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Effectiveness of new york state level hazard mitigation plans

Abstract

New York State has engaged the expertise of local academic institutions to prioritize and rebuild New York with greater resiliency. The New York State Resiliency Institute for Storms and Emergencies (NYS RISE) was launched as a consortium that addresses the vulnerabilities of the built and natural environments to extreme weather. Led by New York University and Stony Brook University, NYS RISE acts as a hub for in-depth research, analysis and education on disaster preparedness. The basic research consists of approximately 30 projects. This research was one of the projects in which hazard mitigation plans (HMPs) were evaluated throughout the New York state for the first time, and ranked available HMPs based on a number of resiliency criteria. The analysis calls attention to the outstanding plans in Ulster, Orange, Montgomery, and Tioga counties.

The project will provide a roadmap for improvement elsewhere across the state. Hazard mitigation plans in New York State counties that had a Federal Disaster declaration in Hurricane Irene, Tropical Storm Lee, or Hurricane Sandy were evaluated on multiple criteria, and the impact plans have on reducing floodwater damage from storms was assessed. 21 available HMPs were evaluated and scored using eight principles that were selected based on content analysis and coding drawn from Federal Emergency Management Agency (FEMA) guidance documents and the hazard mitigation literature. HMP scores were then compared to the damage caused by the three storms. The weakest principles on average were Proposed Action, Monitoring and Implementation and Capability Assessment. These low scores confirm the findings of Berke et al. Furthermore, no significant correlations were found between the quality of the HMPs and damages incurred in the three storms. We subsequently make recommendations on how counties and states can improve the HMP planning process.

Keywords: roadmap, Federal Emergency Management Agency guidelines

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Abbreviations: NYS RISE, The New York State Resiliency Institute for Storms and Emergencies; HMPs, hazard mitigation plans; FEMA, Federal Emergency Management Agency

Introduction

Hurricane Irene, Tropical Storm Lee, and Hurricane Sandy had major impacts on communities throughout New York State (NYS). Much attention is being directed at recovery and rebuilding and long-term planning for disaster and hazard mitigation. The Federal Emergency Management Agency (FEMA) recognized the importance of planning for hazard mitigation and disaster relief as early as 1969. In that year, FEMA passed the Disaster Relief Act which authorized grants for establishing comprehensive disaster-relief plans.[1] Planning for hazard mitigation became required under the Disaster Mitigation Act of 2000 for states and localities to qualify for pre- and post-disaster assistance from the federal government. This Act is intended to "alleviate the suffering and damage that results from disasters by... encouraging hazard mitigation measures".[2] Both state and local governments have been drafting hazard mitigation plans (HMPs) for many years.

Local governments must review and update their plans every five years to be eligible to continue to receive funding. In NYS, HMPs are written at the county level and local governments generally sign on to these plans. Although many counties have HMPs, the plans have never been examined to determine their relative effectiveness, strengths, and weaknesses. Questions that should be asked include: Are the plans simply an administrative box to check off, or do they significantly contribute to better preparedness and mitigation of hazards? How can they become even more effective in future conditions, especially given the consequences of climate variability and change? FEMA requires HMPs because they are thought to have an impact on reducing damage and casualties from disasters. Yet, the plans are not routinely examined to determine their relative effectiveness, strengths, and weaknesses.

A number of academic studies have shown that HMPs are often inadequate and poorly implemented. Rovins, who was a Senior Mitigation Planner with FEMA, questioned whether the HMPs actually reduce disaster damage and recovery expenses.[3] At a more analytic level, questions about the relative quality of plans have been asked by a number of researchers. Kaiser and Goebel et al.[4] studied the quality of state-level plans required under Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, and found that the plans were inadequate. According to their study, the plans lacked essential elements such as goals, objectives, assessment of mitigation capabilities, plan monitoring, evaluation and updating procedures. Additionally, states did not follow through on adoption, funding, and follow-up action. They concluded that the plans became a "hoop to jump through," rather than contributing to significant mitigation. This study was a work unit in the New York State Resiliency Institute for Storms and Emergencies (NYS RISE).

NYS RISE was launched in November of 2013 as a consortium to address the challenges associated with enduring severe weather

events. It acts as a hub for in-depth research, analysis, and education on disaster preparedness. Berke, Smith, Lyles et al.[5] conducted an analysis of 30 state and local HMPs to assess their quality and variability. They found that the plans met basic FEMA requirements, and that risk assessments were the strongest element of the plans while monitoring and implementation were the weakest elements. The plans had strong emergency management perspectives but lacked incorporation of land use plans. This study followed the method described by Berke, Smith et al.[6] to assess the quality of hazard mitigation planning in NYS. The plans were examined and measured on a number of dimensions, including adequacy of goals and objectives, assessment of follow up, implementation, and funding. The study ends with recommendations on how NYS can improve outcomes by reforming requirements and procedures in the planning process.

Methodology

Geographic scope of study

The counties selected for this study were those designated as Federal Disaster Areas by Governor Andrew Cuomo under FEMA guidelines. They include counties that were funded by the Department of Housing and Urban Development's (HUD) Action Plan under the Community Development Block Grant (CDBG) program, as well as additional counties that experienced major flooding or a storm-related disaster such as Hurricane Sandy, Hurricane Irene, or Tropical Storm Lee. The counties where disasters were declared for each storm are: Hurricane Sandy: Bronx, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster and Westchester. Hurricane Irene: Albany, Bronx, Clinton, Columbia, Delaware, Dutchess, Essex, Green, Herkimer, Kings, Montgomery, Nassau, Orange, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Suffolk, Ulster, Warren, Washington and Westchester. Tropical Storm Lee: Broome, Chemung, Chenango, Delaware, Delaware, Fulton, Herkimer, Oneida, Orange, Otsego, Schenectady, Schoharie, Tioga and Ulster.

Gathering data

Figure 1 shows the availability of HMPs in each county. Each county colored green has an available HMP and was evaluated in this study. Each county colored yellow had a disaster declared and is a candidate for CDBG Action Plan funding, but did not have an HMP available. The remaining counties did not have a disaster declared and were not considered for study.

The format of each HMP is a pdf file and contains different chapters and topics such as Planning Process, Risk Assessment, Mitigation Action, Plan Monitoring, Plan Maintenance, Implementation Strategy, Mitigation Goals, Action Item Evaluation and Prioritization. Although it's required by NYS that counties follow HMP preparation procedures, not all of the HMPs were consistent. In addition, some counties have separate Hazard Mitigation Plans for smaller communities such as towns. This inconsistency was remedied by combining all the HMPs within the county in to a plan that is called "master HMP". This master HMPs were made for the purpose of evaluation in this study. The main issue in such counties and master plans is lack of upstream comprehensive management in a county level. In other words, while some counties are legislating policy and management in a county level, these master plans are organized in a number of town levels attached to each other. of the counties are and subsequently allocating the required policy and budget for potential hazards in each individual county. The analysis of these master plans is then be downscaled to a town level instead of a county level (Figure 1).

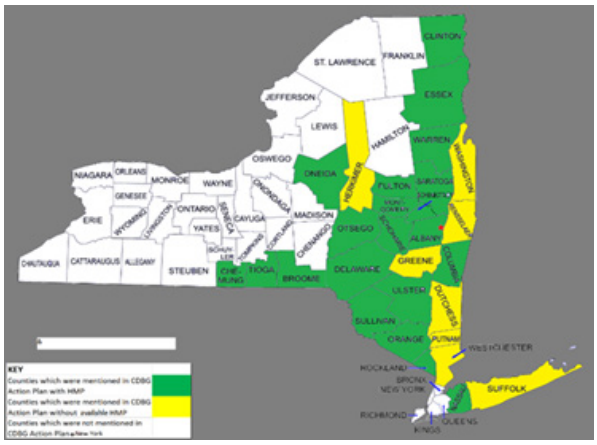

Figure 1 Availability of HMPs in different Counties of New York State.

Defining principles

The original coding instrument used to evaluate the HMPs is called the "UNC-CH State Hazard Mitigation Plan Coding Instrument," and was developed by Berke, Godschalk, Kaiser, Rodriguez et al.[7] and modified by Berke, Smith, Lyles et al.[5] The following quality principles were used to evaluate the HMPs: 1-Plan basics, 2-Participation, 3-Inter-Organizational Coordination, 4-Hazard Identification, 5-Capability Assessment, 6-Goals, 7-Proposed Actions and 8-Monitoring. These principles were selected based on FEMA guidance documents and hazard mitigation literature, and were adapted to align with the five sections required in all HMPs as described in FEMA's Local Mitigation Plan Review Guide.[8] Table 1 shows a matrix demonstrating the relationship between the FEMA Sections and Requirements and the eight quality principles.

Table 1 Plan Principles comparing to FEMA sections

FEMA Sections and Requirements (FEMA 2011)	Corresponding Principles (Modified from UNC-CH instrument for NYS-RISE)
Planning Process	Participation, Inter-Organizational Coordination
Documents planning process, coordination among agencies and program integration	
Hazard Identification & Risk Assessment	Hazard Identification
Identifies and profiles hazards, assesses vulnerability and estimates potential losses	
Mitigation Strategy	Goals, Proposed Actions, Capability Assessment
Identifies goals, Mitigation action; and implementation information	
Plan Review, Evaluation, and Implementation	Plan Basics, Inter- Organizational Coordination, Monitoring
Monitoring, evaluation and updating the plan and monitoring the progress of mitigation actions	

Coding protocol

A numerical method was used to evaluate the eight quality principles and compute the overall HMP scores. Each quality principle

was scored using a binary and ordinal scale.[9] For the binary scale, each quality principle received a score of 0 or 1; a score of 0 means that the quality principle was not described in the HMP and a score of 1 means that the quality principle was described. For the ordinal scale, each quality principle received a score of 0, 1 or 2; a score of 0 means that the quality principle was not mentioned in the HMP, a score of 1 means that the HMP had a brief, general description explaining the quality principle, and a score of 2 means that the HMP described the quality principle in detail and included lists, table, figures, and maps, where applicable. To calculate the aggregate result, binary scores were added together and then standardized on a scale of 0 to 10. To keep the scale consistent for the ordinal scores, the scores were divided by 2, added together, and then standardized on a scale of 0 to 10.

Tables 2 through 9 show all eight quality principles, their subcategories and whether they are scored on a binary or ordinal scale. Plan Basics assesses whether the HMP includes an issue date, is multi-jurisdictional, and has recently been updated (Tables 2).

Participation evaluates whether the county involved formal and informal actors, other governments, the private sector, and non-profits in preparing the HMP. This principle assesses adequate public engagement techniques, such as holding open meetings and workshops with adequate public notice and using targeted outreach initiatives including having a website. This category also evaluates the extent to which the plan explains why the organizations identified were involved, and makes clear which sections were revised as part of the update process (Table 3).

Inter-governmental coordination involves recognizing the interdependent actions of state and local organizations that should be coordinated for effective plan implementation. For this principle, HMPs were evaluated on whether other organizations were involved in the planning process, and whether other plans, policies and programs were integrated into the HMP, such as adjacent counties HMPs, comprehensive land use plans, disaster recovery plans, flood mitigation plans, and the State HMP (Table 4).

Table 2 Plan Basics

Principle 2: Participation
2A - Public Engagement Techniques 0/1
2B - Develop and Update Plan 0/1/2
2C - Organizational Roles 0/1/2

Table 3 Inter-Organizational Coordination

Principle 3: Inter-Organizational Coordination
3A - Organizational Involvement
3B - Plan Integration 0/1/2

Table 4 Hazard Identification and Risk Assessment

Principle 4: Hazard Identification/Risk Assessment
4A - Hazard ID 0/1
4B - Hazard Prioritization 0/1
4C - Hazard Assessment - Coastal Erosion 0/1/2
4D - Hazard Assessment - Earthquakes 0/1/2
4E - Hazard Assessment - Floods 0/1/2
4F - Hazard Assessment - Hurricane/Coastal Storms/Nor'easters 0/1/2
4G - Risk Assessment 0/1/2
4H - Vulnerability Assessment 0/1/2
4I - Jurisdiction-Specific Information in Multi-Jurisdiction Plan 0/1/2

Hazard identification and risk assessment involves identifying and prioritizing hazards, assessing vulnerability, and estimating potential losses. This should be done for coastal erosion, earthquakes, floods, and coastal storms like tropical storms and nor'easters. HMPs were scored by addressing each individual hazard on the following criteria:

1. Likelihood of occurrence
2. Location and boundaries of hazardous areas
3. Magnitude and severity of hazard
4. Hazard characteristics
5. Information on past events. In addition, plans should include an overall vulnerability assessment focusing on critical facilities, environmental assets, vulnerable populations, land use trends, population exposed to the hazard, and repetitive loss properties (Table 5).

Capability assessment evaluates how the HMP addresses the ability of federal, state and local programs, policies, laws or actions to reduce exposure, vulnerability and risk from hazards. This principle also evaluates whether the HMP demonstrates how policies should be modified to reduce risk. The HMP should address various federal programs such as the Flood Mitigation Assistance Program, the Hazard Mitigation Grant Program, and the National Flood Insurance Program. The HMP should also address state polices and laws, such as coastal management regulations, emergency management planning, land conservation, and transportation plans. Finally, the HMP should incorporate the impact of local laws and policies, such as development regulations and building codes, on hazards. (Table 6).

Goals assesses whether the HMP includes methods for achieving future desired conditions. This includes whether jurisdiction-specific goals are included in a multi-jurisdiction plan (such as a county plan). This principle also measures the strength of the plan on its coordination efforts, including whether the HMP sets goals to increase coordination among state and local governments. Finally, this principle assesses whether the HMP sets goals to reduce social inequities, reduce economic losses, protect public safety, improve environmental quality, and promote sustainability and resilience (Table 7).

Proposed Actions and Implementation Information assesses key elements involved in implementing a proposed action. These actions may include land acquisition, structure acquisition, beach nourishment, stormwater regulations, development incentives (such as density bonuses and tax abatements), development regulations, financial incentives, building awareness and education (such as providing pamphlets and radio broadcasts, posting signs indicating hazardous areas, and providing technical assistance to developers and the public), preparing emergency plans, sheltering plans, vegetation and debris removal, protection of public facilities, and enacting post-disaster regulations (Table 8).

Table 5 Capability Assessment

Principle 5: Capability Assessment 0/1/2
5A – Federal
5B – General
5C – Local
5D – State

Table 6 Goals

Principle 6: Goals 0/1
6A - General
6B - Coordination
6C - Hazard Loss
6D - Overarching Vision

Table 7 Proposed Actions and Implementation Information

Principle 7: Proposed Actions (Present) and Implementation Information (Cost, Responsible Agency, Spatial Specificity, and Timetable) 0/1
7A - Acquisition and Elevation
7B – Awareness/Knowledge
7C - Coordination
7D - Development Incentives
7E - Development Regulations
7F - Financial Assistance
7G - Preparedness/Response
7H - Protection of Public Facilities and Infrastructure
7I - Recovery Measures
7J - Structural Controls

Table 8 Monitoring

Principle 8: Monitoring
8A - Monitoring Implementation 0/1
8B - Monitoring Plan 0/1
8B.4 - Process for Incorporating into Other Planning Mechanisms 0/1/2

Monitoring evaluates the extent to which the HMP tracks its performance over time. This principle includes measures on monitoring implementation, such as whether the HMP establishes timelines and funding to implement the plan, whether the HMP provides for mediation, assesses potential obstacles, tracks losses from disasters, and whether it provides for indicators and public involvement in its implementation performance.

More details about the subcategories of each principle and their definitions can be found in Appendix A, Tables 10 through 20.

Results and discussion

Since this study is of interest to many actors who deal with hazard mitigation and have participated in preparing HMPs including consultants, government agents, and other parties, the results have been interpreted in four ways:

Describing the results by each principle

The scores for each principle were normalized on a scale of 0 to 10. Then, the mean score and standard deviation of each principle across all the counties were determined. Figures 2 through 17 illustrate the county-level variation in plan quality across the eight principles. For each principle, each county was placed into one of four quality categories based on its standard deviation from the mean. That is, each county was mapped based on how it ranks in comparison to the average plan. Those plans that scored more than one standard deviation above the mean are considered high quality and colored dark blue. Those plans that scored more than one standard deviation below the mean are considered low quality and colored red. The light blue and pink colored counties are moderate in quality. Those plans with scores less than one standard deviation above the mean are colored light blue, and ranked fairly better than the counties with scores less than one standard deviation below the mean colored pink.

Describing the results using a resiliency factor

Although considering all of the eight quality principles is necessary in terms of HMP evaluation, not all of the principles play significant role in strengthening resiliency in the counties. The following five principles make up the Resiliency Factor: Hazard Identification, Capability Assessment, Goals, Proposed Actions and Monitoring. Table 10 shows the dimensions that were evaluated for each resiliency principle.

Analyzing the subcategories of each principle

Analyzing the subcategories of each quality principle is important for determining the strengths of each plan and their areas for improvement.

Comparing the overall damages during sandy, irene and lee with the resiliency scores

This approach compared the trends of the damage that happened during Sandy, Irene, and Lee with the resiliency scores of each county. This approach revealed the similarities and differences between the trends, and determined whether or not the plans helped mitigate storm damages and if this was a reasonable comparison.

Evaluation of each principle

Plan basics

The mean Plan Basics score across all counties was 9.21 out of 10, and the average standard deviation from the mean was 1.8. 17 out of 21 counties scored a 10, indicating that they met all three criteria. Albany, Columbia, Delaware, and Orange counties received less than 10 indicating that they were not updated or were not multi-jurisdictional.

Participation

The mean Participation score across the counties was 7.48 out of 10, and the average standard deviation was 1.32. The counties that scored the highest were Clinton, Essex, Montgomery and Schoharie, all receiving a score of 9 out of 10. The counties that scored the lowest were Columbia, Sullivan, Delaware, and Chemung, receiving scores of 4.5, 5.0, 5.5, and 6.0 out of 10, respectively.

Inter-governmental coordination

The mean Inter-Governmental Coordination score across counties was 6.27 out of 10, and the average standard deviation was 1.97. The counties that scored the highest were Delaware, Fulton, Montgomery and Ulster, receiving scores of 9.2, 8.3, 8.3, and 8.3, respectively. The counties that scored the lowest were Essex, Columbia, Sullivan and Chemung, receiving scores of 2.9, 3.3, 3.3, and 3.8 out of 10, respectively.

Hazard identification and risk assessment

The mean Hazard Identification and Risk Assessment score across all counties was 6.17 out of 10, and the average standard deviation was 1.19. The counties that scored the highest were Rockland, Fulton, Montgomery, and Ulster, receiving scores of 7.9, 7.6, 7.6, and 7.6 out of 10, respectively. The counties that scored the lowest were Chemung, Oneida, Otsego and Sullivan, receiving scores of 4.0, 4.0, 4.4, and 4.9 out of 10, respectively.

Capability assessment

The mean Capability Assessment score across all counties was 5.29 out of 10, and the average standard deviation was 1.57. The counties that scored the highest were Orange, Montgomery, Tioga, and Essex, receiving scores of 7.3, 7.3, 7.0, and 7.0 out of 10, respectively. The counties that scored the lowest were Fulton, Oneida, Delaware, and Chemung, receiving scores of 2.1, 3.0, 3.0, and 3.2 out of 10, respectively.

Goals

The mean Goals score across all counties was 6.73 out of 10, and the average standard deviation was 1.96. The counties that scored the highest were Broome, Clinton and Delaware, all receiving a

score of 10. The counties that scored the lowest were Essex, Oneida, and Montgomery, receiving scores of 3.6, 3.6, and 4.3 out of 10, respectively.

Proposed actions and implementation information

The mean Proposed Actions and Implementation Information score across all counties was 4.67 out of 10, and the average standard deviation was 1.27. This was the lowest mean score of all the principles. The counties that scored the highest were Montgomery, Ulster and Fulton, receiving scores of 6.6, 6.3, and 6.1 out of 10, respectively. The counties that scored the lowest were Broome, Oneida, Warren, and Schoharie, receiving scores of 2.2, 2.7, 2.9, and 3.2 out of 10, respectively.

Monitoring

The moderate mean result shows that Monitoring was not a priority when the counties were establishing their HMPs. The counties that scored the highest were Ulster and Montgomery, receiving scores of 9.4 and 7.5 out of 10, respectively. The counties that scored the lowest were Albany, Chemung, and Clinton, receiving scores of 0, 1.3, and 2.5 out of 10, respectively. Figure 2 & Figure 3.

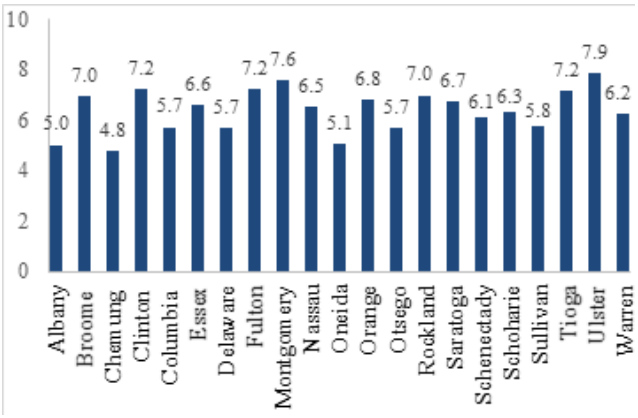

Figure 2 Aggregate HMP quality scores.

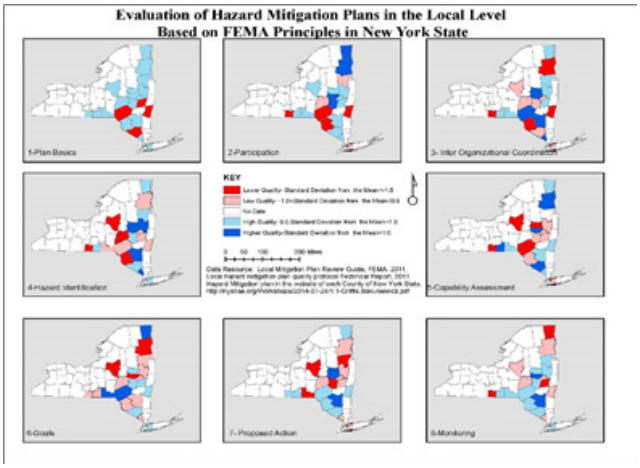

Figure 3 Evaluation of HMPs in the local level.

Scores for each principle were normalized on a scale of 0 to 10 and, mean scores and standard deviations for each principle for each county were determined. For each principle, each county was placed into one of four quality categories based on its standard deviation from the mean. That is, each county was mapped based on how it ranks in comparison to the average plan. Those plans that scored more than one standard deviation above the mean are considered high quality and colored dark blue. Those plans that scored more than one standard deviation below the mean are considered low quality and colored red. The light blue and pink colored counties are moderate in quality. Those plans with scores less than one standard deviation above the mean are colored light blue, and ranked fairly better than the counties with scores less than one standard deviation below the mean colored pink. Figure 18 illustrates the aggregate HMP quality scores, calculated based on the mean score of all eight principles for each county. The aggregate HMP quality scores show that the highest rated HMPs belong to Ulster and Montgomery counties, receiving scores of 7.86 and 7.58 out of 10, respectively.

Ulster County's HMP received high scores in four principles including Inter-Organizational Coordination, Hazard Identification and Risk Assessment, Proposed Actions and Implementation Information, and Monitoring. Montgomery County's HMP received high scores in 6 principles including Participation, Inter-Organizational Coordination, Hazard Identification and Risk Assessment, Capability Assessment, Proposed Actions and Implementation Information, and Monitoring. On the other hand, the lowest rated HMP belongs to Chemung County. Chemung's HMP received a score of 4.77, less than half of the highest possible score.

This result was expected since this HMP scored very low in five principles including Participation, Inter-organizational Coordination, Hazard Identification and Risk Assessment, Capability Assessment, and Monitoring. The HMPs with the next lowest scores belong to Albany and Oneida counties. The overall score range for the rest of the counties varies between 5.05 and 7.58. These counties did not have any major fluctuations in their scores for the eight principles. Evaluating Resiliency Factors Boosting the resilience of communities across NYS is extremely important since many are increasingly experiencing severe weather.

According to FEMA[10] communities do not need to implement expensive structure protection measures in order to increase their resilience. The most effective way to promote resilience at the community level is to consider risk factors and ways to reduce or eliminate them in decision making. This includes establishing goals and policies that are linked to risk reduction and resiliency, and incorporating awareness of hazard risks into public outreach practices. An additional aspect of this project was to update the HMP evaluation criteria to include only those pertaining to resilience. Of the eight evaluation principles, the last five directly relate to resiliency, including Hazard Identification and Risk Assessment, Capability Assessment, Goals, Proposed Actions and Implementation Information, and Monitoring (Table 9).

The Aggregate HMP quality scores including resiliency factors can be seen in Figure 19. A visual representation of each county's Aggregate HMP quality including resiliency factors can be seen in Figure 20 (Figure 4 & Figure 5).

The HMP scores of Ulsters, Orange, Montgomery, and Tioga counties have a standard deviation greater than one since these plans paid more attention to a wide range of resiliency items. When comparing the Aggregate HMP Quality scores for each county, the counties with high scores when considering all eight quality principles also had high scores when only considering the Resiliency Factors. Therefore, counties with higher scores fared better because they placed more emphasis on resiliency measures.

On the other hand, the standard deviation from the mean for Oneida and Chemung County are less than one. That indicates the two counties did not emphasize resiliency measures in their HMPs.

Table 9 Resiliency Factors that were addressed in HMP

4-Hazard Identification	4B-Hazard Prioritization	Prioritization classification used
	4E-Hazard Assessment-Floods	1- Delineates likelihood of flood events
		2- Delineates location and boundaries of hazardous areas
		3- Delineates magnitude and severity of flood hazards
		4- Delineates separate characteristics of coastal flood hazards
		5- Includes information on past coastal flood events
	4F-Hazard Assessment- Hurricanes/Coastal Storms/ Nor'easters	1- Delineates likelihood of storms
		2- Delineates location and boundaries of hazardous areas
		3- Delineates magnitude and severity of storms
		4- Delineates separate characteristics of storms
		5- Delineates information of previous storms
	4G-Risk Assessment	1- Loss estimations for private structures
		2- Loss estimations for public structures
		3- Multi-hazard risk assessment
		4- Systematic risk assessment
	4H-Vulnerability Assessment	1- Critical facilities
		2- Environmental assets
		3- Especially vulnerable populations
		4- Land use trends
		5- Population
		6- Private property (Household)
		7- Repetitive loss properties
5-Capability Assessment	5A-Federal	1-FEMA Flood Mitigation Assistance
		2-HMA Hazard mitigation Assistance
		3-HMGP Hazard Mitigation Grant Program
		4-NFIP/CRS National Flood Insurance Program
		5-PDM Pre-Disaster Mitigation
		6-Post-disaster Community Development Block Grant (CDBG)
		7-Public assistance
		8-Acquisition and elevation
	5C-Local	1-Awareness and knowledge
		2-Coordination
		3-Development incentives
		4-Development regulations
		5-Financial assistance
		6-Preparedness/response
		7-protection of public facilities and infrastructure
		8-recovery measures
		9-structural controls
	5D-State	1-coastal management
		2-emergency management
		3-land conservation program
		4-mitigation specific programs
		5-natural resources/ environment
		6-planning
		7-transportation
6-Goals	6B-Coordination	1-local-local coordination
		2-state-local coordination
	6C-Hazard Loss	1-protect public safety
		2-reduce damage to private property
		3-reduce damage to property in general
		4-reduce damage to public property
		5-reduce impacts on environmental and natural resources
	6D-Overarching Vision	1-increase resilience
		2-promote sustainability
7- Proposed Actions	7B-Awareness/ Knowledge	1-encourage insurance purchase
		2-post signs indicating hazardous areas
	7F-Financial Assistance	1-develop revenue sources
		2-fund using state and federal grants
		3-provide nonfederal match to property owner
	7H-Protection of Public Facilities and Infrastructure	1-Adjust public infrastructure
		2-retrofit existing public facilities
		3-site public facilities
	7I-Recovery Measures	1-building design change
		2-land use change
		3-post-disater capital improvements adjustments
		4-recovery organizations/committee
8-Monitoring	8A-Monitoring Implementation	1-conflict management/dispute resolution
		2-identifies obstacles

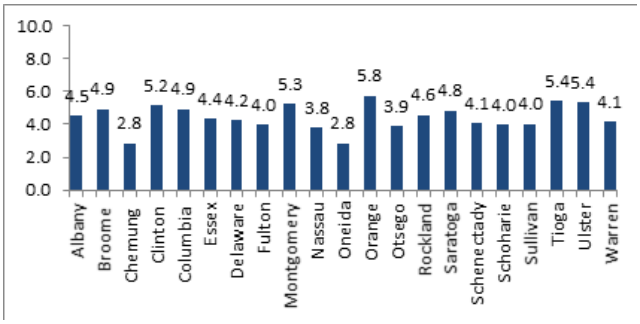

Figure 4 Aggregate HMP quality scores only considering resiliency principles.

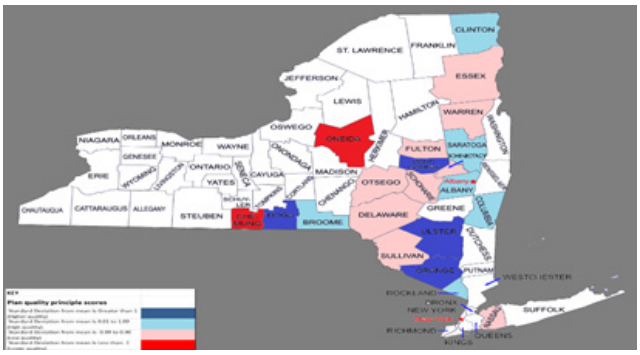

Figure 5 Standard deviation from mean for aggregate HMP scores including resiliency factors.

Except for the six counties that either provided adequate or no information on the resiliency subcategories, the standard deviations of the other 15 counties were close to the mean. Therefore, these counties with standard deviations between 0 and 1 or between -1 and 0 cannot be considered resilient.

Analyzing each subcategory

Analyzing each subcategory reveals the specific strengths and weaknesses of each plan, in addition to the strengths and weaknesses of the plans in general. This section discusses two subcategories as examples: Hazard Assessment (Floods) and Vulnerability Assessment.

Figure 21 illustrates the Hazard Assessment criterion which includes the likelihood of flood events, location and boundaries of hazardous areas, magnitude and severity of flood hazards and information on past coastal flood events. As Figure 21 shows, all of the HMPs provide detailed descriptions on the boundaries of hazardous areas using geographical information, and the likelihood of flood events by determining the return period and probability of occurrence.

Most of the HMPs have a detailed description for the rest of the subcategories which include the magnitude and severity of floods, separate characteristics of coastal flood hazards, and information on past coastal flood events. However, four HMPs do not provide any description on the magnitude and severity of flood hazards, and three HMPs have a brief description without much detail. Additionally, five HMPs do not have a description for separate characteristics of coastal floods, and one HMP has a brief description. Finally, two HMPs do not have information about past coastal flood events and three counties have a brief description.

Overall, this principle is considered one of the best in terms of being mentioned and described in detail in the majority of the HMPs (Figure 6).

Vulnerability Assessment and its related subcategories are shown in Figure 22. A range of subcategories including private property, population, land use trends, especially vulnerable populations, environmental assets and critical facilities are incorporated in this principle.

A majority of the HMPs [3]have detailed descriptions on three subcategories including population (the number of people exposed to a hazard), critical facilities exposed to hazards (such as hospitals, bridges, sewage treatment plants, water treatment plants, schools, power plants, and police and fire stations), and land use trends. 13 HMPs have detailed information on especially vulnerable populations including the number of people and the demographic groups. 10 HMPs provide a clear narrative on private properties, and 9 HMPs include a wide range of data related to environmental assets.

On the other hand, 12 HMPs do not provide any information related to environmental assets, which is the worst result in this principle. Additionally, 7 HMPs did not include information on private property.

Overall, most of the counties received favorable results, especially in critical facilities, land use trends and population. The only subcategory whose result is not satisfying is environmental assets since the number of HMPs that do not have any description is more than the counties that have detailed descriptions (Figure 7).

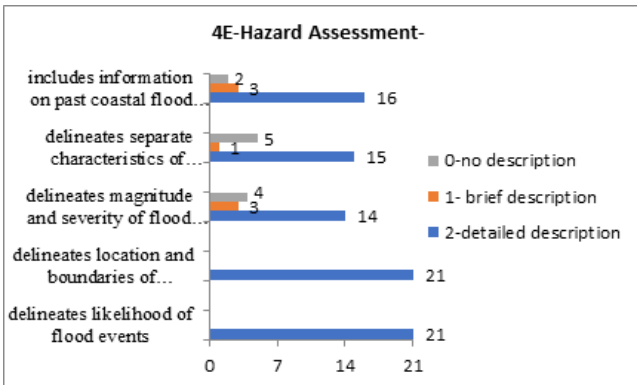

Figure 6 Hazard Assessment-Floods.

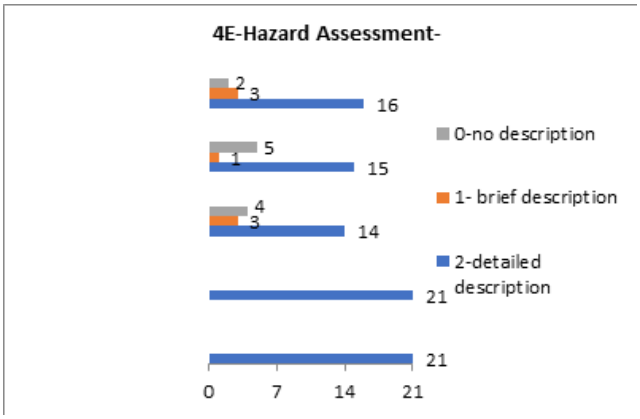

Figure 7 Vulnerability Assessment.

Damage and resiliency score

The goal of this analysis was to compare the trends between the damages faced by each county due to Hurricanes Sandy, Irene, and Tropical Storm Lee and their Resiliency Score. To start, the total dollar damage caused by the three storms for each county was approximated. To normalize the damages faced by each county due to

differences in property values, it was necessary to determine the ratio of the total dollar damage in each county to the average property value in each county. A high dollar damage value does not necessarily mean the county experienced more damage; high property values could in fact be the reason for the high dollar damage. The average property value in each county was estimated by dividing the aggregate value of all properties in the county by the county population. The results are shown in Figure 23.

Comparing the trends between the damages faced by each county and their Resiliency Score is one way to determine the effectiveness of the HMPs. As the Resiliency Score increases, it is expected that the damages faced by the counties decreases. This result suggests that the mitigation plans were effective in reducing the damages caused by the three storms. The graph in Figure 23 seems to follow this trend.

However, a few outliers including Nassau, Broom, Orange and Tioga counties make trusting this trend difficult. To try to improve the result, these four counties were eliminated from the data. The resulting graph, shown in Figure 24, is even further away from the expected outcome than the graph including all counties. Figure 8 & Figure 9

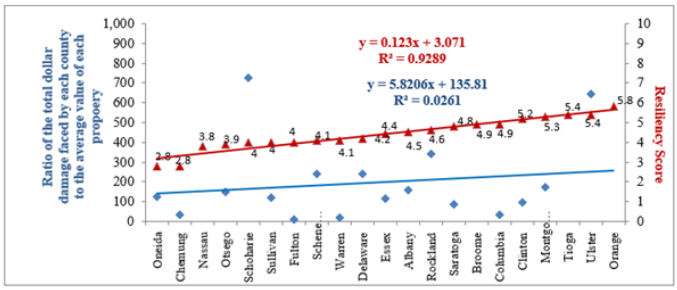

Figure 8 Comparing the Sandy + Irene + Lee Damages with Resiliency Scores.

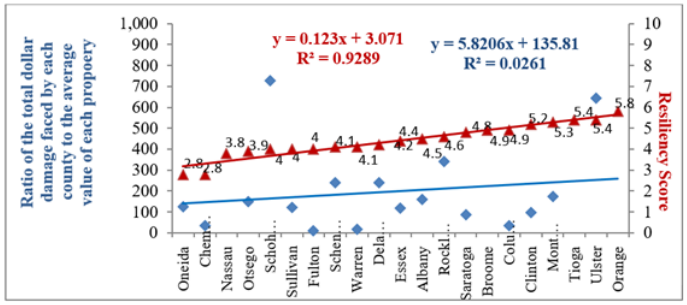

Figure 9 Comparing Sandy + Irene + Lee Damages with Resiliency Scores eliminating four counties.

Conclusion and recommendations

In this study, county HMPs were evaluated and scored on the following quality principles: 1-Plan Basics, 2-Participation, 3-Inter-Organizational Coordination, 4-Hazard Identification, 5-Capability Assessment, 6-Goals, 7-Proposed Actions and 8-Monitoring. These principles were selected based on FEMA guidance documents and hazard mitigation literature, and were adapted to align with the five sections required in all HMPs as described in FEMA's Local Mitigation Plan Review Guide[8]

The results were interpreted in the following four ways

Describing the results by each principle

Results from evaluating the principles show that Proposed Actions and Implementation Information received the lowest score, followed by Monitoring and Capability Assessment, respectively. These low scores confirm the results that Berke et al. found in their research.

i. To receive a high score for the Proposed Action and Implementation principle, plans are expected to provide a detailed methodology on implementation strategies of various activities including determining the costs of different hazard mitigation alternatives. Additionally, plans are expected to introduce the responsible agencies and establish a timetable that includes activities that communities, small businesses and industries can complete to receive funding. Most counties should take these factors into consideration to improve their plans, particularly Broom, Oneida, Warren and Schoharie counties.

ii. The Monitoring principle is significant as it evaluates the ability of the counties to determine the effectiveness of their HMP through performance tracking. Counties cannot know whether the goals set in their HMP are realized unless the activities conducted in the aftermath of a disaster are monitored. Unfortunately, many plans are lacking in this principle, especially Albany, Chemung and Clinton counties.

iii. The Capability Assessment principle addresses the relationship between federal, state and local requirements and their roles in HMPs. Many counties lacked a clear explanation of the role of government in their plans including Fulton, Oneida, Delaware, and Chemung.

Describing the results using a resiliency factor

Of the eight evaluation principles, the last five directly relate to resiliency, including Hazard Identification and Risk Assessment, Capability Assessment, Goals, Proposed Actions and Implementation Information, and Monitoring. Results show that the counties with high scores when considering all eight quality principles also had high scores when only considering these Resiliency Factors. Therefore, this connection shows that counties performed better when they placed more emphasis on resiliency measures.

Analyzing the subcategories of each principle:

Analyzing each subcategory reveals the specific strengths and weaknesses of each plan, and the level of detail of each subcategory description.

Comparing the overall damages during sandy, irene and lee with the resiliency scores:

After comparing the trends between storm damages and Resiliency Scores, results show that there is no correlation between the damages caused by Hurricanes Sandy, Irene and Tropical Storm Lee to each county and their Resiliency Score.

i. Evaluating the damages incurred by each county was difficult due the lack of data. Even after recent hurricanes and floods, counties do not have clear descriptions of the extent to which they were affected or even a rough estimate of the damage that occurred. Each plan should explain the impacts of recent hazards; this can be achieved by surveying damage more extensively.

Sorting through 21 HMPs based on FEMA guidance illuminated a fundamental key in improving the quality of the local plans: all of the plans should have a uniform body. Having a uniform body will not only be helpful with further assessment of HMPs but …… The "Local Mitigation Plan Review Guidance" by FEMA (2011) mentions that all local mitigation plans should include at least these 6 elements:

4.1 ELEMENT A: Planning Process,

4.2 ELEMENT B: Hazard Identification and Risk Assessment,

4.3 ELEMENT C: Mitigation Strategy,

4.4 ELEMENT D: Plan Review, Evaluation, and Implementation,

4.5 ELEMENT E: Plan Adoption,

4.6 ELEMENT F: Additional State Requirements.

Not all of the plans that have been studied contain the mentioned elements.

Reorganization of the county plans based on FEMA requirements can help guide stakeholders to information relevant to them, and can provide space for further modifications. One way to achieve this is to establish an organization in each state that filters and organizes the HMP before issuance. Additionally, since each county experiences hazards such as hurricanes and floods differently, including a section on how various mitigation strategies rank in terms of their effectiveness would be very useful for both the local government and the State. The State could use this information to distribute funds to the resiliency and recovery projects more effectively. The State could also use this information to compare the local plans with each other, and make any budgetary adjustments they deem necessary. Ultimately, counties would benefit from a more efficient recovery process.

Although the HMPs did not satisfy the needs for complete recovery, and there are lots of unmet issues to be addressed in housing, small businesses, infrastructure, etc., the effort of NYS to reduce the impact of disasters and improve resiliency is unique and appreciable. This study can be continued by improving the HMPs of the most vulnerable counties by filling in the recognized gaps in each principle.

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Conflicts of interest

Author declares that there is no conflict of interest.

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