

# Beyond Infrastructure: Building Resilience to Water-Related Impacts of Climate Change in the U.S. and Overseas

Karen MacClune, Institute for Social and Environment Transition

*Karen MacClune received her PhD in Geophysics from the University of Colorado where she studied glacial hydrology and micrometeorology of the Antarctica Dry Valleys. From 2001 to 2009 Karen was employed with S.S. Papadopoulos & Associates where she worked with multiple and diverse stakeholders in addressing water resource and conjunctive surface water/groundwater use issues in the southwestern U.S. In 2009 Karen joined ISET-International, a US-based non-profit working to build the field of urban climate change resilience in South and Southeast Asia. With ISET Karen has worked on water issues in Vietnam, Nepal, and Thailand in addition to leading ISET's climate change resilience training materials development team. Karen is currently working with Zurich Insurance to develop a systematic post-event methodology for forensic analysis of and learning from disasters, with the State of Colorado to pilot the Colorado State Resiliency Framework in Larimer and El Paso Counties, and with BoCo Strong, a Boulder County resilience initiative, to develop and pilot community resilience projects.*

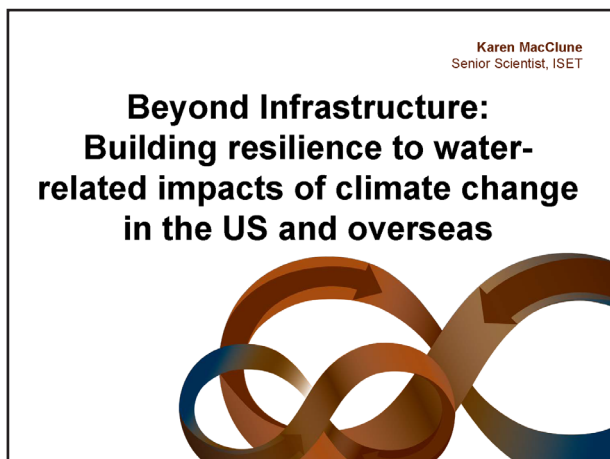


Figure 1. Introduction.



Figure 2. Karnali Basin, Western Nepal.



Figure 3. Food resilience case studies.



Figure 4. Resilience terms.

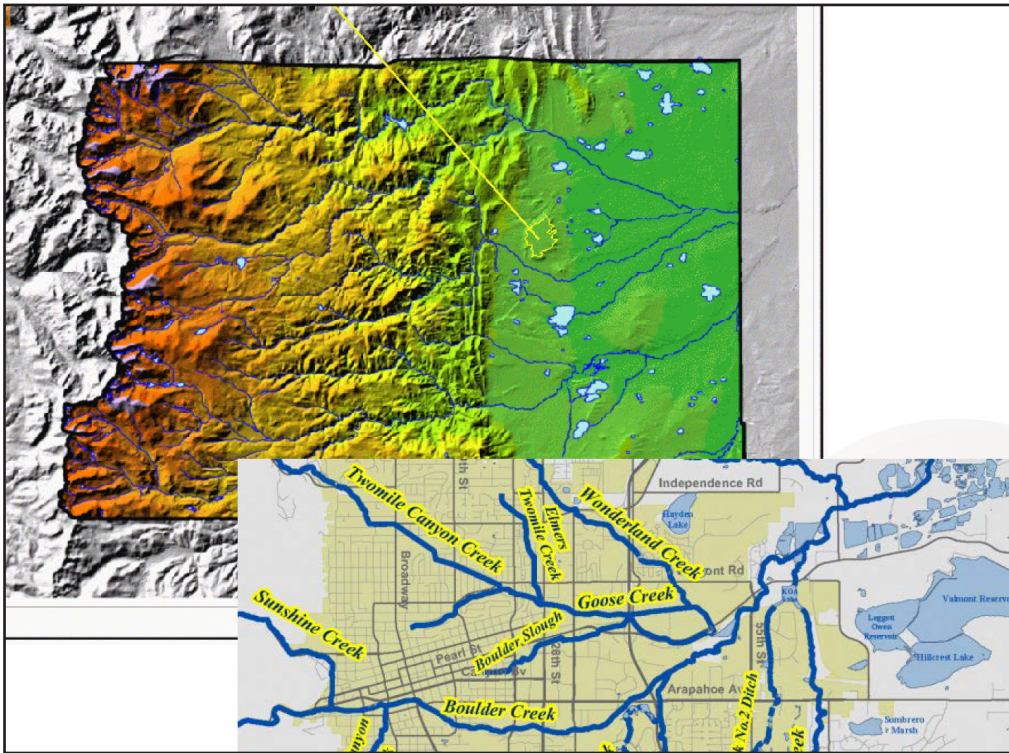


Figure 5. River basins of Boulder, Colorado.

**Boulder Floods**

Infrastructure:

- In the City of Boulder, Greenways channeled water as intended... but it was a ~1-in-50 year flow
- Lyons, which got ~1-in-1000 year flow, was severely impacted
- Across the county, 6 of 7 canyon roads were lost




Figure 6. Boulder floods: infrastructure impact.

People and Organizations:

- Emergent groups volunteered 1000s of hours for response and recovery
- Latent capacity and resources – which require transportation, communication, and sometimes power to leverage
- Post-flood, individuals and households have invested a lot – how can we better harness and leverage that?




Figure 7. Boulder floods: disaster response.

**Legal and Cultural Norms:**

- Many citizens have a reliance on government response that is out of proportion to what is possible in a large disaster
- How people responded, both during and after the flood, is heavily constrained by the culture in which they function.
- Boulder and Larimer Counties are now working on building a culture of connectedness and interdependence




Figure 8. Boulder floods: legal and cultural norms.

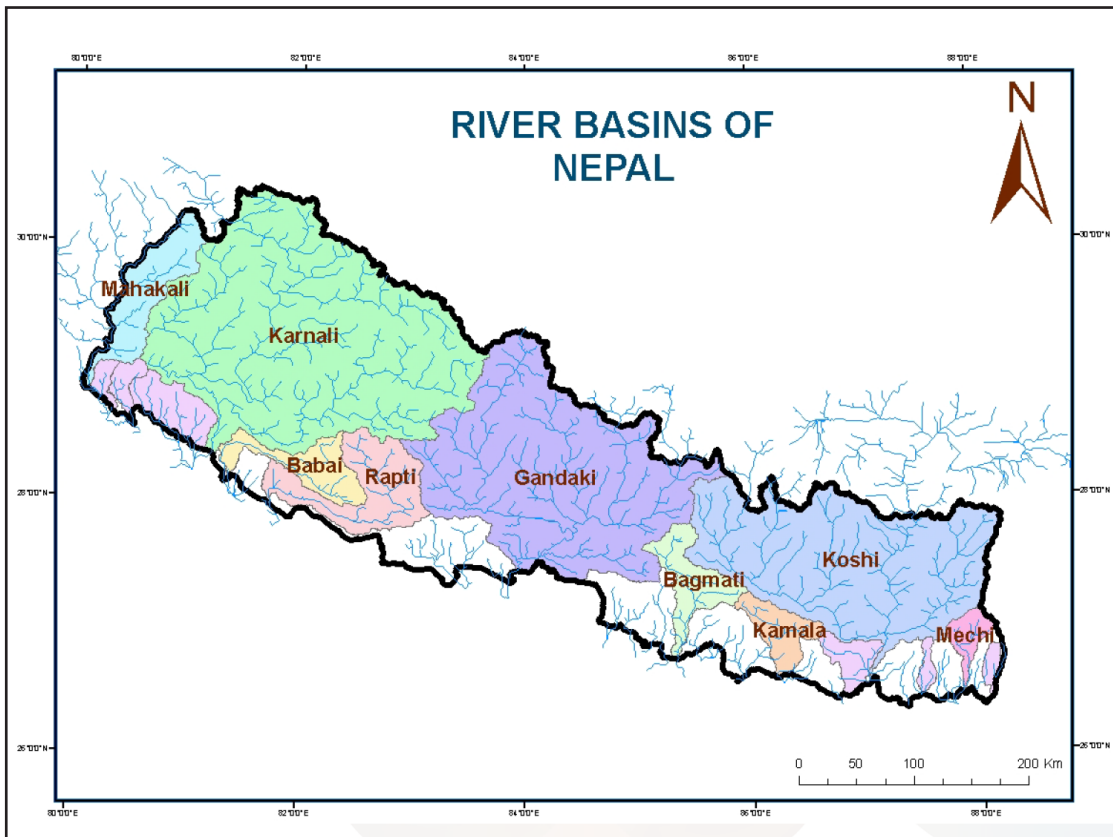


Figure 9. River basins of Nepal.



Figure 10. Karnali Basin in Western Nepal.

**In August 2014, three days of torrential monsoon rainfall led to widespread floods in the Karnali Basin in Western Nepal**

- Nearly 500 mm of rain in 24 hours
- Rivers rose rapidly in the middle of the night
- 222 people killed
- major impact on 120,000 others, damaging infrastructure and property and displacing households
- Perhaps a 1-in-1000 year event

Figure 11. August 2014 floods in Karnali Basin.

- Hazard-rich natural landscape
- Low disaster awareness, preparedness and management
- Lack of mechanisms and capacities to deal with disaster
- Rapid population growth, improper land-use, slow economic development, deforestation, poor building practices, and encroachment into floodplains

Figure 12. Karnali floods: socio-political landscapes of the Tarai.

**Infrastructure:**

- Embankments failed, creating new risks — floodwaters came from unexpected directions.
  - Rivers carry a huge sediment load and river beds are aggrading at ~10 cm/year
  - Rainfall intensities are increasing
- Embankments were also safe refuges for people living along the river (but you could build a lot of safe-houses for the price of one embankment)

Figure 13. Karnali floods: infrastructure.

**Legal and cultural norms:**

- Flood response was hierarchical and politicized, causing delays.
  - Good communication, previously established relationships, and clear protocols and policies that are followed and enforced are critical aspects of resilience.
- Minority populations and landless were marginalized
- Individual and households have been left to enact their own recovery with little support

Figure 14. Karnali floods: legal and cultural norms.

**Karnali Floods**

**People and organizations:**

- An early warning system – based on cell phone communication between the gauge reader and communities downstream – saved lives.
- NGO supported and trained Community Disaster Management Committees were instrumental in responding to community needs amid the chaos and confusion of external response

Figure 15. Karnali floods: disaster response.

- Flood resilience, and disaster resilience in general, is not only about resource and economic capacity.
- Although developed nations have higher capacities than developing nations, both have similar gaps in their resilience.
- Cultural blinders at all levels can limit our preparedness, leave us vulnerable, limit our response, and hobble our recovery

Figure 16. Lessons learned.



Figure 17. Hoover Dam.



Figure 18. St. Francis Dam collapse.



Figure 19. 2010 Indus river flood in Pakistan.



Figure 20. 2010 Indus river flood on Pakistan (cont.).

- Both these floods were beyond anything planned for – and this is increasingly going to be our reality
- Looking backward isn't enough – and, it can limit our imaginations as to what future disasters might bring.
- Using a resilience lens we can pose questions that will help respond to conditions we cannot yet imagine.

Figure 21. Take-home message.

- Community is the fabric that enables us to respond. Strong networks can prevent events from escalating to disasters.
  - Rugged, individual culture may be the US norm, but we need to color outside those lines.
  - New Mexico has this in place, around shortage sharing, around water governance
  - Your challenge now is to model this for the rest of the US.

Figure 22. What does it mean for us coloring outside the lines?