Adaptation to Climate Change:

A Prospective Collaboration

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A AMONG THE *many contributions from the University of Texas at Austin to Latin America, collaborative research on climate change adaptation is an area of study ready for expansion. UT has expertise in human-environment relationship, environmental engineering, and regional planning that could respond to this growing field. In this article, students from the Fulbright-sponsored course Energy and Climate Change taught by Prof. Oswaldo Lucon (see article p. 22) explore climate adaptation in the two regions and UT's role as a catalyst for South-South and North-South provision of adaptation techniques.*

Despite continuing global debates over both the effects of greenhouse gases and mitigation of their effects, the risk is high that climate change will occur despite any response. Consequently, solutions will require both mitigating future damage and adapting to inevitable changes. Climate adaptation—finding ways to live with the consequences of global warming—will become increasingly important. Warmer average temperatures mean more energy in the atmospheric system, leading to more extreme and frequent weather events, increased effects of natural disasters, and changes to rainy seasons (IPCC 2007). Societies in both the developed and the developing world are not yet prepared to respond to these changes and have much to learn from each other.

in Flood Control

Yanamito water retention structure to store water during wet seasons for use in dry seasons.

Vulnerability to climate change is a function of exposure to climate conditions, sensitivity to those conditions, and the capacity to adapt to the changes (USAID 2007). The world's poor are often considered most vulnerable to these impacts. Most economic activities in the developing world are sensitive to climate, and infrastructure used to regulate environmental extremes is not well developed. While developing nations may face challenges that developed countries are better equipped to handle, there is much to learn from nations that have dealt with harsh environments since long before concerns over anthropogenic climate change. On the same note, the developed world has a responsibility to share adaptation techniques with developing countries. Thus, bidirectional collaboration and technology transfer could benefit both developed and developing countries. Institutions like the University of Texas at Austin can serve as catalysts by studying and developing climate adaptation techniques transferable to nations of both the developing and developed worlds.

Climate Adaptation in Texas

Implementing flood control mechanisms without compromising livability has been a major success in Texas. Developing linear parks along rivers and streams has helped avoid risky development in floodplains while increasing value in communities. Cutting through urban areas along waterways, linear parks act as corridors connecting formerly undeveloped areas within a fragmented urban environment and provide great natural amenity within densely populated cities. Exemplifying this idea in Austin, the Lady Bird Lake hike and bike trail has transformed the lake's once barren floodplains into a beautiful recreational area for outdoor enthusiasts, leading to development and higher quality of life for Austin's urban core. In Dallas, the Trinity River Corridor Project began in 1998 to extend the city's flood protection through a complex network of levees, wetlands, downtown lakes, recreational parks, hike and bike trails, and equestrian centers. Once completed, this project is anticipated to be among the United States' largest urban parks (TRCP 2011).

The San Antonio River Walk, along the banks of the San Antonio River, is one of the most famous of Texas's linear parks and currently the number one tourist destination in Texas ("The Official Website of the San Antonio River Walk" 2011). Although the River Walk is home to many of the city's most popular bars, restaurants, shops, museums, and cultural centers, its dams and floodgates also provide critical flood protection to the city above. The concept of the River Walk began in the 1920s in response to a decade of devastating floods. However, recently variable water flow had made the River Walk unsustainable. Beginning in 2000, recycled water from the city's water treatment and reuse system replaced the Edwards Aquifer as the main water source of the River Walk in efforts to slow the aquifer's depletion and to provide constant flow for the attraction. A valuable resource, the aquifer provides 99% of the city's municipal supply (Glennon 2002). Other recent environmental initiatives aim to protect indigenous and remove invasive species, and to improve the hydrology of the river to ensure adequate water flow, enhanced water quality, and reduced flood risk (SWA 2001).

Austin, located in the Central Texas "Flash Flood Alley," is prone to flooding events due to frequent and intense storms. Flood policies are determined in Austin through detailed studies by the Federal Emergency Management Agency (FEMA), which runs the National Flood Insurance Program. NFIP's studies result in delineation of 100-year and 500-year floodplains, which represent a 1% and 0.5%, respectively, chance of flooding in any year. Compounded, however, this represents different risk. For example, in a 30-year period, a property within the 100-year floodplain has a 26% chance of being flooded sometime in the period. Cities like Austin have regulations that prevent building within 100-year floodplain as a way to live with the natural process of flooding. Central Texas streams normally flow sparsely, but during heavy rain events they quickly flood, putting lives and property at risk. Flood control structures can temper this risk and modify the floodplain to make otherwise unsuitable areas available for development.

The Waller Creek Tunnel project under way in downtown Austin is attempting to mitigate flood risk while building amenity in the city center. Like other Austin streams, Waller Creek frequently overflows its banks. Its location along the eastern edge of downtown prevents adjoining land from being developed because of flood hazards. Current flood policy and hazards limit development along Waller Creek; according to the City of Austin, if flooding hazards were controlled, an additional 11 percent of downtown would become available for development. The City of Austin is pursuing a flood control project that will control water by diverting flows underground. The floodwater will bypass creeks and flow through a tunnel system directly into Lady Bird Lake. This flood control system will modify the floodplain both to reduce the flood hazards and increase land available for development.

Texas linear parks present examples of adaptation techniques that can serve as models of floodplain management applicable to urban areas worldwide. Other examples of environmental management and monitoring can serve as models as well. One often taken for granted in Texas is weather monitoring from the National Weather Service (NWS). Providing the public with warnings and watches helps keep people prepared for severe and inclement weather. Sophisticated monitoring helps build data-sets that improve the accuracy of floodplain mapping. Monitoring technologies like Doppler radar, satellite imagery, and weather gauges enhance weather alert systems as well. In an age of uncertainties, these systems and the people at the NWS are a great asset in coping with climate change.

Climate Challenges for Latin America

Latin American climate challenges and responses provide opportunities for study of climate change adaptation. This section provides a look at UT research in several areas of this region, and exhibits how multiple disciplines are researching and addressing climate adaptation. Interaction between UT and Latin American universities through information exchange, technology transfer, and capacity building could expand this research to other regions of Latin America, benefiting both UT and Latin American universities.

The Andean glaciers provide natural buffers in Latin American ecosystems. Glaciers in Ecuador, Peru, and Bolivia have all been observed to be rapidly shrinking. Considering IPCC climate change scenarios, these glaciers are expected to continue retreating in the coming century (Vuille 2008). Daene McKinney, Professor of Civil Engineering at the UT Center for Research in Water Resources, studies how structural systems can be installed to reduce the urban flooding impact of variable runoff resulting from glacier loss and melt. According to McKinney's and students' models, the main impact of glacier melt is lower water flows during the dry season and unpredictable flows in general. With glacier loss, the smoothed water flow of slowly melting ice also will be lost. Andean region hydrology instead would be regulated by rainstorm events and precipitation. In the Rio Santa Basin of Peru, this forces rural populations into situations where they must adapt. Here, the UT Chapter of Engineers Without Borders (EWB) is installing water retention structures to store water during wet seasons for use in dry seasons. These small-scale projects can be replicated throughout this and other glacial regions to provide reliable water supplies to rural populations. While technological solutions play a large role, understanding beliefs of societies affected by climate change facilitates removing social barriers to adoption. The EWB project consulted UT professors who specialize in the region to learn how to integrate this system effectively into the society it benefits.

Kenneth Young, Professor of Geography at UT Austin, studies different scales of climate adaptation in Latin America: household, community, regional, national, and multinational. Professor Young's research has highlighted the differences between adaptation strategies of rural mountain communities and those of mega-cities like Lima. People living in smaller communities in Peru, and more generally across Latin America, tend to be well-adapted to climate variability, regularly living with flood hazards, droughts, and other climatic variation. To reduce impacts, they plant diverse crops—including over 80 varieties of potato—across various parcels at different elevations to hedge against crop failures due to drought, flood, and insect infestation. Developed over generations, indigenous techniques are threatened by imported practices. Understanding and documenting indigenous methods is vital, not only for scholarship but for knowledge and methodology transfer. Exemplary functional Andean technologies can benefit rural areas in the developing and developed worlds. UT can position itself as a catalyst for technology transfer by studying these systems and reframing the discourse on methods that could be innovative adaptation strategies in other parts of the world.

While flooding is a major problem in Latin America, adaptation to it provides benefits. Through fieldwork, Mario Cardoza, PhD candidate in the Department of Geography and the Environment, has observed indigenous population adaptation regimes for flooding, using methods both to sustain their livelihoods and profit economically. The Iquitos farmers of the Peruvian Amazon adapt to flooding by planting their crops based on flooding patterns: faster growing crops are planted in areas lower in flood plains, and longer developing crops in upper areas. Cardoza notes that with sediment and nutrients delivered by alluvial deposits, floodplains are the most fertile lands in this region with predominantly poor soils. Providing lessons in adaptation, the Iquitos' practices exemplify indigenous methods learned from and adapted to harsh environments.

On a regional scale, climate adaptation is difficult in Latin America, where rapid urbanization occurs, and economies are closely linked to climate-sensitive resources. Latin America has the highest urbanization rate of the entire developing world. At the same time, rainfall in some areas of the region accumulates at a volume equal annually to that of Hurricane Katrina. This has an immense impact on dense urban areas, with flooding killing thousands yearly. Increased severity of urban and rural flooding is expected with climate change, as natural buffers—such as glaciers—that exist slowly disappear, while land-use and land-cover changes increase runoff.

Throughout Latin America from Mexico to Argentina, megacities flood every year due to a combination of impervious ground cover, largely brought from Spain and Portugal, and the high volumes of rain. Climate change models predict longer droughts and stronger rains. UT School of Architecture professor Fernando Lara is researching ways to adapt architectural response to rainfall levels greater then 40 inches per year. Professor Lara is a founder of Studio Toró, a nonprofit group focused primarily on the threat of flooding. He explores how the urban environment can be built to adapt to the hazards of flooding. Through his experience in Latin America he sees parallels to Austin, which, as it continues to grow and densify, must plan for the possibility of more extreme droughts and flooding as the impacts of climate change are realized. Urban areas in Latin America could serve as a model for living with hazards if solutions can be developed in the region and shared in North-South technology transfers.

Conclusions

Climate-change adaptation is about more than learning how to live in harsh environments. It also is about modifying our systems both quickly to handle rapid change, and successfully for the types of changes that will come. People have lived and thrived in widely different environments of the world, so adaptation knowledge exists. Studying and sharing this knowledge across boundaries will help all nations face the uncertainty of climate change.

Acknowledgments

The authors would like to thank the experts at UT who were consulted for this article, including: Troy Kimmel, Daene McKinney, Kenneth Young, Mario Cardoza, and Fernado Lara. Also they would like to thank their professor, Oswaldo Lucon, for guidance and support.

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