Disaster Risk Management in an Age of Climate Change: A Summary of the April 3, 2008 Workshop of the Disasters Roundtable

DETAILS

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AUTHORS

William A. Anderson; National Research Council

Disaster Risk Management in an Age of Climate Change

A Summary of the April 3, 2008 Workshop of the Disasters Roundtable

By William A. Anderson

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FOREWORD

The Disasters Roundtable (DR) seeks to facilitate and enhance communication and the exchange of ideas among scientists, practitioners, and policymakers concerned with urgent and important issues related to natural, technological, and other disasters. Roundtable workshops are held three times a year in Washington, D.C. Each workshop is an open forum focused on a specific topic or issue selected by the DR steering committee. For upcoming meetings, please visit http://www.nationalacademies.org/disasters.

The DR steering committee is composed of seven appointed members and sponsoring ex-officio members. The appointed members at the time of the workshop were William H. Hooke, chair, American Meteorological Society; Ronald T. Eguchi, ImageCat, Inc; John R. Harrald, The George Washington University; Juan M. Ortiz, Tarrant County Office of Emergency Management; Monica Schoch-Spana, University of Pittsburgh Medical Center; Deborah S. K. Thomas, University of Colorado at Denver; and Darlene Sparks Washington, American Red Cross. The ex-officio members were Stephen Ambrose, National Aeronautics and Space Administration; Frank Best, PB Alltech, Inc.; Lloyd Cluff, Pacific Gas & Electric; Timothy A. Cohn, U.S. Geological Survey; and Margaret Davidson and John Gaynor, National Oceanic and Atmospheric Administration. The DR staff included William A. Anderson, director, and Brianna R. Cash, senior program assistant.

This document presents the rapporteur's summary of the forum discussions and does not necessarily reflect the views of the Roundtable members or other participants. For more information on the Roundtable visit our website: http://dels.nas.edu/dr or contact us at the address below.

Disasters Roundtable
The National Academies
500 5th Street, NW
Washington, DC 20001
Phone: 202-334-2402
Fax: 202-334-3362

This summary has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published summary as sound as possible and to ensure that the summary meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this summary: James E. Beavers, University of Tennessee, and Ross B. Corotis, University of Colorado.

Responsibility for the final content of this summary rests entirely with the author and the institution.

Workshop Objective

In its report *Climate Change 2007* the Intergovernmental Panel on Climate Change (IPPC) noted that global change is likely to result in increased drought, intense tropical cyclone activity, heat waves, and floods in certain regions of the world, including parts of the United States, other developed countries, and developing nations. It further suggested that such developments would require policy makers and other stakeholders to give increased attention to managing new levels of risk posed by extreme events and their adverse impacts. The objective of this workshop was to consider disaster risk management challenges in the context of climate change. Knowledge derived from science and the experience of policy makers and practitioners informed the discussion.

William Hooke, chair of the Disasters Roundtable and director of the Atmospheric Policy Program at the American Meteorological Society, welcomed attendees to the workshop. He noted that the workshop brought together experts from both the climate change and disaster communities, and expressed his hope that this would lead to further interaction and collaboration between them in the future.

Session I: Global Vulnerabilities and Emerging Responses To Climate Change-Related Disaster Risks

New Challenges to Reducing Disaster Risks in the Context of Climate Change

Ian Burton, emeritus professor at the University of Toronto, began the session by paying tribute to his former mentor, the late geographer and flood hazard expert Gilbert White. Burton mentioned efforts by White's family, colleagues, and friends to erect a flood elevation marker at Boulder Creek in Colorado in honor of his work on flood hazards. He noted that White used to say that "Floods are acts of God, but flood losses are largely acts of man." However, Burton now wonders if this observation should be changed to "Floods are increasingly becoming acts of man." In his opinion, this would show we now understand that few things can be blamed on the external world, including disasters.

Burton indicated that like a few others at the workshop, he works in both the climate research and policy community and the hazards research and policy community and that these two communities define key concepts differently, at times resulting in a communication problem. In the language of the climate community, mitigation means controlling and reducing greenhouse gas emissions, while adaptation means reducing the impacts of climate change. The latter is almost synonymous with what the disaster community refers to as mitigation, creating a certain amount of confusion among scientists in the two communities, as well as in the media and public.

Burton sees climate change and certain disasters, such as floods and severe storms, as interrelated, with each producing problems on both a local and global scale. He therefore believes it is important to find ways in which the climate change and disaster communities can

be better integrated to work on a common agenda, as well as ways to mainstream climate and disaster risks into development investments, policies, and measures.

Burton noted that losses due to disasters continue to mount around the world, even while we obtain more scientific knowledge about disasters. He and Disasters Roundtable chair William Hooke are members of a planning group established under the International Council for Science (ICSU) to explore this issue. That planning group has recently developed the idea of a ten-year program called International Research on Disaster Risk which would become an international program similar to other ICSU activities. The focus of the program would be on improving the characterization of hazards, vulnerability, and risk; furthering the understanding of risk decision making; furthering loss reduction through sound knowledge-based actions; capacity building; and disaster case studies. Burton stated that this would have the goal of accelerating international cooperation, thereby helping to replace the tendency of each country attempting to deal with disaster loss problems independently.

Emerging Climate Change-Related Global Disaster Risk Management Initiatives

Henrike Brecht, program specialist at the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), began her presentation by pointing to the global trend in increased disasters caused by such agents as floods and windstorms. She noted, for example, that between 1980 and 2002, earthquakes killed 32,000 people in India, while during the same period only 143 died from such disasters in the U.S. Aside from casualties, developing countries are also more vulnerable to economic losses, as reflected, for example, in the greater percentage of **GDP** that is lost following disasters in poor countries. Brecht argued that the global trend in increased disaster losses can only be reversed if poverty reduction is addressed. Vulnerability is increasing especially among the poor because they have few options and are forced to live under conditions of high-risk, such as in floodplains and in unsafe homes.

Brecht noted that there are a number of actions that can be taken to reduce disaster vulnerability:

- Map and avoid high-risk zones
- Build hazard-resistant structures
- Protect and develop hazard buffers (forests, reefs, etc)
- Improve early warning and response systems, and
- Build institutions and development policies and plans to actively contribute to these goals.

Brecht pointed to a number of international initiatives that have evolved in the past 20 years to frame and further disaster reduction around the world. These have included the International Decade for Natural Disaster Reduction (IDNDR), which promoted global disaster reduction from 1990-1999 from its base at the UN; its successor the International Strategy for Disaster Reduction (ISDR), which was created in 2000; and the Hyogo Framework for Action, which was signed by 186 governments during the World Conference on Disaster Reduction in Kobe in 2005 and reflected issues growing out of the 2004 Indian Ocean tsunami disaster. The Global Facility for Disaster Reduction and Recovery was created after the Hyogo Framework for Action and is a joint partnership between the United Nations, ISDR, and the World Bank, where it is housed. The GFDRR supports ISDR in its global and regional efforts, and works on specific projects

related to such topics as risk assessment, community resilience, climate change, and post-disaster reconstruction and recovery.

In terms of the climate change agenda, the priority for the GFDRR is to further the integration of actions to reduce climate and disaster risks into development decisions at the World Bank and other stakeholder organizations. Brecht characterizes this as a risk-based approach to climate change adaptation which uses models to project climate change and disaster impacts. Technical assistance is provided client countries in order to make climate change and disaster risk a central issue in their development actions.

Emerging Plans and Initiatives for Latin America

Ciro Ugarte, regional advisor on emergency preparedness and disaster relief at the Pan American Health Organization (PAHO), began by observing that climate change is one of the areas that his organization, which serves as the regional office of the World Health Organization (WHO), underscores. He noted that the public health impacts of disasters can stem from such conditions as communicable diseases, population displacement and climate exposure, as well as problems with food and nutrition, water supply and sanitation, and damage to the health infrastructure. Both physical and mental health problems can emerge following disasters.

Ugarte indicated that while much more research needs to be done, modeling and other types of analyses, including those carried out by the IPCC, project serious health risks resulting from increased weather and temperature extremes caused by climate change. These could stem from water and food-borne diseases, vector-borne and rodent-borne diseases, the effects of food and water shortages, and the impacts of such disasters as storms and heat waves. What makes this outlook so troubling is that countries throughout the world are not even well prepared for dealing with public health issues now, especially in poor countries. Critically important in the future, particularly in poor countries, will be factors that shape the health of populations, such as education, health care, public health initiatives, and infrastructure and economic development.

PAHO has put climate change high on its agenda, especially in connection with poor countries, according to Ugarte. The organization is conducting vulnerability assessments of climate-related health risks in several countries in the Americas and producing reports describing health risks. Such public health risk reduction efforts are being integrated with other public health initiatives undertaken by PAHO. A forthcoming meeting will be held in Brazil on April 9-11, 2008 to develop a plan of action on climate change and health for the Americas. It has been PAHO's understanding, gained from experience visiting countries to provide technical assistance, that local solutions are sometimes already being developed by stakeholders. These will be incorporated into the plan of action.

The open discussion following the presentations touched upon such subjects as important research topics for advancing knowledge on reducing the risks from climate change, the involvement of the private sector in climate change and disaster risk reduction, and the role of the military. While climate adaptation and epidemiological studies were mentioned as key areas for future research, participants also noted that stakeholders need to be encouraged to apply the knowledge that has already been generated by the research community. In addition,

participants observed that the private sector is increasingly involved in addressing climate change issues, while the military's role has primarily involved disaster relief.

Session II: Some U.S. Vulnerabilities and Responses to Climate Change-Related Disaster Risks

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The Nation: Public Health Risks of Disasters in the Context of Climate Change

George Luber, acting associate director for global change, National Center for Environmental Health, Centers for Disease Control and Prevention (CDC**)**, noted that climate change is a public health issue, but that the public health community is rather late in considering climate change and is largely unprepared from a national perspective to deal with the consequences of this risk.

Like the previous speaker, Luber indicated that climate change is expected to have a wide variety of effects on health in the U.S. and globally, from the direct effects of increased heat, which can manifest as heat-related illness and cardiovascular disease, to the direct effects of severe weather. He also noted the effects on air pollution from increased temperatures exacerbating both the ground level ozone and particulate matter; changes in disease ecology, including changes in vector-borne diseases and waterborne diseases; as well as vulnerabilities to the country's food supply. But in addition to these effects of ecosystem change, we also have to be cognizant of the tertiary effects of population dislocation on top of the more subtle effects of anxiety and despair from confronting a seemingly insurmountable challenge that climate change brings, according to Luber.

Luber noted that there will be significant regional variation in these outcomes. The areas that currently experience vector-borne diseases might experience more such outbreaks, and new areas might be impacted as well. In addition, the effects of climate change will be disproportionally borne by those least able to prepare for it, and least able to adapt to it. Thus there will be significant demographic variation in risk exposure, which will need to be considered when developing public health approaches to reduce vulnerabilities, according to Luber.

Luber indicated that there are important reasons why disasters are such vexing problems for public health. Because they are sporadic, it is difficult to maintain public concern before they occur. Also, unexpected numbers of deaths and injuries can often overwhelm available resources, taxing even the best-prepared systems, including local health infrastructure and emergency response capacity.

Luber observed that the CDC has three priority areas in its response to the public health needs of a community following disaster: rapid assessments to determine health needs; surveillance to determine what conditions victims are suffering from most; and epidemiologic studies which can serve as a basis for making preparedness decisions. Luber indicated that these cornerstone activities will become even more important as climate change increases the frequency of certain types of disasters. Such might be the case with heat waves, for example, which cause more deaths than hurricanes, lightning, tornadoes, floods, and earthquakes combined, although this generally goes unrecognized (Klinenberg 2002). This challenge is made even more daunting by

the greater exposure to heat in urban areas, where people around the world are increasingly living. The elderly are particularly vulnerable in such locales. Luber noted that CDC is partnering with such agencies as NOAA and FEMA in developing guidelines to prepare for extreme heat episodes in cities, which include information on the fundamental elements of a heat response plan, which agencies should be involved, and which vulnerable groups to reach out to.

New York City: The Hurricane Threat

Klaus Jacob, special research scientist at the Lamont-Doherty Earth Observatory, Columbia University, focused his remarks on climate change as it relates to the New York City metropolitan region. He noted that northeastern states contribute considerably to global carbon dioxide emissions. The emerging climate change risks for New York City include warmer temperatures, for example increased frequency in 90 degree F days, and more precipitation. According to Jacob, the former means more air conditioners and more energy consumption.

Jacob indicated that the potential impact of climate change on the infrastructure in New York City is a crucial issue, especially in relation to expected sea level rise in combination with extreme storm events. Putting this in a comparative perspective, Jacob further noted that what he is saying about metropolitan New York City also applies to Taipei, Tokyo, Shanghai and similar coastal cities where significant assets are increasingly put in harm's way. A large sewage treatment plant in the Bronx, which became dysfunctional after a huge storm in 2001, demonstrates this vulnerability. Nor'easter storms drive a surge into New York harbor and the water treatment plants cannot discharge their sewage. As major precipitation events increase, so will this problem.

Jacob noted the high frequency and severity of hurricanes that have struck the New York City metropolitan area between 1888 and 1998. With climate change such storms are projected to increase in severity. He indicated that using the FEMA HAZUS program to model a Saffir-Simpson scale category 3 storm with maximum effect on New York City results in estimated losses of $350 billion in wind related damages to buildings, 1.8 million displaced households, and a total of 3 million evacuees, not taking into account the impacts on the New Jersey side.

Jacob observed that there are two approaches to reducing the risk to New York City: mitigation and adaptation. Mitigation in climate change terminology involves reducing global warming. Adaptation on the other hand, involves making decisions that will reduce the impacts of climate change, including designing more disaster resilient buildings and infrastructure systems, effective land use planning and zoning to keep people and assets out of harm's way, and preparedness planning for such actions as early warning and evacuation. Jacob noted that the mix of options for both mitigation and adaptation can be extremely expensive and require significant rethinking about priorities by the government, the private sector and other stakeholders as well as significant political will on their part. However, the consequences for not taking climate change seriously will be great, according to Jacob.

Ending on a more positive note, Jacob suggested that New York City is becoming more aware of the climate change challenge, especially in terms of adaptation aspects. He indicated that besides this new awareness, there are smart policies in the making; the mayor's plan was published last

year; and key agencies like the Metropolitan Transportation Authority and the Port Authority of New York and New Jersey are working on the problem. This effort will be very expensive, but it will have to be paid for if the challenge is to be met, according to Jacob.

During the discussion following the session presentations, a participant pointed out that it is not yet clear how climate change might lead to a reduction in cold weather related deaths. It was also noted by one of the participants that communicating climate change risks to the public should be done in such a way as to motivate vulnerable people to take protective actions rather than making them so fearful that they think there is nothing they can do to protect themselves. Another point raised by participants was that for planning purposes, such as to make decisions about infrastructure facilities, it is important to conduct probability analyses of extreme events occurring at different time frames, such as 50- year, 100-year, and 500-year events.

California: Planning to Meet Increased Threats

Michael R. Boswell, associate professor, City and Regional Planning Department, California Polytechnic State University, noted that he and colleagues at the university, including Kenneth Topping, were hired by the state of California to help improve its hazard mitigation planning. He began his joint presentation with Topping by outlining California's hazard profile. The primary hazards identified in the state mitigation plan are earthquakes, wildfires, and floods; secondary hazards are levee failures, landslides and tsunami; and climate-related hazards include avalanches, coastal flooding, erosion, sea level rise, drought, extreme heat, freezes, and severe weather and storms. Since Katrina and the failure of levees in New Orleans, the levee risk in California has become much more salient to decision makers and the public. A $4.09 billion bond measure was passed in 2006 to address the levee threat in California, which could produce a catastrophic levee failure much greater than what followed Katrina in New Orleans, in part because of a possible lack of warning from an earthquake-triggered collapse.

Drawing on the work of the California Climate Change Center**,** Boswell discussed the climate change risk to California. While noting that low, moderate, and high release greenhouse emissions scenarios were possible, he focused on the low emissions scenario. With the low emissions scenario, it is projected that the sea level in California would rise 6-14 inches, putting important California communities in danger of increased coastal flooding and cliff erosion, according to Boswell. He also noted that, perhaps more importantly, this will put increased pressure on the Bay delta levee system, which is on the east side of the San Francisco Bay, in terms of its ability to hold, manage, and direct water. Another big concern is that climate change will result in a more rapid snow melt, putting additional pressure on the levees.

A second important impact using the low emission scenario is increased wildfire incidence. With this scenario, a 10-35 percent increase in the risk of large wildfires is expected. Boswell further noted that not only is an increase in wildfire intensity likely, but a redistribution of the spatial impacts of wildfires as well. In such a situation, northern California, which has had little experience with wildfires, would be at a greater risk along with southern California.

Drought and heat emergencies are also expected to become a growing problem. This will result in more heat-related deaths and put stress on California's economy because of negative impacts on food production, according to Boswell.

Boswell discussed local hazard mitigation planning in California related to the federal government's Disaster Mitigation Act of 2000 (DMA 2000). Although the program is voluntary, the DMA requires local governments to develop and submit local hazard mitigation plans (LHMPs) for FEMA approval in order to be eligible to receive grants from the Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program grants. The requirements of the planning program include the following tasks:

- Identify hazards
- Profile hazards
- Assess vulnerability
- Develop local hazard mitigation goals
- Identify and analyze mitigation actions
- Implement mitigation actions
- Monitor, evaluate, and update plans

Boswell, Topping, and colleague William Siembieda carried out a study of 534 LHMPs in California. As of the summer of 2007, 241 cities and 30 counties had participated in the voluntary program, which covers about 71 percent of the state. The most commonly identified hazards in the local plans were earthquakes, wildfire, and flood, with none of the jurisdictions identifying climate change as a hazard to be taken into account in their planning efforts. Also, most of the plans were not linked with either state or federal plans. Additionally, the study showed that most of the jurisdictions were resource constrained, not knowing, for example, where they would get funds to pursue the indicated mitigation measures.

Boswell turned the second part of the presentation over to his colleague, Kenneth Topping, who is a lecturer in the Department of City and Regional Planning, California Polytechnic State University, and was project director at the university for the state of the *2007 State of California Multi-Hazard Mitigation Plan*. Whereas Boswell discussed local planning under DMA 2000, Topping discussed the state of California's planning under the program. The team from CPSU was hired as consultants to assist the state in its planning efforts, which involved working with the California Governor's Office of Emergency Services.

Topping noted that disasters are increasing because of such factors as population growth, especially in cities, poor planning, and climate change. Disasters damage or destroy resources, but recent research by the Multihazard Mitigation Council indicates that investment in mitigation pays off**,** demonstrating the importance of both local and state planning.

In working with the state to enhance its mitigation plan, the CPSU team reviewed the disaster history of California from 1950-2007, learning that:

- Over 400 declared disasters have occurred since 1950

- Wildfires are the most frequent type of disaster, accounting for the third largest combined losses (deaths, injuries, and costs)
- Floods are the second most frequent disaster, and the deadliest in terms of lives lost
- Earthquakes are the least frequent, but have the greatest combined losses and greatest catastrophic potential

Topping suggested that California is the first state to include climate change in its hazard mitigation plan. According to Topping, California is important in demonstrating such leadership because it is the most populous state, has the third largest land area, and has the most diverse population. It is also complex governmentally, with nearly 500 cities, 58 counties, and over 100 tribal governments. Additionally, if it were a separate country it would have the seventh largest GDP.

Topping noted that not only has California put climate change on the agenda in its planning under DMA 2000, it has also exhibited leadership in setting up mechanisms for reducing greenhouse gases, and for this he gives Governor Arnold Schwarzenegger a great deal of credit. He noted that in 2005, for example, the governor signed executive order **S-03-05,** which established the following greenhouse gas emissions reduction targets for the state:

- By 2010, reduce to 2000 emission levels
- By 2020, reduce to 1990 emission levels
- By 2050, reduce to 80 percent below 1990 level

Also after passage by the state legislature in 2006, the governor signed the California Global Warming Solutions Act, Assembly Bill 32, which provides a comprehensive program to achieve quantifiable, cost-effective greenhouse gas reductions on a scheduled basis, with mandatory caps beginning in 2012 for significant sources.

Topping suggested that real progress can be made in the state to combat future hazard and climate risks if local jurisdictions and the state can begin to integrate their planning efforts while reaching out to regional stakeholders as well.

Florida: Disaster Vulnerabilities Related to Climate Change

Stephen P. Leatherman, professor and director of the International Hurricane Research Center, began by noting that due to its geography two of the major issues in Florida are hurricanes and sea level rise. These threats are further increased because the population is rapidly growing, which is also accompanied by major development, especially along Florida's coastline, placing more people and resources at risk. For example, according to Leatherman high rise development is now stretching from Miami to Palm Beach, with Miami dubbed "crane city" because of all the building that is occurring, even in the face of climate change and hurricane risks.

Leatherman noted that Florida is the state most vulnerable to sea level rise. Within the state, Miami-Dade is taking climate change and its possible consequences such as sea level rise more seriously these days. Leatherman gives a lot of credit for this to the influence of Harvey Rubin**.** Rubin is the Miami-Dade clerk of courts who has become a champion for preparing for climate

change, chairing a committee which is taking the lead on such matters as encouraging the collection of data on projected sea level rise on which sound decision making can be based. Researchers and other experts in Florida have been mapping barrier islands and other landscapes using remote sensing and other technologies**,** carrying out storm surge mapping, and preparing sea level rise scenarios in order to educate policy makers and the public regarding community vulnerabilities.

Turning to the hurricane threat, Leatherman noted that most meteorologists do not expect climate change to produce more hurricanes in Florida; the big debate is about their intensity. He feels that a real danger is that future hurricanes could be more devastating if they produce storm surges in areas where sea levels have already risen. There is already a problem of how to communicate the threat of storm surges to exposed residents, such as those living in the Florida Keys, who too frequently ignore warnings because they do not understand the information that is provided by officials. Leatherman also argued for the need for new surge models that provide more refined predictions.

During the discussion period, participants expressed the view that perhaps more attention needs to be given to the possibility that climate change will increase the risk of landslides. Recovery planning was also brought up by a member of the audience, and it was noted that the state of California is likely to give more attention to this in future planning efforts. It was further suggested by a participant that local jurisdictions in California will be giving more attention to climate change issues in the future due to encouragement from state officials.

Session III: Urban Design, Insurance, and Floodplain Adaptation to Climate Change-Related Disaster Risks

Urban Design and Disaster Risk Management: A Perspective on Smart Growth and New Urbanism in the Context of Climate Change

Philip P. Berke, professor of city and regional planning at the University of North Carolina, Chapel Hill, addressed the issue of how population and settlement trends are associated with environmental risks. According to Berke, the U.S. is growing at a rate only surpassed by India and is expected to reach 400 million in the next 35 years. The distribution of this growing population becomes an important issue. The U.S. has a sprawling society, according to Berke, where development, including housing and commerce, have been at low density, resulting in the consumption of a significant amount of space. This has resulted in strip malls, huge shopping centers and big parking lots, along with long commutes, traffic congestion, and air pollution.

Berke noted, however, that a new vision of development has emerged to challenge the dominant low density pattern. Called new urbanism, this emerging movement has been translated into a policy framework named smart growth, which has received a great deal of attention in the state of Maryland. New urbanism advocates envision what they consider to be a positive contrast to low density sprawl and conventional suburban development. New urbanism involves a compact urban form that is characterized by mixed land use, interconnected street patterns, and homes that are built on narrower streets, smaller lots, and with porches, driveways and sidewalks on

both sides of the street. This new urban pattern is seen as reducing auto dependency because residents have greater access to a range of land uses activities (neighborhood-oriented commercial services, places of employment, and mass transit). Other advantages include less emission of greenhouse gases because of reduced driving and reduced costs for such infrastructure as roads and utilities. New urbanism advocates, including the Congress of New Urbanism, also see community cohesion and a sense of place as an outgrowth of this urban form. However, despite these potential benefits, new urban developments have been woefully ineffective in giving sufficient attention to natural hazards risks, according to Berke.

There is a growing market for the new urbanism approach, according to Berke. In 2003, there were 640 of these projects, which tend to be big, in the U.S. and the latest count showed over 1100, with 3 million people. This is a small percentage of the current U.S. population, but it is rapidly increasing. The largest numbers are found in states in the southeast and west, where the urban village concept is attractive because of the great need to reduce the negative impacts of sprawl.

New urbanism development projects are going into high risks locations around the country, including flood prone areas. Berke and a group of colleagues designed a study to determine if such projects performed better with regard to hazard mitigation than the conventional sprawl development. The study involved comparing new urbanism and conventional development projects in flood hazardous areas across the country having similar characteristics, such as age, size, and number of dwelling units. They found that there was no significant difference between new urbanism and conventional projects when it came to such demonstrably effective mitigation measures as flood plain avoidance and the protection of critical environmental areas like wetlands. According to Berke, this finding raises serious concern since new urban developments have considerably higher densities than conventional low-density suburban sprawl projects, and are increasingly being located in hazardous locations in the country. Berke therefore noted that model codes promulgated by new urbanists and local government land use and development requirements and incentives need to give more attention to integrating mitigation practices into new urban developments to reverse the trend of placing an increasing number of high-density new urban projects in hazardous locations.

Furthering Adaptation through Insurance

Clive Q. Goodwin, assistant vice president, FM Global (www.fmglobal.com), began his presentation with comments about his company, one of the world's largest industrial and commercial insurers. Their client base comprises approximately 40 percent of Fortune 1000 companies and includes health care, utilities and state entities. Goodwin noted that the company is comprised of about 1500 engineers worldwide and has an $85 million research campus, largest in the world, where large-scale testing is conducted to replicate fires, explosions, wind, and other risks for the purpose of developing guidelines to help clients reduce their property risks. Company scientists and engineers assess and work to develop solutions that prevent losses, reduce clients' risks and lessen reliance on insurance. According to Goodwin, FM Global's perspective is that most losses are preventable, noting that Gulf Coast clients who took their advice before Hurricane Katrina struck suffered eight times less loss than those who have yet to implement the company's engineering recommendations. He estimates that their clients saved $450-$460 million by taking actions on advice they had been given prior to the event.

In looking at the insurance industry as a whole, Goodwin noted that most insurers take an **actuarial** approach to underwriting, which involves evaluating the long-term financial implications of risk decisions using historic losses and financial information. FM Global, in contrast, takes an engineering approach based on their knowledge of insured locations and risk assessments and loss prevention activities.

Goodwin noted that one of the biggest problems facing the nation is that people are not sufficiently aware of their exposure to particular hazards. Such is the case, for example, of many communities in California that face catastrophic risks from possible levee failures and even residents who live in coastal communities threatened by major hurricanes. Thus Goodwin suggested that more effective ways of communicating risks need to be developed and utilized so that people and organizations make good choices and become better prepared to respond to them, which may include obtaining insurance coverage that can meet their needs.

A Perspective from the Association of State Floodplain Managers

Gerald E.Galloway, Glenn L. Martin Professor of Engineering at the University of Maryland, spoke on behalf of the Association of State Floodplain Managers (ASFPM). In his overview of ASFPM, Galloway indicated that its mission is to mitigate the losses, costs, and human suffering caused by flooding and to protect the natural and beneficial functions of floodplains. The growing association currently has 26 chapters located throughout the country that are involved in all aspects of floodplain management.

The task before the ASFPM and other stakeholders is formidable because the annual losses from flood damages have reached $6 billion annually, a four-fold increase from the early 1900s. According to Galloway, flood damages are going to increase unnecessarily for a number of reasons, including the fact that current policies promote settlement in high risk areas, ignore changing conditions, and undervalue natural floodplain functions.

Galloway stated that climate change will be an important factor in accelerating the cost of floods in the U.S. It is bringing increased flood risk – more highly variable weather, stronger storms, and sea level rise in many places in the U.S., according to Galloway. And the resilience of many ecosystems is likely to be exceeded. He also noted that the accumulated impacts of decades of wasteful land use and mining of water-related resources is tipping the balance against environmental equilibrium, reflected in the fact that billions of dollars are being spent to try and restore the everglades and coastal areas of Louisiana and Mississippi.

Galloway sees a number of other disturbing conditions in society that also do not bode well for floodplain management and other risk reduction approaches, including the fact that the nation is reaching the end of the design life for much of its infrastructure – roads, bridges, storm water systems, dams, and levees- and the lack of use of the available science and technology in policy decision making. He predicts that if business-as-usual prevails, in forty years or so flood losses throughout the country will be horrific, ecosystem degradation will worsen, and the quality of life will be diminished. On the other hand, the ASFPM has a vision of a different future, one which is characterized as follows:

- Land and water are treated as precious resources, so that the natural and beneficial functions of floodplains, wetlands, and coastal areas are protected
- There is a natural mitigation of flooding
- The market favors sustainable development, so that flood prone construction rarely occurs
- New development is designed and built to have no adverse impact on flood levels, sedimentation, erosion, riparian or coastal habitat, or other community designated values, and is responsive to climate change

The ASFPM is particularly advocating the concept of "no adverse impact" in actions undertaken related to floodplains because it reduces the likelihood that one's decisions are going to cause damage to others and the community. Galloway believes that the adoption of this concept into national policy, the identification and communication of risk, and the utilization of the nation's vast scientific knowledge about water could significantly improve floodplain management in the context of climate change.

In the discussion period following the panel presentations, some of the discussion centered around the involvement of the private sector in community hazard planning, the functions of the National Flood Insurance Program, and the responsibilities of various levels of government for hazard reduction. The importance of hazard disclosure to citizens so that they can make informed risk decisions was another topic discussed.

Following the discussion, William Hooke, chair of the Disasters Roundtable's committee, announced that the 23rd workshop will focus on the topic "Making the World Safer from Disasters: The U.S. Role" and is scheduled for October 2, 2008 at the National Academies. He then announced the adjournment of the 22nd workshop.

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