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Hurricane Floyd/Matthew Empirical Disaster Resilience Study

Jae G. Park

Hampton Roads Sea Level Rise Flooding Adaptation Forum

Hurricane Floyd/Matthew Empirical Disaster Resilience Study

Presented by Jae G. Park, Ph.D, CFM
Funded by DHS S&T

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1 RESEARCH INSPIRATIONS

Purpose of the Study and Approaches

- **Purpose of the Study:**
  - To improve the understanding of the impacts of state and local level activities intended to enhance community resiliency, support effective and equitable recovery, and reduce flood fatalities and losses

- **Research Approaches**:
  - An exploratory examination of indicators of resilience
  - Examination of losses avoided due to hazard mitigation in six North Carolina counties (Bertie, Columbus, Edgecombe, Lenoir, Robeson, and Wayne)

North Carolina – Hurricane Floyd Impacts

- Hurricane Floyd made landfall September 16, 1999, at Cape Fear, NC, as a Category 2 hurricane with 105 mph winds
- 10- to 15-foot-high storm surges and heavy rainfall of up to 20 inches

Impact	Hurricane Floyd	Hurricane Matthew
Damaged homes	55,000	88,266
Destroyed homes	7,000	4,424
Number of businesses reporting loss to FEMA	11,650	8,000
Total damage estimates (includes homes and business structures)	$4.32 billion (adjusted to 2016 dollars)	$1.9 billion

North Carolina – Resilience Building

- Established Hurricane Floyd Disaster Relief Commission
  - Create a disaster reserve fund for relief;
  - Establish a disaster studies institute to facilitate and coordinate research on disaster planning, response, recovery, and mitigation;
  - Integrate long-term recovery into emergency operations; and
  - Strengthen the performance and accountability of local emergency management teams
- Statewide and created digital FIRMs (DFIRMs) using LiDAR

North Carolina – Resilience Building

- Flood Risk Management for general public and communities :
  - iRISK
  - North Carolina Flood Risk Information System (NCFRIS)
  - North Carolina Flood Inundation Mapping and Alert Network
- Hazard Mitigation projects - $300 million for property acquisition, elevation and stormwater management
- HUD CDBG DR - $600 million for housing and economic recovery
- Public Assistance program funding - $300 million

Community Resilience Indicators

- **Social Resilience Indicator**
  - Is “the capacity of a social entity (e.g., a community) to ‘bounce back’ or respond positively to adversity” (Maguire and Hagan, 2007). Theorists suggest that resilience is a product of the individual wealth and health of residents of a community
- **Economic Resilience Indicators**
  - Economic resilience is the ability of a community to resume normal economic activity following a disaster (Rose, 2004). Theorists suggest that this ability is related to returning to work and accessing jobs.

Community Resilience Indicators

- **Physical Indicators of Resilience**
  - Is the ability of the built environment (buildings and infrastructure), as well as of the natural environment, to withstand the effects of a natural hazard. With greater physical resilience, recovery time decreases (NIST, 2016)
- **Disaster Management Indicators of Resilience**
  - Relates to a community's ability and preparation to manage the impact of a hurricane. With better planning, a community should be able to recover from the impacts of a hurricane more quickly (Berke et al., 2015)
- **Resilience Indicator in this study**
  - Identified over 50 from literature review
  - Narrowed down to 27
  - 17 indicators in the final analysis do to lack of data or differences (i.e., building code, NFIP, recovery plan, freeboard etc.)

Final Resilience Indicators

Category	Indicator of Resilience	Category	Indicator of Resilience
Social	**Individual wealth**	Economic	Unemployment
	• Percent of households having low to moderate income		Educational attainment
	• Per capita income		Access to a vehicle
	• Median monthly household income Individual wealth	Physical	Housing stock type
	• Homeownership rate		Housing constructed before the county joined NFIP
			Value of owner-occupied housing units
	Health of population		Road and bridge projects completed after Hurricane Floyd (funded by the FEMA PA program)
	• Healthcare availability	Disaster Management	FEMA-funded housing hazard mitigation projects
	• Food insecurity		Integration of planning mechanisms
	• Availability of parks		Flood insurance coverage

Dependent Variables

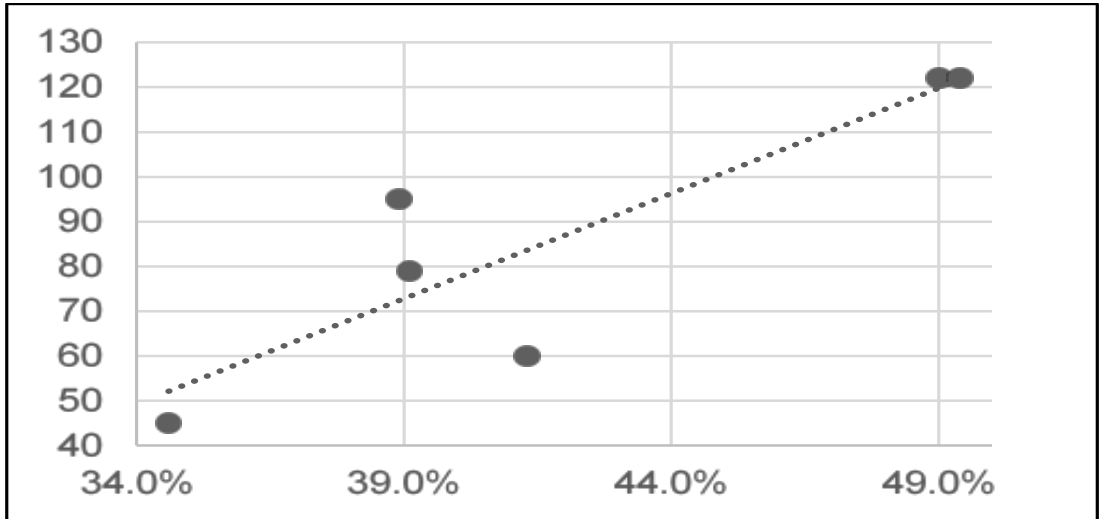
Included in the Study
Number of days schools were closed
Number of days of Disaster Recovery Center operated
Number of road closures due to Hurricane Matthew
Percent of occupied housing units that received NFIP flood insurance payments after Hurricane Matthew
Average NFIP payment
Percentage of housing units that received FEMA's Individuals and Households Program funding
Average IHP housing damage assistance payment
Total FEMA PA program award, by county
Not Included in the Study (Data Not Available for County Level)
Utility disruption
Displacement
Emergency rescue

2 FINDINGS

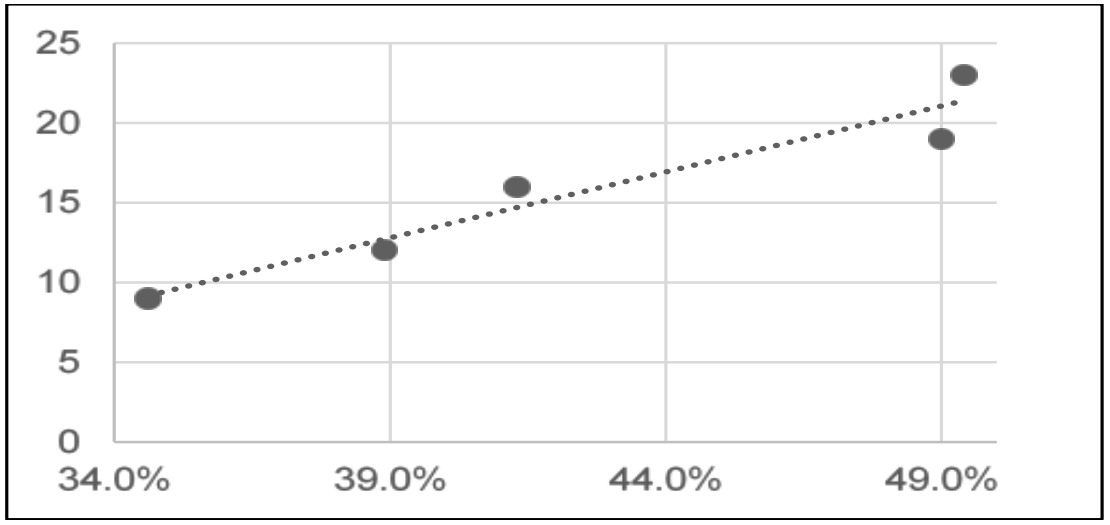
Social Indicators of Resilience

Graph showing paired comparisons of measures of one indicator of resilience with one Hurricane Matthew outcome measure

County	Households having low to moderate income	Number of days the DRC was kept open
Bertie	34.6%	45
Wayne	38.9%	95
Columbus	39.1%	79
Lenoir	41.3%	60
Edgecombe	49.0%	122
Robeson	49.4%	122



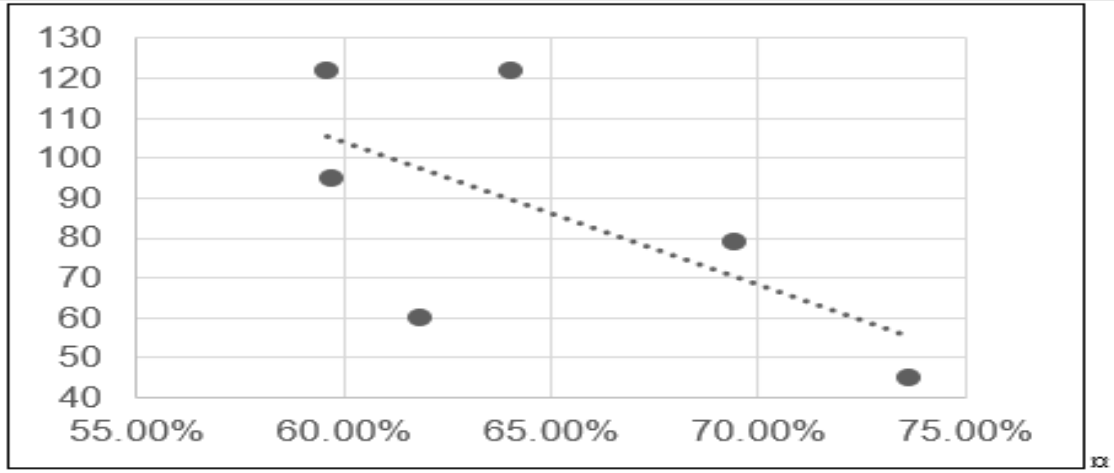
County	Percent of households having low to moderate income	Number of days until all public schools re-opened
Bertie	34.6%	9
Lenoir	41.3%	16
Edgecombe	49.0%	19
Robeson	49.4%	23
Wayne	38.9%	12



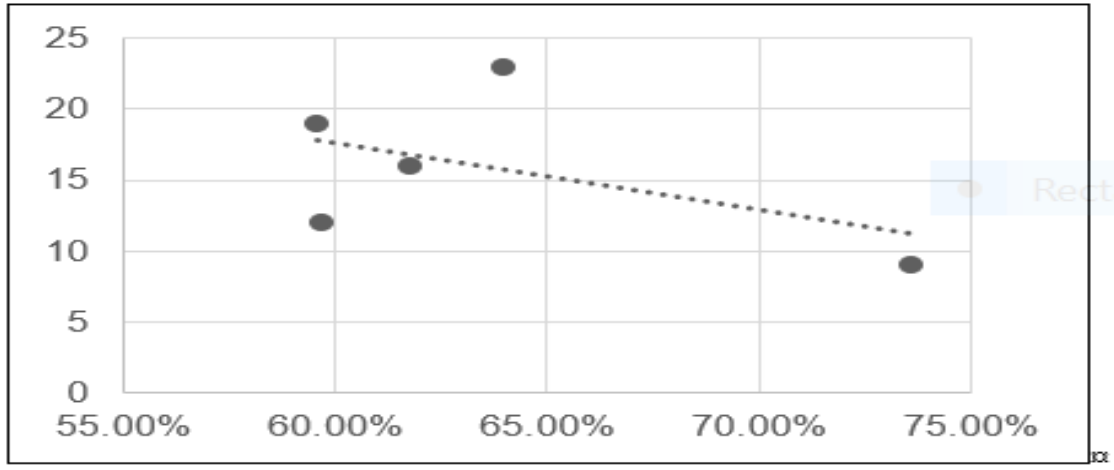
Social Indicators of Resilience

County	Percent homeownership	Number of days the DRC was kept open
Edgecombe	59.60%	122
Wayne	59.70%	95
Lenoir	61.80%	60
Robeson	64.00%	122
Columbus	69.40%	79
Bertie	73.60%	45

Graph showing paired comparisons of measures of one indicator of resilience with one Hurricane Matthew outcome measure

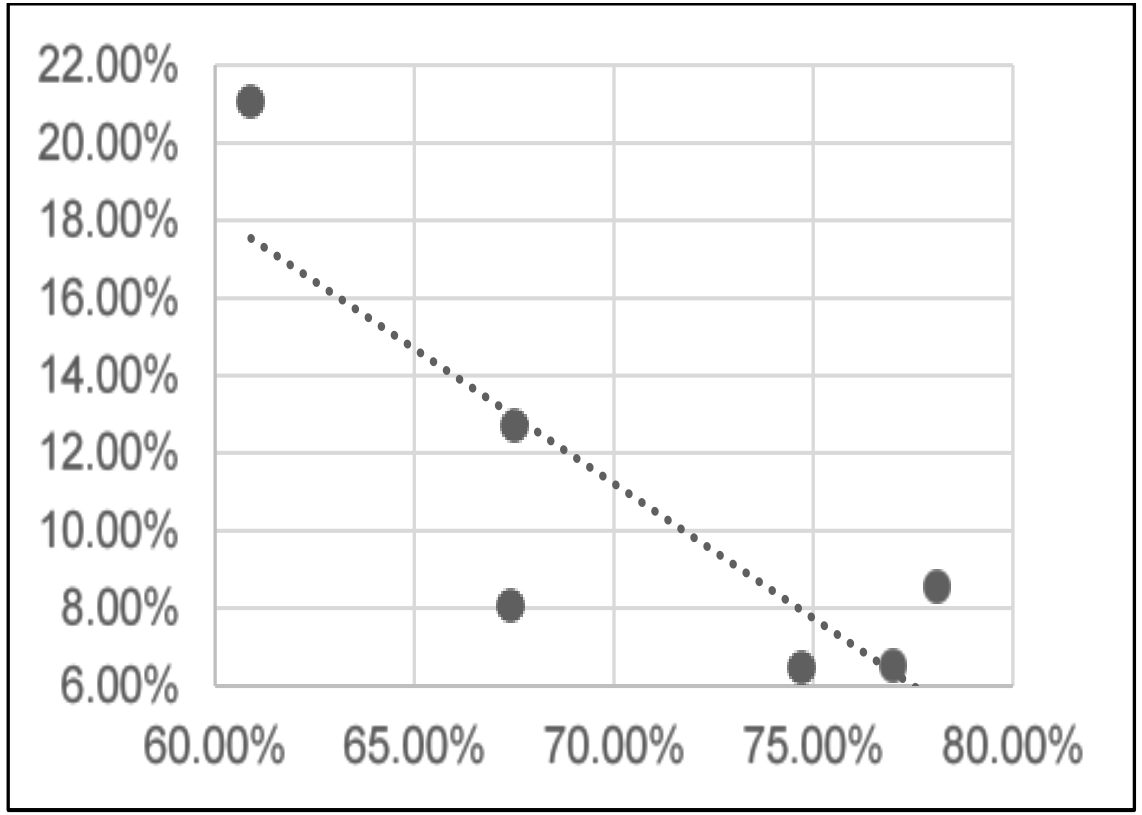


County	Percent homeownership	Number of days until all public schools re-
Edgecombe	59.60%	19
Wayne	59.70%	12
Lenoir	61.80%	16
Robeson	64.00%	23
Bertie	73.60%	9



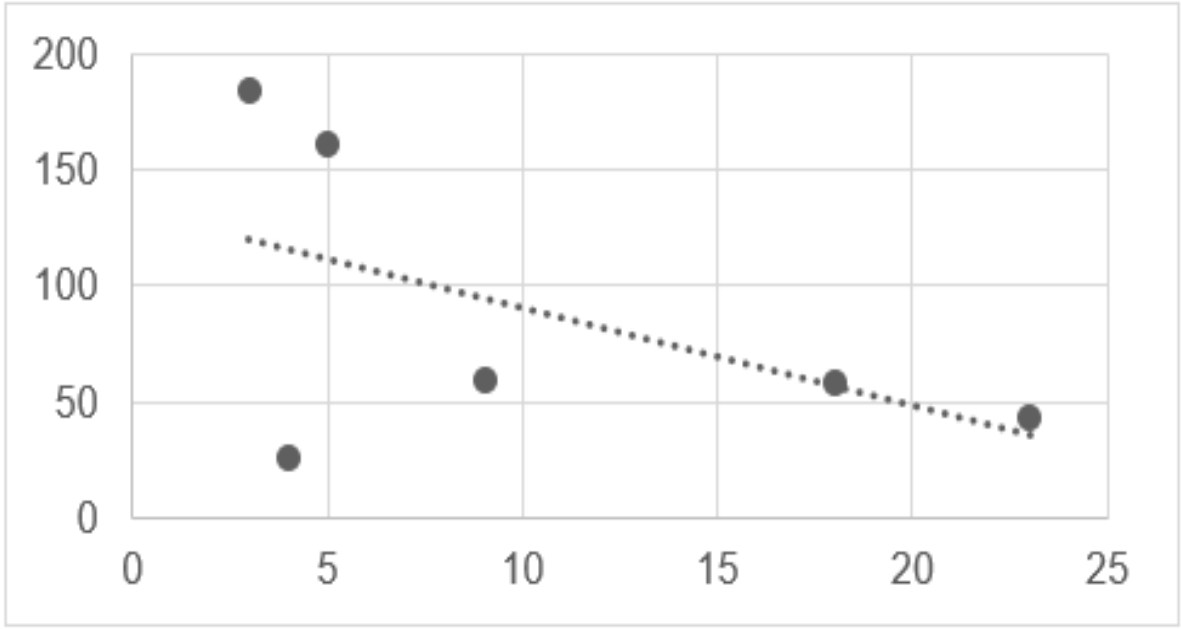
Physical Indicators of Resilience

County	Percent Not Mobile Homes	Percentage of households receiving housing damage assistance
Robeson	60.90%	21.07%
Bertie	67.40%	8.07%
Columbus	67.50%	12.70%
Wayne	74.70%	6.47%
Lenoir	77.00%	6.52%
Edgecombe	78.10%	8.57%

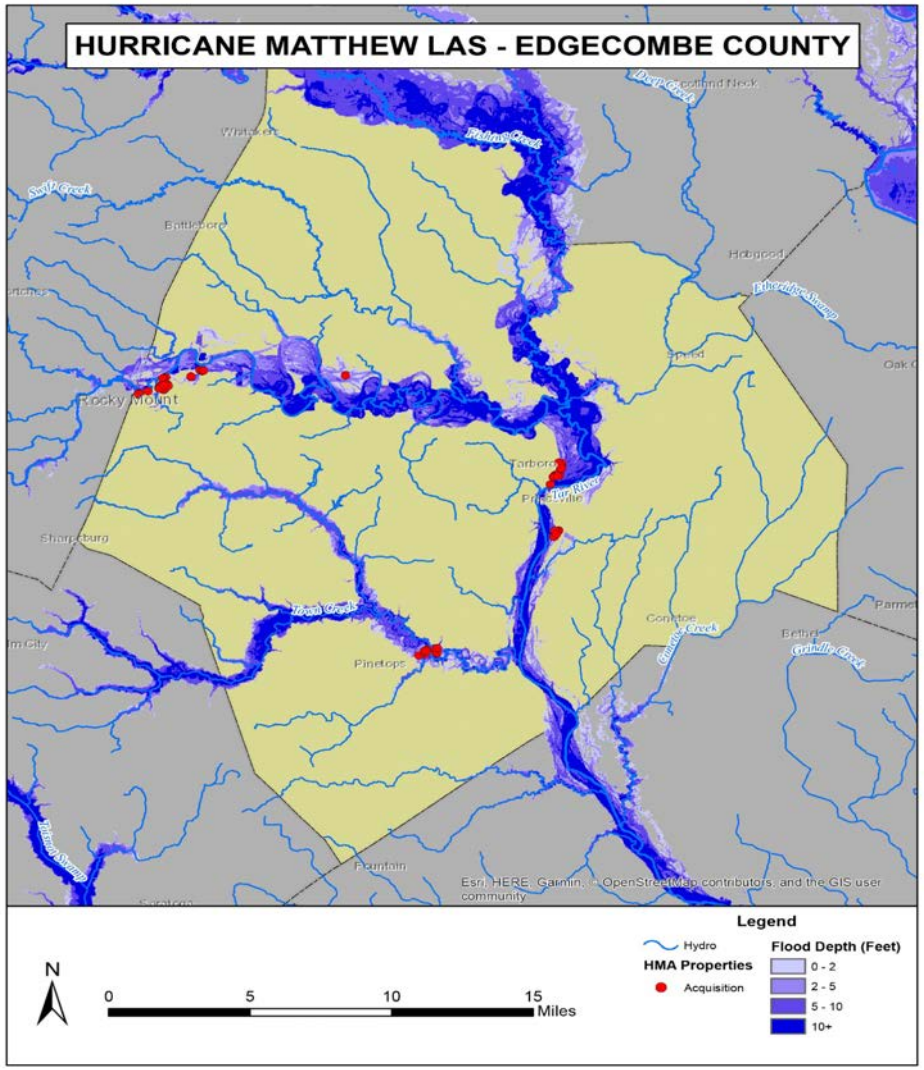


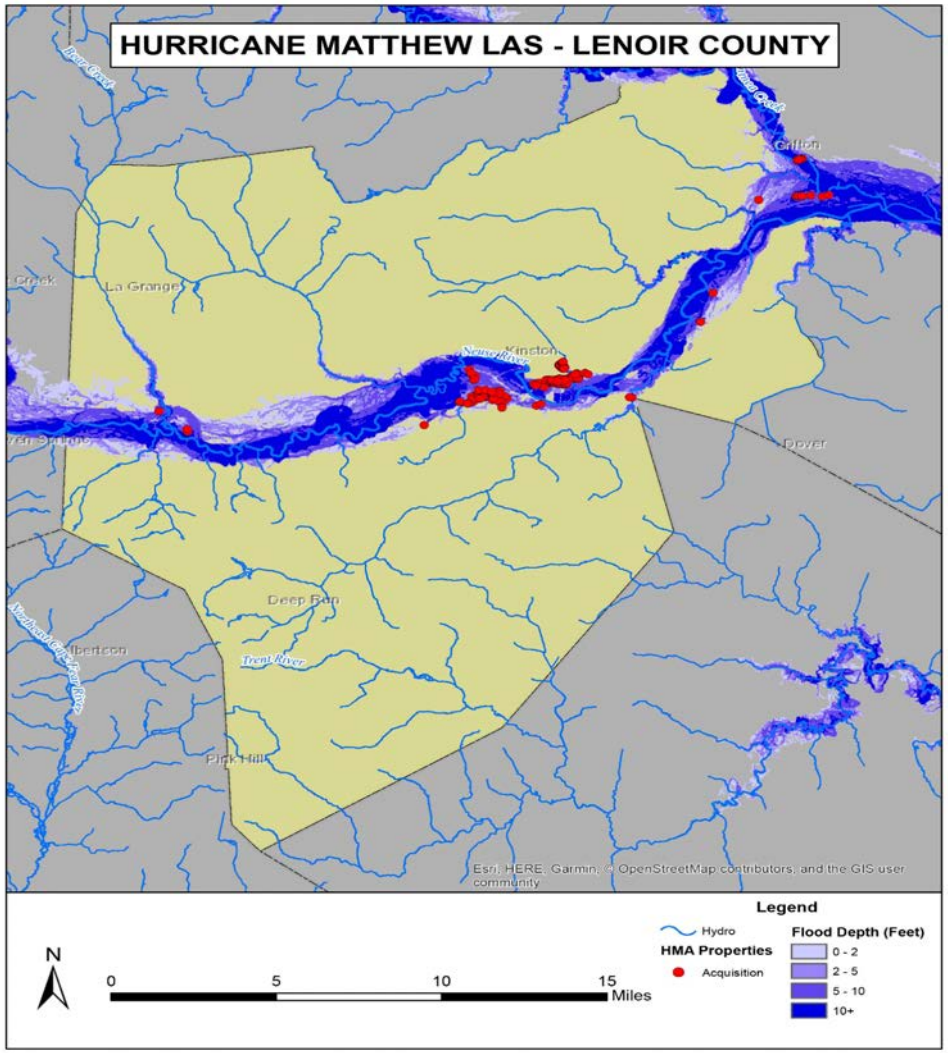
Physical Indicators of Resilience

County	Road and bridge projects completed after Hurricane Floyd	Number of road closures due to Hurricane Matthew
Robeson	3	184
Bertie	4	26
Wayne	5	161
Lenoir	9	60
Edgecombe	18	59
Columbus	23	43



Losses Avoided Study





Losses Avoided Study

Losses Avoided During Hurricane Matthew

County	Number of Structures[1]	Avoided Building Damages[2]	Avoided Contents Damages[3]	Avoided Displacement Cost[4]	Total Losses Avoided
Bertie	25	$1,859,840	$505,280	$1,037,380	**$3,402,500**
Columbus	10	$908,000	$244,400	$557,836	**$1,710,236**
Edgecombe	170	$10,271,520	$2,824,640	$4,863,940	**$17,960,100**
Lenoir	450	$22,747,360	$6,331,520	$9,072,178	**$38,151,058**
Robeson	87	$6,001,760	$1,638,880	$2,984,913	**$10,625,553**
Wayne	396	$33,028,480	$8,925,440	$19,299,175	**$61,253,095**
				Total	**$133,102,542**

ROI: $133,102,542 / $116,842,353 = 1.14 for 1,138 Buyouts


National Aeronautics and Space Administration
NASA
REACH
NEW
HEIGHTS
BENEFIT
ALL
HUMANKIND
3
RECOMMENDATIONS
REVEAL
THE
UNKNOWN

Lessons Learned and Recommendations

- Number of Samples and Unit of Analysis
- Lack of long-term post disaster impact data
- Data collection on a day-to-day basis in the weeks and months after a disaster
- Include post-disaster funding in data collection to document the rapidity with which post-disaster grants are implemented

Questions?