Adaptive change needs in water resources management

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What are adaptive changes?

- Adaptive changes are needed to deal with challenges that can be **hard to identify** and often present **no obvious solution**
- Adaptive changes must target potential long-term solutions for **risk management**
- Adaptive changes require **learning** for problem definition and solution exploration, via **experimentation** with various new approaches and practices
- Decision makers should be **open** to contrasting opinions and perspectives and create an environment where issues can be openly discussed and resolved

What is adaptive water management?

- Adaptive management is a systematic process for improving management policies and practices by learning from the outcomes of implemented management strategies

- "***Adaptive water management aims to increase the adaptive capacity of the water system by putting in place both learning processes and the conditions needed for learning processes to take place***." (Claudia Pahl-Wostl, 2006; *Requirements for Adaptive Water Management*)

Case study: Adaptive flood management in the US

- Reliance on engineering before 1960's
- Floodplain management, a landmark set by Gilbert White "Human adjustments to Flooding"
- "*Floods are acts of God, but flood losses are largely acts of man*"
- Overreliance on structural works in the US had actually increased damage by flooding, rather than decreasing them. **Hurricane Katrina in 2007** is an example of engineering failure

Human Adjustments to Flooding according to Gilbert F. White, 1942

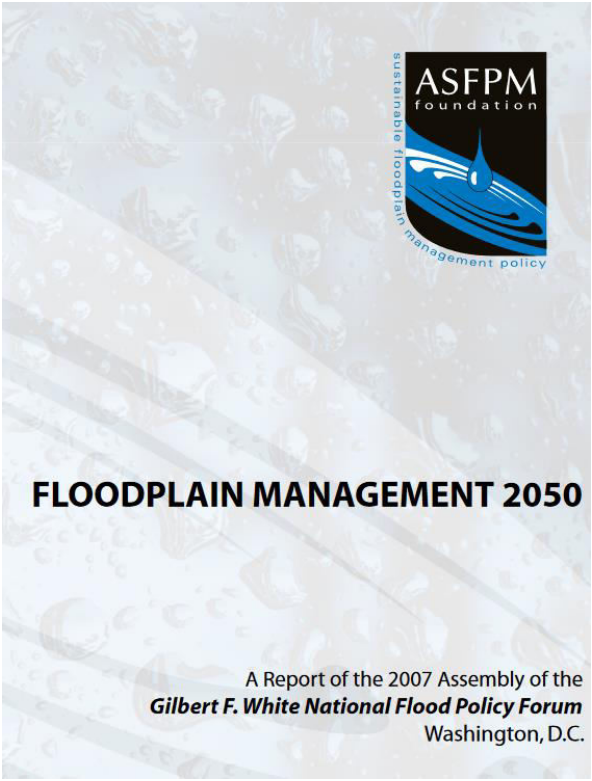
- Land Use
- Flood Abatement (watershed management)
- Structural Alterations (building & development standards)
- Elevation of Land
- Insurance
- Relief
- Emergency Measures
- Structural Flood Protection

"More Than Climate, Engineering Worsening Flooding Along Mississippi" (M. D. Therrell).

Case study: Adaptive flood management in the US

Floodplain management 2050 (Marvin Center, George Washington University, 2007)

- Comprehensive land use planning that begins with a template of its land and water and related resources and hazards
- Congressional passage of a national floodplain management policy, implemented through holistic techniques and applied by state and local governments
- Completely AVOIDING construction in floodprone areas, and increasing elevation of the land surface through fill or elevating buildings to a specified level
- Flood insurance as a part of all-hazards insurance coverage that is mandatory throughout the country
- Structural flood protection would be used only to protect existing development, and then only as an option of last resort; non-structural solutions to a flood "problem" would be considered first.
- Public awareness and education could have led gradually to a voluntary reduction in building in floodplains



Case study: Recent floods in North China

- Men-Tou-Gou District: The highest amount of rainfall over the past 140 years with precipitation in the area
- What would happen if the same rainfall event happened 100 years ago? Larger or smaller floods (with **more land for flood** but **less flooding control engineering infrastructure**)?
- As some media claimed, victory was achieved during this historical flood event; disaster occurred but life losses were under control
- But what will happen if such an extreme flooding event comes again or if an even more severe event comes?
    - With bad luck of some possibility if the engineering system fails (e.g. major dam or river bank break)
    - Higher economic and social cost with the floodplain use

Implications for adaptive changes in flood control

What do people learn from the major flood disasters?

- Keep doing what has been done?
- Any doubt about what has been done?
- What should be leaned from people who suffered the disaster?
- What should be leaned from scientists and engineers?

What new options should be considered and experimented?

To list some measures but not limited to:

- Make room for rivers, oceans, and adjacent lands
- Reverse perverse incentives in government programs
- Restore and enhance the natural, beneficial functions of riverine and coastal areas
- Generate a renaissance in water resources governance
- Identify risks and resources and communicate at public and individual levels
- Assume personal and public responsibility

(Floodplain management 2050 , U.S.)

What will be the strategies to balance the needs of short-term crisis and long-term risk management?

- Reliability and timing of predictions
- Trust in forecast
- “Wait and See” and “Do it Now”

Social learning and citizen behavior change

- The role of social media
- Reducing the number of “stubborn” individuals

Du, E., XM Cai, Z. Sun, B. Minsker (2017). Exploring the role of social media and individual behaviors in flood evacuation processes: An agent-based modeling approach, *Wat. Resour. Res.*, 10.1002/2017WR021192.

Summary

- **Changes**!
- **Open environment** for various options and thoughts
- Long-term solutions for **risk management**
- **Learning** and **experimentation**

“摸着石头过河, step into the river by touching bottom rocks”(Deng, Xiaoping)

Who tells how deep the river ahead is?

“与时俱进 advancing with time” (Jiang, Zemin)

Who tells it is the time to make a change?

Do you have any questions?

THANK YOU FOR YOUR ATTENTION!