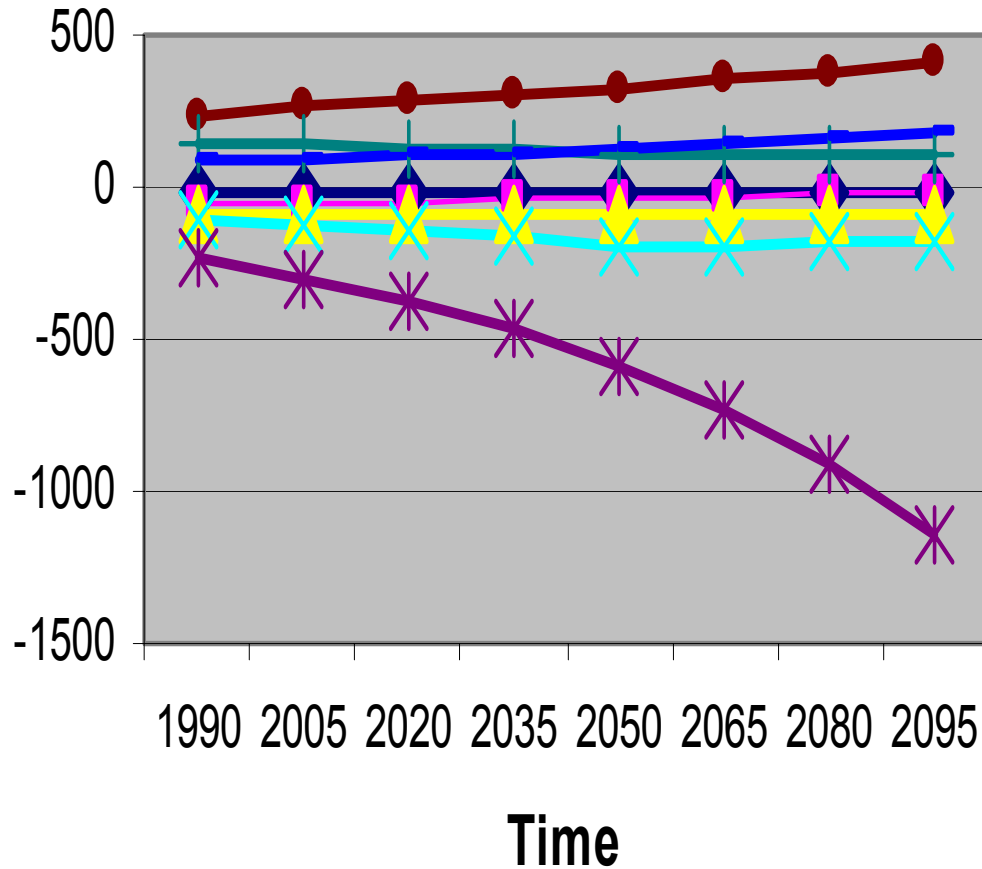
# Sensitivity/Coping-Adaptive Capacity by Sector



# Senegal Rapid Growth Scenario



# USA Rapid Growth Scenario



- ◆ settlement sensitivity
- food sensitivity
- ▲ human health
- × ecosystem sensitivity
- \* water sensitivity
- economic capacity
- + human resources
- environmental capacity

# Use leading indicators to prioritize analysis/program development

- Indicators point to potential problems or strengths
  - Focus detailed assessment of adaptive capacity
- Also need to examine coping pathways, difficult-to-quantify factors, and other potential effects
  - Kinship networks, institutional capacity, civic organizations
  - Employment loss or creation, change in efficiency/competitiveness
- Can help identify strategies for building resilience

# A good indicator reflects existing conditions and issues of concern

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***Sustainability Indicators*, Bedřich Moldan and Suzanne Billharz, editors, contains at least 35 different indicators, for example--**

- **% of population with access to sufficient clean water & sanitation at their place of habitation**
- **% of energy, water and food that could be supplied from other sources than the present ones**
- **average transportation distance for key resources (water, energy, food materials)**
- **% unpolluted stream and beach kilometers**
- **annual withdrawals of ground and surface water**
- **domestic consumption of water per capita**
- **groundwater reserves**
- **concentration of faecal coliform in freshwater.**

***Adapting to Climate Change: Assessments and Issues*, Joel Smith et al., editors, contains 18 different indicators, for example--**

- **annual per capita freshwater supply**
- **hydroelectric generation/energy demand**
- **irrigation use and efficiency**
- **insurance against water shortages.**

# Some critical questions to address in moving forward:

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- How are the concepts of vulnerability and adaptation relevant to USAID programs?
- Do integrated water management programs address vulnerability?
- How can a focus on vulnerability and adaptation provide an integrative focus for existing and planned programs?

# For further information:

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- <http://www.pnl.gov/globalchange/projects/vul/index.htm>
- Our Planet, Our Future:  
<http://www-esd.worldbank.org/planet/>
- USGCRP: <http://www.usgcrp.gov/>