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Community Adaptation to Flooding in a Changing Climate: Municipal Officials' Actions, Decision-Making, and Barriers*

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What is the Issue?

Over the next century, climate change is predicted to expand the areas at risk for flooding in the U.S. by 40-45%¹. In the past decade alone, numerous extreme weather events have led to devastating floods in New York State's (NYS) Hudson Valley, even in several areas that may not have experienced flooding before. Climate change is expected to increase the intensity and frequency of flooding in this region, with the number of annual 2-inch (or more) precipitation events predicted to increase by 50% in the next century². Local government can play an important role in preparing their communities to reduce the negative impacts of floods. Due to the increasing threat of climate change-related flooding, the way in which communities prepare for and adapt to flood conditions is critical to understand.

The Importance of Local Governments for Flood Adaptation

Municipal officials face an extraordinary challenge in addressing these changing flood patterns. As NYS is a home rule state, many decisions that affect energy, infrastructure, and land use are made at the local level. Flood adaptation includes the steps that can be taken to reduce the impacts of future flooding. Examples of community flood adaptation include flood planning and zoning, relocation, or housing improvements that reduce vulnerability. Many communities have adopted energy policies, collaborated with neighboring municipalities on flood mitigation efforts, or joined national climate change initiatives. However, researchers still need to understand the barriers, actions, and motivations for municipal action to flood adaptation.

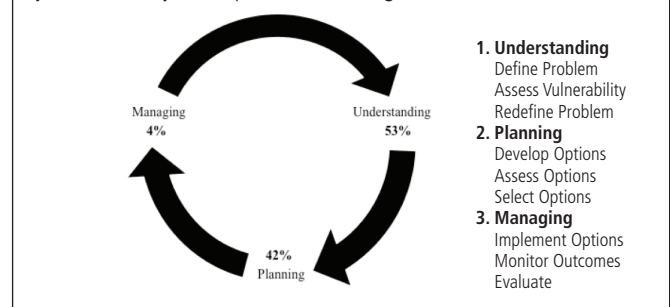
Research was conducted to determine how municipal officials in the Hudson Valley are addressing flooding, the barriers that they face in doing so, and what resources and information they may still need to advance flood adaptation in their communities. Researchers at Cornell University, Human Dimensions Research Unit (HDRU) and Cornell Cooperative Extension (CCE), interviewed 37 municipal officials (e.g., Town Supervisors, Highway Officials, County Emergency Management Personnel) in ten counties in the Hudson River Estuary. The interview questions were designed to determine if and how communities are adapting to flooding, what barriers to flood adaptation exist, and what informational resources municipal officials need in order to overcome such barriers.

Stages of the Flood Adaptation Process

To better understand when and why barriers exist for municipal officials addressing flooding, we employ a framework³ which outlines a cyclical decision-making process of adaptation: *understanding*,

planning, and *management* (Figure 1). Using such a framework helps organize and identify where in the adaptation process municipal officials encounter barriers. The framework can also help advance efforts to overcome those barriers and address flood adaptation more effectively. A qualitative analysis of the interview data revealed that the majority (53%) of quotes could be categorized within the *Understanding* stage. Less than half (42%) of the quotes were categorized within the *Planning* stage, while only 4% of were categorized in *Managing* stage (Figure 1). The results of this categorization scheme raise the question about why these municipal officials are not further along in the adaptation process and what resources they may need to move their municipalities through the process more effectively.

Figure 1: Cycle of the flood adaptation process. Percentages represent the number of quotes categorized within each adaptation stage, made by Hudson Valley municipal officials during interviews.



How are Communities Addressing Changes in Flood Patterns?

Municipal officials in the Hudson Valley are taking action to protect their communities from flooding (Figure 2). Among the most utilized flood adaptation actions cited are emergency response, flood planning, dredging, and communication among and within municipalities. Unfortunately, not all these actions are effective in reducing flood risk. Dredging, for example, can actually increase flood damage. Some of the flooding problems we see today were caused by past disturbance of stream channels. Nearly one-third of municipal officials are adapting flood-damaged infrastructure (e.g., roads, culverts, and water treatment plants) to better withstand floods as opposed to simply maintaining the current infrastructure. For example, some municipalities are restricting development in floodplains, increasing culvert sizes, widening bridges, or protecting infrastructure by installing backup generators for sewer pumps and placing them

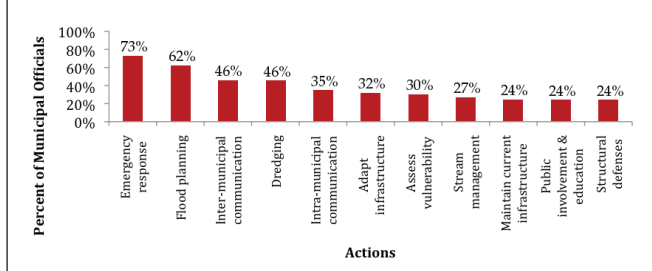
¹ FEMA. 2013. The impact of climate change and population growth on the National Flood Insurance Program through 2100. Prepared by AECOM.

² Rosenzweig, C., Solecki, W., DeGaetano, A., O'Grady, M., Hassol, S. and Grabhorn, P. (Eds.). 2011. Responding to climate change in New York State: the ClimAID integrated assessment for effective climate change adaptation. *Technical Report*. New York State Energy Research and Development Authority (NYSERDA), Albany, New York.

³Moser, S.C. and Ekstrom, J.A. 2010. A framework to diagnose barriers to climate change adaptation. *PNAS*. 107(51): 22026-22031.

above flood level. However, less than a third of municipal officials report assessing community vulnerability or involving the public in flood adaptation efforts or education. Furthermore, less than a third of municipal officials report using stream management techniques, such as re-establishing natural channels or bank erosion control, or erecting effective structural defenses.

Figure 2: Actions taken towards flood adaptation, by Hudson Valley municipal officials



Inter-municipal cooperation was strongly related to emergency response, flood planning, and vulnerability assessment. Municipal officials taking action on emergency response are more likely to communicate with other municipalities, prioritize public safety, recognize which roads are most vulnerable during floods, and consider flood planning as a future option for flood adaptation. Municipal officials undertaking proactive flood planning are more likely to use structural defenses and stream management techniques to combat flooding, but also feel a lack of control over flooding, and identify stormwater runoff as a contributing cause of flooding.

“Part of our [flood] zoning allows wetlands to be considered as part of the open space. And always people react to that to say ‘you can’t do anything with wetlands’ but the point is, it gives them added protection and they act as what they were intended to be, which is an aquifer recharge and a storm water holding entity. So our zoning actually, I think, helps mitigate some of it.” – **Town Supervisor**

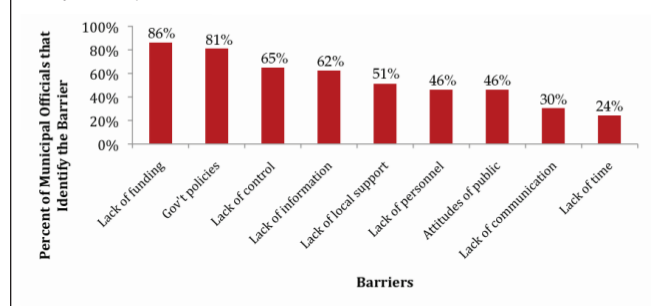
What are the Barriers to Flood Adaptation?

Most (86%) study participants identified lack of funding as a barrier to effective flood adaptation (Figure 3). Many participants (81%) felt that the state government hindered their ability to respond to flooding, with “red tape” paperwork as well as with restrictions on working in streams to remove debris (e.g., log jams or sediment). Sixty-five percent felt somewhat helpless to control the negative effects of “mother nature,” citing factors such as the weather, runoff, topography, or tidal fluctuations as out of their control. Over half (62%) of the municipal officials felt that a lack of information about local climate change or future flood conditions hindered flood adaptation efforts. Out-of-date or large-scale climate or flood data may not be applicable at the local level, yet it is often the only data that are available. Lack of flood planning was a barrier to only 11% of participants; one person did not identify any barriers to flood adaptation.

“Money. It all boils down to economics. We know what we should do. We don’t know that we can do it. Sometimes one has to rely on a Band-Aid of sorts.” - **Highway Superintendent**

“We’re part time folks who have a lot on our plate. For too long I think the storm planning side of the job was almost non-existent, and because the weather events have changed so significantly suddenly we’re [expected to be] experts in emergency management.” – **Town Supervisor**

Figure 3: Barriers faced in the flood adaptation process, by Hudson Valley municipal officials



What Additional Education or Information Resources do Municipal Officials Still Need?

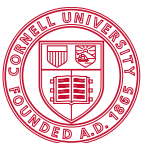
In the interviews, municipal officials were asked what education or information resources would help them to address flooding in the future. Local climate change and flooding was the most often identified issue about which municipal officials felt they needed additional information or educational resources. Other areas where participants felt they needed assistance were: forming partnerships; understanding government policies; and educating community members on flood-related issues. These results suggest a need for local, site-specific climate change and flood data, education, and partnership facilitation for municipal officials and community residents in the Hudson Valley.

“I think we need more information on the correlation between [weather] and flooding. And time frames. We don’t really have a sense of, other than just informal experience, what happens when rainfall rates are projected to be higher for the Town officials to plan a response.” - **Highway Supervisor**

Conclusions

While local governments are the first responders for flooding in small communities, many municipalities in New York State’s Hudson Valley are not adequately prepared for changing flood patterns. Although most municipal officials in this region have a reasonable understanding of the flood issues they are facing, our research underscores the need to provide them with additional information, support, and education as they deal with the complexity of decisions surrounding flood-related issues in their communities. For example, there is widespread awareness that flood patterns are changing, but little implementation of planning efforts. Many officials and their communities would benefit from support in moving *through* the planning stage and *into* the managing stage, where actual implementation of flood plans and policies can occur. While local actions might emphasize emergency response, flood planning, and dredging, the latter may actually increase flood risk. Municipal officials cited the issue of outdated or large-scale climate change models that do not help them plan for local flooding. This highlights the need for connecting officials with local climate change and flood models. In sum, our research supports the position that local flood adaptation efforts must receive higher priority for funding from the state and federal government in order for local municipal officials to have the resources they need to make informed decisions and plans to protect their communities.

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Cornell University

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