

# Public Support for Policies to Reduce Risk After Hurricane Sandy

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A phone survey was conducted in New Jersey in 2013 four months after the second of two major devastating tropical storms (Sandy in 2012 and Irene in 2011). The objective was to estimate public support for restricting land uses in flood zones, requiring housing to be built to resist storm waters, and otherwise increasing mitigation and resilience. Respondents who supported these mitigation and resilience policies disproportionately were concerned about global climate change, trusted climate scientists and the federal government, and were willing to contribute to a redevelopment program through taxes, bonds, and fees. They also tended to have collectivist and egalitarian worldviews. Half of the respondents supported at least four of the seven risk-reducing policies. How their support translates into public policy remains to be seen. Lack of willingness to personally fund these policies is an obstacle.

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**KEY WORDS:** Building codes; Hurricane Sandy; land-use controls; public preferences; risk-reducing policies

## 1. INTRODUCTION

Efforts to reduce vulnerability of people and structures in flood-prone areas have been an ongoing international challenge, especially in places with heavy seasonal storms and large populations living in flood-prone areas. The U.S. Gulf Coast and Atlantic Ocean coastline are among these vulnerable places, and recent tropical cyclones have raised the stakes. Michel-Kerjan and Kunreuther<sup>(1,2)</sup> note that 20 of the 30 most extensive worldwide disasters between 1970 and 2011 occurred since 2001, that 13 were in the United States, and that all, with one exception, were natural disasters.

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Hurricane Katrina, which struck the U.S. Gulf Coast in 2005, was the single most destructive U.S. hurricane, with costs estimated at over \$100 billion.<sup>(3,4)</sup> Yet, arguably, the State of New Jersey, the most densely populated state in the United States, currently is the most beleaguered place along the east coast, replacing Florida, which had that distinction for the first decade of the 21st century.<sup>(5)</sup> In a state-of-the-state speech in January 2013, New Jersey Governor Chris Christie reported that Sandy, which made landfall on October 29, 2012, had cost New Jersey 8,000 jobs, \$189 million in small business loans had to be issued to help businesses survive, 2.5 million cubic yards of debris had been removed, 346,000 homes were damaged or destroyed, 7 million people had lost power, often for two weeks, and that the total cost was estimated at over \$40 billion and increasing.<sup>(6,7)</sup>

Even before Sandy, in 1999 tropical storm Floyd and 2011 Hurricane Irene had inundated much of the state. In an op-ed article for the *Star-Ledger*, the widest-circulation newspaper in New Jersey, James

Lee Witt, former director of the U.S. Federal Emergency Management Agency (FEMA), wrote: “When everyone rebounds from Sandy, together New Jersey and its neighbors’ highest priority should be preparing for the next one – because it will happen.”<sup>(8)</sup> Witt’s remarks resonated with some elected officials, emergency management personnel, and many other professionals in New Jersey, and a great deal of analysis and planning focused on mitigation and resilience is underway.<sup>(9–14)</sup> Yet, is the public willing to reduce vulnerability by supporting policies that will redevelop devastated areas in ways that will make them less vulnerable to the next event?

Using data collected in New Jersey in February and March 2013, four months after Sandy and 19 months after Irene struck the east coast, we sought to answer two questions:

- (1) What proportion of New Jersey respondents support government-led programs that will restrict use of high-risk areas, such as allowing government to prohibit housing in some areas, require housing in some areas to be built in ways that makes it highly resistant to natural disasters, and in other ways reduce the likelihood of serious consequences?
- (2) What factors are most strongly associated with willingness to support these policies?

After stating seven expectations and reviewing the associated literature, the article uses a survey and statistical analyses and ends by describing the limitations of the study and the implications for theory and research.

## 2. BACKGROUND LITERATURE

This section describes elements of the literature that informed seven expectations.

### 2.1. Question 1: Support for Government-Led Mitigation and Resilience Programs

*Expectation 1:* A clear majority of residents of New Jersey in 2013 would support mitigation and resilience policies.

*Expectation 2:* Because Sandy most heavily impacted the New Jersey Shore, residents of that area of New Jersey would disproportionately support the policies.

Reynolds *et al.*<sup>(15)</sup> pointed out a lack of public knowledge about global climate change in the United States in the early 1990s, but 15 years later, U.S. res-

idents had a better understanding of global climate change. Other studies have added to our knowledge of public perceptions of global climate change.<sup>(16–19)</sup> A recent special issue on “Climate Change Risk Perceptions and Communication” in *Risk Analysis, An International Journal*<sup>(20)</sup> underscored a set of key issues in public response to the threat of global climate change. In the context of the current study, the authors show that the public has had psychological distance from global climate change.<sup>(21–24)</sup>

In the summer of 2013 in New Jersey, public ignorance of global climate change is hard to believe. Post-Sandy mass media polls provide evidence that a large segment of the population is close to the global climate change issue. In February 2013, Watson<sup>(25)</sup> reported that two-thirds of New Jersey residents want risk to be assessed before rebuilding. Spoto<sup>(26)</sup> reported that 58% of respondents felt that those who did not follow the FEMA’s rebuilding guidelines should forfeit federal resources, and two-thirds want people to rebuild their homes in ways that protect their homes against major weather events. Murray<sup>(27,28)</sup> conducted public opinion polls in December 2012 and February 2013. In December 2012, 38% of respondents said that they would do more to be prepared for the next storm; by February 2013, that number had increased to 42%. Over 80% favored storm-resistant buildings and 68% supported the construction of dunes, seawalls, or other water obstructions. Notably, 62% felt that the storms were more serious than they had anticipated and 42% expected a similar magnitude storm during the next five years.

A rare political bipartisan attitude about hazard mitigation and resilience seems to exist in New Jersey,<sup>(29)</sup> which should increase public support and permit serious consideration to urban planning, engineering, architecture, public health, and emergency-management-based ideas that can be broadly called mitigation and resilience.<sup>(30–32)</sup> One of these is avoidance, that is, do not allow nursing homes, police and fire stations, schools, and other sensitive land uses in areas that are very likely to flood. This policy can be accomplished by buying property in the most vulnerable areas and turning it into green space, less sensitive land uses, and by adopting zoning ordinances that forbid specific types of land uses, as well as steering investments in infrastructure away from flood-prone areas. Vulnerability is reduced by rebuilding damaged infrastructure away from sensitive locations and not adding new infrastructure in high-risk areas. A third clear policy is to require developers to build in ways that make structures highly resistant to

natural disasters, for example, by structure elevation and using more resistant building materials. Government grants and loans can enhance these design practices. The fourth and last approach is to use economic leverage to drive people out of high-risk areas. This can be done by declining or limiting insurance coverage, as well as by limiting the number of times someone can receive financial assistance. In fact, while FEMA has offered to buy out and relocate property owners, it can also decline to provide flood benefits if people do not relocate and are flooded again.<sup>(30)</sup> Seven variants of these four major options were used in this study as policy choices (see below).

Our expectation was that support for these options would be strongest in the shore areas of New Jersey that were hardest hit by the winds, waves, and flooding associated with Sandy. Indeed, some media polled only residents of these areas of the state. We surveyed the entire state, and for purposes of our survey, the remainder of New Jersey served as a comparison group.

## 2.2. Question 2: Correlates of Support for Mitigation and Resilience Policies

Those who are most supportive of the policies were expected to have the following attributes:

*Expectation 3:* A great deal of concern about the impact of global climate change.

*Expectation 4:* Willingness to contribute to a dedicated fund to rebuild devastated areas.

*Expectation 5:* Trust scientists who study global climate change and the federal government to play a major role in the land-use and building management program.

*Expectation 6:* Have egalitarian/collectivist worldviews.

*Expectation 7:* There will be relatively strong associations between concern about global climate change, trust of science and the federal government, egalitarian/collectivist worldviews, and willingness to contribute to a state program with funds dedicated to redevelopment of devastated areas. An important part of the analysis was to determine if these four attributes made distinct contributions to understanding support for the proposed policies or if they were so intertwined as to make their contributions statistically indistinguishable.

We consulted three literatures to answer this second research question (what factors drive support for the policy options). The first of these is about global climate change. In areas that have been repeatedly subject to extreme weather events, we assumed that people increasingly believe James Lee Witt's warning, quoted earlier, to prepare for these events because they will occur in the near future. Our expectation was that those who agree that global climate change is real, is a threat in the not too distant future to them and their family, and is a high priority for government to address would support all or many of the policies. Much of the literature, however, points out that those who oppose government policies have launched vigorous efforts to discredit the science<sup>(33,34)</sup> and for the public as a whole the impacts are not immediate and personal.<sup>(21,22)</sup> In New Jersey, we expected that many people would believe the scientists and find the issue personal and immediate because of the two storms, at least for a few years.

In New Jersey, strong personal recollections of previous tropical storm disasters would amplify personal feeling of concern. We expected, first, that first-hand experience with a hazard event that left strong distressing indelible so-called flashbulb memories<sup>(35-40)</sup> would increase support for the policies.

Being concerned about global climate change, we expected, would not suffice to motivate people to support policies that may imply a reduction of individual property rights. Supporters need to be persuaded that the people examining the science and in charge of implementing these policies are competent and will communicate honestly with them, and share some of their values. This expectation took us directly to the trust literature, which is well developed with case studies and theory that demonstrate the importance of the dimensions of trust based on competence, communications, and values.<sup>(41-44)</sup>

With that context, shortly after Sandy hit New Jersey, the state's political leaders, including the governor (a Republican), a member of the U.S. Senate from New Jersey (a Democrat), and three members of the U.S. House of Representatives from New Jersey (Democrats and Republicans), as well as members of the state legislature, all indicated that the federal government had important roles to play and was a partner in the process to redevelop devastated areas. The Republican governor worked publicly together with the Democratic President of the United States touring devastated areas; despite it being a presidential election year, the

governor continued to communicate and work with the president.<sup>(45,46)</sup> The very public bipartisan efforts, indeed, calling Sandy a bipartisan storm,<sup>(29)</sup> should have the effect of increasing the trust of government as a whole, and especially the federal government around actions related to Sandy.

The U.S. federal government is providing financial resources to New Jersey to address the devastation. New Jersey, according to Governor Christie, will receive \$20–\$25 billion from the U.S. federal government and private insurance.<sup>(47,48)</sup> The estimated damage and rebuilding costs are likely to be \$35 billion or more, leaving a large financial gap to fill. Hence, willingness to personally support some portion of the cost of these programs was expected to be an essential condition for supporting the policies. Personally contributing through income, sales, and other taxes, and through bonds and other financial mechanisms is well established, but the record tells us that the vast majority of people are not willing to contribute through these mechanisms.<sup>(49,50)</sup> We expected only those who were trusting and concerned about global climate change to support a policy that would obtain revenue to set aside to support rebuilding with mitigation and resilience as part of the plan.

We anticipated that egalitarian/collectivist world views would disproportionately be represented in the supporters of the policies. That is, respondents who believe that as a whole we would be better off if wealth is more equally distributed, that discrimination against minorities continues to be a serious problem, and that society should help disadvantaged people and would support programs designed to protect a collective of vulnerable people and places. Adults who identify with the Democratic Party are expected to be more supportive because these policies are viewed as collective and egalitarian. Yet, a recent survey<sup>(51)</sup> showed that Republicans increasingly want to reduce global climate change even if it means higher energy costs and more government regulation. Finally, with regard to demographic attributes, the literature suggests that gender (women), income, and education would increase support, but that age would not be predictive.<sup>(52–56)</sup> Overall, our key expectations were focused on concern about global climate change, trust of authorities, worldviews, and willingness to financially support these programs, with demographic attributes expected to be secondary factors.

We expected interactions among the variables used to operationalize expectations numbers 3–6 (expectation 7). The core part of the model expects

that willingness to support land-use and building policies is associated with perceptions about global climate change, feelings about trust, and egalitarian/collectivist values, and that these three interact. If a respondent is not worried about global climate change, it makes no sense for him or her to support policies that many U.S. residents consider interference with private property rights. Respondents who trust the science behind the consensus on global climate change should be concerned about that impact on them, their families, and communities. If these respondents also trust government to manage prevention and resilience programs, then they should support the land-use and building policies. Also, those who have a collectivist view rather than an individualistic perspective should be more supportive of a government-led set of policies to reduce vulnerability to individual homes, neighborhoods, and larger areas even if the individual does not directly benefit. For example, dunes protect buildings inland from beaches. Yet along the New Jersey shore, there was considerable angst when officials, including the governor, argued that new dunes were going to be constructed and older ones enhanced. The argument opposing dunes was that they interfered with ocean views and might lower property values.<sup>(14)</sup> We would expect those who believe that dunes will protect against future tropical storms, who trust engineers, architects, and planners to locate and design dunes, and who believe in protecting all assets inland of beaches would be the most supportive of dunes. Each of these three decision-informing drivers—concern about global climate change, trust, and egalitarian/collectivist worldviews—should have a strong feedback loop to the others.

The relationship of these three to willingness to personally support a dedicated fund for redeveloping devastated areas should be more tenuous. One reason is that some people do not believe that they have the economic resources to provide economic support. Second, the State of New Jersey has a recent history of diverting funds intended for education, smoking cessation, and other programs for other uses. It would not be irrational in this state to assume that the same diversion could happen to a fund dedicated for rebuilding devastated areas. Hence, while we expected strong relationships among global climate change, trust, and worldviews, their association with willingness to pay should be weaker. Shore versus nonshore location was expected to be independent of the other variables.

### 3. METHODS

#### 3.1. Questions

The survey data were gathered beginning about four months after Sandy hit New Jersey on October 29, 2012. We deliberately waited to conduct this survey in order to make sure that the public was not overly influenced by the immediacy of the event and to attenuate the corresponding media coverage. This is not to say that people were not emotionally involved in the follow-up of the storm when the survey was conducted, but putting four months temporal distance between the storm and the need to consider policy responses facilitated a greater balance of cognition and emotion in survey response. Also, several media-sponsored public opinion polls were conducted shortly after the event, and as noted earlier, we were able to draw on the results of these for our survey.

With respect to the first research question, risk-reducing options, we asked: "Some people are talking about efforts to try to reduce New Jersey's vulnerability to hurricanes. Here are some proposals that could be used in redeveloping the New Jersey shore. As I read each proposal, please let me know whether you agree strongly, agree somewhat, are neutral, disagree somewhat, or disagree strongly." The seven options, which were randomized in presentation, included (1) allowing local governments to prohibit housing in some areas, (2) requiring housing in some areas to be built to resist natural disasters, (3) giving financial incentives to rebuild in ways that reduce risk, (4) relocating infrastructure away from the most vulnerable areas, (5) having government purchase property in vulnerable areas and turn it into open space, (6) having government identify areas that must not be developed because they are natural buffers in the event of storms, and (7) not provide federal government money for those who had been flooded multiple times.

As noted, we expected that respondents had to be convinced that these storms are not isolated events, that global climate change is a major threat to them individually, and that the impacts it causes need to be a priority to address. Consequently, we asked respondents to tell us if they believe global climate change is a risk to them, their families, and their friends, as well as to the State of New Jersey as a whole.

We asked about global climate change in multiple other ways. For example, we provided respon-

dents with 11 indicators of the impacts of global climate change and asked respondents to indicate which of these was of greatest concern, including higher allergy and asthma rates,<sup>(57,58)</sup> the spread of infectious disease, increased likelihood of drought, and seven other outcomes. The options were as follows: (1) great concern, (2) some concern, (3) little concern, and (4) no concern. Don't know and refused were also recorded. Our assumption was that respondents who felt that many or all of these were of concern would be more likely to support the risk-reducing policies.

Another way of assessing public concern about reducing vulnerability and rebuilding damaged areas was to compare their concern with other common priorities. Limiting property taxes and controlling auto traffic have been major public concerns in this and most other places for many years.<sup>(46)</sup> We provided these two, along with education, healthcare, and protecting open space, as well as redevelopment of areas devastated by Sandy. Those who prioritized redevelopment of devastated areas as a high priority were expected to support the policies.

Another probe about the link between willingness to support restrictive policies and global climate change asked if recent hurricanes in New Jersey had changed respondent beliefs about global climate change. The objective was to determine the proportion that believe that global climate change is occurring, and to assess the extent to which recent hurricanes have either strengthened that view or increased the level of concern. A final set of questions about global climate change assumes that respondents who have deep-seated memories of past devastating storms would be more likely to commit to these policy changes.<sup>(35-40)</sup> In this case, we examined the relationship between "flashbulb memories" of four events. In the preamble to the questions, respondents were asked how much they remembered about four major hazard events. Response options were "not much," "a few details," "many details," and "many details and clearly remember where I was when I learned about it." The four events, randomized in presentation, included the World Trade Center attack in 2001, and Katrina, Irene, and Sandy. Since the focus of the analysis was tropical storms, we only counted the three storms in building the variable. Those who responded that they "remember many details and where I was when I heard about the event" were coded as having a "flashbulb" memory. We used the total number of flashbulb memories of Katrina, Irene, and Sandy as a predictor. We

expected those with more flashbulb memories of these painful events to be more concerned about major hazard events and, in turn, likely to support the policies.

As noted, three other conditions also had to be present to predict policy support. One was that supporters of the policy changes should trust scientists who have developed the data and government officials who must develop and implement the policies and communicate information. Consequently, we asked multiple trust questions. One set of questions asked how much respondents trust the international scientific community's understanding of the science behind global climate change, and the ability of the scientific community to accurately report its findings. We asked the public about state and local officials' understanding of the implications of global climate change and about the media's capability of communicating that information to the public.

A key expectation is that strong support for these policies depends on trust of the federal government. Even though these seven restrictive policies would be implemented largely at the local scale, the public must believe that the federal and secondarily state government can competently organize and manage the program, wisely use the resources, and communicate information in an accurate and timely manner to the public. Accordingly, we asked respondents which of these four groups they most trusted to manage redevelopment and rebuilding of storm-devastated parts of New Jersey: the federal government, the state government, local governments, or private developers. Those who supported the federal government were expected to be more supportive of the seven policies.

Respondent worldviews were expected to be part of the attribute set that supported the policies. Some people have a tendency to be individualistic, that is, focused on their own needs, whereas others are more heavily committed to the needs of society as a whole, including its least affluent and powerless members.<sup>(59,60)</sup> We asked three commonly used questions that should be associated with reaction to government policy changes. Our assumption was that those who favored a more equal distribution of wealth, who believed that discrimination was still a serious issue, and who disagreed that too many people expect society to do things for them that they should do for themselves would support these policies as part of their worldview.

The fourth condition for support of the policies was willingness to help pay for these programs. While it is true that New Jersey, New York, and other states have been receiving funds from the federal government to pay for the cleanup and redevelopment of devastated areas, as noted, we do not believe that the resources available from the federal government will be sufficient to fully implement the policies. Consequently, we asked respondents to rate proposals for generating more funds dedicated exclusively to reduce New Jersey's vulnerability to hurricanes. The five options were as follows: (1) raise state income taxes across the board by 1% for five years; (2) raise state sales taxes by 1% for five years; (3) add a special additional 1% tax on hotels, motels, airports, and other recreation facilities; (4) approve a multibillion-dollar bond issue to be paid out over 30 years; and (5) add an additional 5 cents per gallon gasoline tax for five years. The options were as follows: (1) strongly agree; (2) somewhat agree; (3) neutral; (4) somewhat disagree; and (5) strongly disagree. While we did not expect any of these options to be popular, we anticipated that those who were willing to support all or any of them would be stronger supporters of the land-use policies.

We expected some respondents to be pessimistic about the future of the environment in their own region and that these pessimists would support the land-use policies. The Democratic Party is thought to be associated with more active government and greater support for environmental protection programs; thus, respondents who identified with the Democratic Party were assumed to be more supportive of the policies.<sup>(61,62)</sup>

### 3.2. Survey Administration

Given the large number of cell-phone-only individuals, it was essential to include a cell phone sample supplement. Cell phone interviews are significantly more expensive to collect than landline interviews because younger individuals are disproportionately cell-phone-only and cell numbers do not consistently reflect current address. However, a supplement is necessary to prevent survey estimates from overrepresenting older populations.<sup>(63,64)</sup> As such, the survey protocol included a dual-frame sample of landlines (65%) and cell phones (35%). The sample size target was 875 and the population was noninstitutionalized persons 18 years and over living in New Jersey. As described later, the data were weighted

to reduce the limited bias that was observed. We observed the American Association for Public Opinion Research's protocols, which eliminate telephones not in service and exclude businesses and other inappropriate landline numbers. In the case of cell phones, we had to eliminate more numbers because, under number portability, many people take their cell numbers with them when they move; thus, although they may retain a New Jersey area code, they are no longer New Jersey residents.

To increase our cell phone sample, we offered to provide cell phone sample respondents a \$10 cash incentive. Landline and cell phone numbers were called as many as eight times in order to increase response rates to approximately 20% and cooperation rates close to 30%. The response rate is the number of complete interviews divided by the number of eligible respondents (18+ years old and New Jersey resident). The cooperation rate is the proportion of completed interviews divided by the number of completed, partial interviews, number of refusals, and breakoffs (see Appendix A for more detail). To reduce bias, phone calls were made at different times of the day and days of the week, including weekends.

### 3.3. Analysis

A variety of statistical tools were used to analyze the data. Each of the seven policy variables was examined as part of answering the first research question (support for increased management of vulnerable land and properties). However, we also assumed that the collective response to the seven might reveal a cadre of respondents who support all or almost all of the policy options. This possibility was tested with Cronbach's  $\alpha$  to determine if the seven variables constituted a single scale and then with principal components analysis to confirm the result. The same methods were used to determine if there was a single dimension that included willingness to spend, global climate change, trust, and the egalitarian/collectivist indicators, or if there were four statistically independent sets of variables.

With regard to the second research question (correlates of support for the increased management of vulnerable land and properties), we used two different approaches. One is linear regression of all the predictors with the dependent variable. The advantage of that approach is that readers can see the correlations between each predictor variable and the dependent variable. The disadvantage is that there are

many independent variables, which makes it cumbersome to isolate the key elements of the model and the interactions among them. While these calculations are presented in Appendix C, only a few are noted in the text.

The alternative was to use principal component analysis to explore the interrelationships between concern about global climate change, trust, worldviews, and willingness to support a dedicated fund, and use the component scores from principal components analysis in regression analysis. In addition, residence in a New Jersey shore county was input as a dichotomous variable in regression analysis.

## 4. RESULTS

The surveys were pretested, which led to minor changes in several questions. Formal data gathering began on February 15, 2013, and ended on March 27, 2013. The first two authors wrote the questions, and data were collected by Abt-SRBI. A total of 875 surveys were collected. In order to collect the data, a total of 35,565 cell and landline numbers were used. A total of 24,689 were not eligible and the eligibility of 4,905 could not be determined because of call blocks, and no answer after eight calls. The final response rates were 19.4% and 17.4% for the landline and cell surveys, respectively, and the cooperation rates were 37.5% and 34.0%, respectively (see Appendix A). The survey was administered in English with a Spanish-language option. Approximately 3% of the sample opted to complete the interview in Spanish.

We compared the sample with the state population baselines for differences by age, race, and gender using the 2009–2011 American Community Survey, and the cell phone use information came from the January–June 2012 National Health Interview Survey.<sup>(65,66)</sup> While the sample was weighted, it should be noted that weighting does not entirely eliminate all survey bias that may result from non-sample effects, such as question wording or order (see Appendix B for the major demographic characteristics of the sample before and after weighting).

### 4.1. Question 1: Support for Restrictions on Sensitive Land Uses

Table I shows that 53% to 63% of respondents strongly favored allowing local governments to require housing in some areas to be built in ways

**Table I.** Proportion of Respondents Who Supported Land-Use, Design, and Financial Changes, Phone Survey of New Jersey Residents, February 15, 2013 to March 27, 2013

Summary Data	Shore <sup>b</sup> or Not Shore	Strongly Agree, %	Somewhat Agree, %	Neutral, %	Somewhat Disagree, %	Strongly Disagree, %
Allow local governments to require housing in some areas to be built in ways highly resistant to natural disasters ( <i>n</i> = 864)	All	62.5	22.4	8.0	3.3	3.7
	Shore	63.7	23.6	6.2	2.5	4.1
	Not shore	60.8	21.1	10.5	4.3	3.2
Have the federal and state government identify the areas to not be developed as they provide natural buffers in the event of storms ( <i>n</i> = 855)	All	61.3	22.3	10.7	2.7	3.9
	Shore <sup>a</sup>	58.6	20.8	13.6	3.3	3.7
	Not shore	64.7	24.2	6.8	2.2	2.2
Relocate water, sewer, natural gas, roads, and other infrastructure away from the most vulnerable areas of the state ( <i>n</i> = 857)	All	53.0	25.8	12.2	4.8	4.3
	Shore	53.3	24.7	12.7	5.0	4.4
	Not shore	52.9	26.6	11.8	4.4	4.1
Have the government give financial incentives to rebuild in ways that reduce future risks ( <i>n</i> = 866)	All	49.1	30.8	10.2	4.3	5.5
	Shore	50.5	29.7	11.5	3.9	4.5
	Not shore	47.2	32.3	8.6	4.9	7.0
Allow local governments to prohibit housing in some areas ( <i>n</i> = 859)	All	42.5	26.6	13.6	9.0	8.3
	Shore	40.0	27.5	14.8	8.4	9.4
	Not shore	45.8	25.6	12.3	9.5	6.8
Limit the number of times homeowners in high-risk areas may receive federal disaster relief ( <i>n</i> = 859)	All	38.2	21.5	11.7	9.2	19.4
	Shore	38.5	19.3	14.0	9.9	18.3
	Not shore	38.1	24.5	8.7	8.4	20.3
Have the federal and state government purchase property in vulnerable areas and turn it into open space ( <i>n</i> = 862)	All	35.0	25.8	17.6	11.2	10.4
	Shore	32.6	26.9	17.5	12.5	10.5
	Not shore	38.4	24.3	17.8	9.2	10.3

<sup>a</sup>Shore counties are significantly different than nonshore counties at  $p < 0.05$  with a chi-square test.

<sup>b</sup>Shore counties are Atlantic, Bergen, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean, Union. Nonshore counties are Burlington, Camden, Cumberland, Gloucester, Hunterdon, Mercer, Morris, Passaic, Salem, Somerset, Sussex, and Warren.

highly resistant to natural disasters, have the federal and state governments identify the areas to not be developed as they provided natural buffers in the event of storms, and relocate water and other infrastructure away from the most flood-prone areas. Forty-nine percent favored allowing the government to provide financial incentives to rebuild in ways that reduce future risk, and 42% supported the idea of prohibiting housing in some areas. And, 35% to 38% strongly favored limiting the number of times homeowners in high-risk areas may receive federal disaster relief, and having the federal and state government purchase property in vulnerable areas and turn it into open space. Overall, 49% “strongly favored” four or more of the seven policy options, and the proportion strongly and somewhat favoring each of the options ranged from 61% to 85%. Overall, Table I shows considerable support for the policies.

Table I shows only minimal differences between shore and nonshore respondents, in other words, expectation 2 was not met.

In general, when a respondent favored one of the seven policies he or she also favored the others. Seven variables produce 21 bivariate correlations ( $7 \times 6/2 = 21$ ). Twenty of the 21 were positively correlated. The one exception was the policy limiting the number of times homeowners may receive financial disaster relief. That variable had lower correlations with all the other six. Cronbach’s  $\alpha$  between the seven variables was 0.592, less than the minimum number of 0.6 typically used as a value necessary for a reliable scale. This exception was also confirmed by a principal component analysis that showed that the financial disaster relief variable did not fit into a single factor. When that variable was dropped as part of a common factor, Cronbach’s  $\alpha$  rose to 0.624 and a single statistical factor was created from the other six policies. We call that resulting component, which indicates support for increased management of vulnerable land and properties, “reduce vulnerability policies.”

Table II shows the composition of that variable. The strongest elements were having the federal and

**Table II.** Elements of the Reduce Vulnerability Policies Component, Telephone Survey of New Jersey Residents, February 15, 2013 to March 27, 2013

Variables <sup>a</sup>	Component Loadings ( <i>r</i> values)
Have the federal and state government identify the areas to not be developed as they provide natural buffers in the event of storms	0.677
Allow local governments to prohibit housing in some areas	0.620
Have the federal and state government purchase property in vulnerable areas and turn it into open space	0.612
Allow local governments to require housing in some areas to be built in ways highly resistant to natural disasters	0.568
Have the government give financial incentives to rebuild in ways that reduce future risks	0.488
Relocate water, sewer, natural gas, roads, and other infrastructure away from the most vulnerable areas of the state	0.476

Note: Eigenvalue of this component was 2.0, or 33% of cumulative variance.

<sup>a</sup>All variables were measured on a 1–5 scale where 1 = strongly agree and 5 = strongly disagree.

state government identify the areas to not be developed as they provide natural buffers in the event of storms ( $r = 0.677$ ) and allowing local governments to prohibit housing in some areas ( $r = 0.620$ ). The weakest correlates of the reduce vulnerability factor were having the government give financial incentives to rebuild in ways that reduce future risks ( $r = 0.488$ ) and relocating infrastructure away from the most vulnerable locations ( $r = 0.476$ ).

#### 4.2. Question 2: Association with Concern About Global Climate Change, Trust, Worldviews, and Willingness to Contribute to a Dedicated Fund

Principal component analysis helped reduce the 21 variables to two components that were then used in linear regression analysis. The first column of Table III shows the correlations resulting from the first component of all 21 indicators of global climate change, trust, worldviews, and willingness to pay. Each set has multiple correlations of  $>0.5$ , with the exception of willingness to pay, which has none  $>0.4$ . This finding demonstrates that willingness to pay is not tightly coupled with the

set of global climate change, trust, and worldview indicators.

Columns 2 and 3 of Table III show the results of two additional principal component analyses. The first captures the interrelationships of the 16 global climate change, trust, and worldview indicators. The strongest correlations (column 2) are with global climate change as a personal risk ( $r = 0.756$ ), and respondent trusts the knowledge of the international scientific community about global climate change ( $r = 0.720$ ). Seven other variables showed correlations of  $>0.5$ : global climate change is risk to New Jersey ( $r = 0.689$ ), an 11-variable scale measuring perception of global climate change impacts ( $r = 0.649$ ), trust the scientific community to report its findings to the community ( $r = 0.631$ ), global climate change is caused by humans ( $r = 0.608$ ), believe global climate change is occurring and recent hurricanes strengthen that belief ( $r = 0.570$ ), society is better off if the distribution of wealth was more equal ( $r = 0.593$ ), and discrimination against minorities is still a very serious problem in the United States ( $r = 0.530$ ).

These nine indicators in a single component identify people who are concerned about global climate, trust the scientists who work on the issue, and believe that the United States has egalitarian/collectivist challenges, presumably including the management of global climate change. The opposite pole includes the smaller group of people in New Jersey who are not concerned about global climate change, who do not trust the science of global climate change, and who do not recognize the egalitarian/collectivist challenges. This component was called perceptions and values associated with global climate change and was used in the regression analysis.

Column 3 of Table III is a principal component of the five indicators of willingness to support an economic fund for redeveloping devastated areas. Those who are most willing to do that support raising state sales tax by 1% for five years ( $r = 0.736$ ), and state incomes taxes across the board by 1% for five years ( $r = 0.667$ ). Other contributors to the component are adding a 5 cents per gallon tax on gasoline for five years, a special additional tax of 1% on hotels, motels, airports, and recreation facilities for five years, and approving a multibillion-dollar bond issue to be paid out over 30 years. Table IV shows how relatively few respondents are willing to support the policies. The component scores of this

**Table III.** Three Principal Component Analyses of Correlates of Support for Land-Use and Building Control Policies (Numbers in the Table Are Correlations Between Variable and Component)

Component	Component Loadings, All 21 Variables Included	Perceptions & Values Associated with Global Climate Change	Willingness to Contribute to a Special Fund
<i>Concern about global climate change:</i>			
Global climate change is a risk to me, my family, and my friends	0.730	0.756	
Global climate change is a risk to New Jersey	0.662	0.689	
I believe global climate change is occurring, and recent hurricanes have strengthened that belief	0.533	0.570	
Global climate change is caused by humans	0.591	0.608	
Scale of 11 indicators of impact of risks associated with global climate change	0.655	0.649	
Global climate change not occurring	-0.558	-0.410	
<i>Trust of authorities:</i>			
Trust the scientific community to honestly report its findings related to climate change	0.645	0.631	
International scientific community understands the science behind global climate change	0.713	0.720	
Media I rely on communicates to us honestly	0.482	0.472	
Our state and local officials understand the implications of global climate change for our region	0.413	0.385	
Trust federal government to manage redevelopment	0.268	0.289	
<i>Worldviews:</i>			
Society better off if distribution of wealth was more equal	0.576	0.593	
Self-identify as Democrat	0.434	0.455	
Discrimination against minorities is still a very serious problem in our country	0.544	0.530	
Local environment will be worse in 25 years	0.123	0.137	
Too many people expect society to do things for them that they should be doing for themselves	0.269	0.385	
<i>Willingness to pay:</i>			
Raise state sales tax by 1% for five years	0.366		0.736
Raise state income taxes across the board by 1% for five years	0.329		0.667
Add a 5 cents per gallon tax on gasoline sales in New Jersey for five years	0.311		0.650
Add a special additional tax of 1% on hotels, motels, airports, and recreation facilities for five years	0.318		0.593
Approve a multibillion-dollar bond issue to be paid out over 30 years	0.380		0.510

willingness to pay component was used in the regression analysis.

Table V is the linear regression analysis of the reduce vulnerability policies component (Table II) with the perceptions and values associated global climate change component ( $\beta = 0.289$ ,  $p < 0.01$ ), the willingness to contribute to a special fund component ( $\beta = 0.208$ ,  $p < 0.01$ ), and the shore versus nonshore resident dichotomy ( $\beta = -0.08$ , not significant at  $p < 0.05$ ). The adjusted multiple  $r^2$  value was 0.167.

Looking at the longer list of individual correlation coefficients in Appendix C, there is not much to add. The strongest single correlate was the willingness to contribute to a designated fund (partial

$r = 0.208$ ). Table IV, however, underscores the small set of respondents willing to contribute to any of these programs: less than 25% for sales, income, and gasoline taxes. The second strongest correlate was created from the 11 potential impacts of global climate change such as allergies, asthma, drought, heat waves, floods, and others (partial  $r = 0.193$ ).

## 5. DISCUSSION

For those who hope the public has become more aware of extreme climate events<sup>(67)</sup> and supportive of policies that mitigate the threat and introduce resilience, these survey results are both positive and negative. The positive message is that almost half of

**Table IV.** Willingness to Support Revenue-Generating Policies in Support of Protecting Vulnerable Areas

Policy	Agree or Strongly Agree, %	Neutral, %	Disagree or Strongly Disagree, %
Add a special additional tax of 1% on hotels, motels, airports, and recreational facilities for five years	52.5	14.3	33.2
Approve a multibillion-dollar bond issue to be paid out over 30 years	42.0	29.5	28.5
Raise state sales tax by 1% for five years	24.2	11.3	64.4
Raise state income taxes across the board by 5% for five years	19.0	12.4	68.6
Add a 5 cents per gallon tax on gasoline sales for five years	14.4	7.8	77.8

**Table V.** Linear Regression Analysis Results of Support for Policy Options to Reduce Vulnerability

Variable	B-value (Standard Error)	$\beta$ value	<i>t</i> -value
Perceptions & values associated with global climate change (component composed of 16 variables)	0.293 (0.037)	0.289	7.86 <sup>a</sup>
Willingness to contribute to a special fund (component composed of five variables)	0.208 (0.038)	0.203	5.53 <sup>a</sup>
Shore resident (1 or 0)	0.080 (0.070)	0.039	1.14
Constant	0.108 (0.106)		1.03

Note: *F*-value was 47.6, adjusted *r*<sup>2</sup> was 0.167, and degrees of freedom were 709.

<sup>a</sup>Statistically significant relationship at *p* < 0.01.

the respondents “strongly” supported at least four of the seven policies, and 30% favored five of the seven. If somewhat supported is included along with strongly supported, the proportion favoring four of seven of the options is about four out of five respondents, a clear plurality. Also, perceptions and val-

ues about global climate change was the strongest factor predicting support for the mitigation and resilience policies. Indeed, 64% of respondents agreed that global climate change is a risk to them, their family, and friends. Even though there is no proof that Irene or Sandy were part of global climate change, after several massive storms, the idea of the importance of global climate change and its impacts on the state has become conventional wisdom, right or wrong, at least for now.

These findings or others in the literature<sup>(67)</sup> do not mean that the policies suggested in this article and also in public meetings for reducing vulnerability will be promulgated. While many do support most of the policies, two obstacles emerge from this article. One is more than half of respondents do not feel that the state and local governments understand the implications of global climate change for their region, and about two-thirds do not trust their local media to inform them about events. Furthermore, there is a generic distrust of the federal government among many in this and other states. It seems to us that the responsible parties need to create a proactive and ongoing dialogue that involves them in contact with each other and with the public. We would personally feel more confident if the government partners had already established a communications protocol targeted at community groups to create a social movement in some of the hardest-hit communities.<sup>(22)</sup> This is being done by several universities and foundations in selected jurisdictions. But their resources are limited in space and time. No such policy consensus or communications program has emerged, and we fear the longer it takes to produce one the easier it will be for the public to disengage from the issue until the next extreme weather event. Moreover, we are concerned that the public will be overstimulated for a short time by so many warning messages that have no follow-up, and that the public will lose interest.<sup>(5,68–71)</sup> Indeed, we speculate that we already see evidence of public disconnection at public meetings as people try to create a new normal for themselves and ignore general policy debates about building the state in a more environmentally sustainable way that may have little direct impact on their lives over a year after Sandy. Based on personal observations of the authors of this article who have attended meetings, many speakers are voicing distrust at the state’s allocation of funds. They have been asserting that the funds are being allocated to address political promises rather than public needs.

Perhaps even more problematic is paying for a sustainable future. As indicated by its governor, New Jersey will receive tens of billions of dollars from the federal government and insurance companies. These funds will address some of the devastation, but if that is the end of the resources, and the state has to rely on raising revenue, then many of these policies will not be implemented, even if they are promulgated. The unwillingness of more than a small fraction of respondents—only about one in five—to contribute to a fund for this purpose through an increase in income taxes, sales taxes, and gasoline taxes was striking. More were willing to rely on bonds and taxes at sports arenas, motels, and other recreation and short-stay facilities, that is, the consensus was to pass the cost to future generations or to visitors, many of whom will not be from the state.

We point to several important study limitations. Given these findings, it would have been useful to have had focus groups or face-to-face conversations with people who would have provided a more nuanced understanding of the respondents. For example, it is possible that the lack of public support to contribute via taxes is a manifestation of lack of income, but we doubt it because people in the highest income category were equally unwilling to contribute as people in the lowest. It is also possible that respondents remember previous “dedicated” money from gambling casinos and cigarette health impacts that were received by the state and shortly became part of the overall revenue stream rather than being dedicated. More in-depth exploration of these kinds of issues requires additional rigorous qualitative research. We think that this is the most critical need for extending this work, and some of it is underway. Are there funding mechanisms that the public is more willing to support than those we tested? Would, for example, the public be willing to support a mechanism that targeted state funds at more resilient infrastructure locations and construction or on buyouts of vulnerable land?

Sample size was a limitation. It would have been desirable to have oversampled in areas that we knew were badly devastated by the events to further close the psychological distance gap.

With regard to building theory to better explain public response to hazard events and policies, we use this data set to underscore a long-standing sore point that limits this kind of research. Lurie *et al.*<sup>(72)</sup> contend that government needs to be more assertive about research on emergency events. Pointing to the H1N1 pandemic, the Deepwater Horizon oil spill, Fukushima Daiichi, the Haiti earthquake, Irene, and

others, they assert that we fail to learn more because we do not have a set of key questions before the event, a plan of action as it unfolds, scientists available at short notice, rapid IRB approval, and that these and others constraints make it difficult, if not infeasible, to develop the most effective design. In this case, the best scenario would have been to have asked many of the same questions a year earlier so that there would have been a control population. Ideally, this would have been a longitudinal survey that would have asked exactly the same people the same questions, although these types of surveys have dropout rates. Alternatively, at a minimum it would be good to at least have a repeat survey of the same area. Lacking the historical data, we cannot tell precisely how much the set of tropical storms have changed these relationships.

The U.S. National Science Foundation does make small grants available during these kinds of events, and researchers are sometimes able to scramble and find other sources of funding as we did in this instance. But Lurie *et al.*<sup>(72)</sup> call for a dedicated effort to develop standardized questions and designs for these kinds of events that will allow analysts to quickly and decisively respond to the events knowing that their results can be compared with others that used the same protocol. Notwithstanding the limitations of the study, the results add a different emphasis to theory building about the impacts of global climate change on public perceptions and behaviors. Here the emphasis was not on willingness to walk or bike more, and use energy-efficient appliances and cars, and in other ways use fewer resources, which has been the focus of a great deal of the global climate change research. Our emphasis is on land-use, building, and financial policies that are normally considered interference with private rights and yet would reduce the number of people killed and injured, evacuated and displaced, and property destruction in a region that badly needs such policies sooner rather than later. The statistical analyses offer literature-grounded hints as to why some people are receptive to these policies and others are not. Candidly, given the increasing temporal distance from the events, the high costs of following the seven policy alternatives, and the powerful politics behind allocating billions of dollars in a state with many ambitious political officials, barring another major event, we expect the group focusing on global climate change and associated values to shrink and the large group unwilling to economically contribute beyond what the state receives from the federal government and insurance companies to increase.

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**Human Participant Protection:** The survey was reviewed and approved by the Rutgers University Institutional Review Board.

**APPENDIX A: DATA METHODOLOGY REPORT**

The table immediately below summarizes the data disposition for the survey. The survey collected 1,750 responses. Some respondents were asked all the questions, and others were asked half the questions.

Category	Landline	Cell
Total phone numbers used	26,120	9,445
Completes and screen outs, %	4.6	11.1
Partial interviews, %	0.2	0.3
Refusal and break off, %	7.9	21.9
Non contact, %	7.3	22.3
Other, %	0.9	1.6
Unknown, %	14.5	11.9
Not eligible, %	64.6	30.9

**APPENDIX B: DEMOGRAPHIC ATTRIBUTES OF RESPONDENTS: WEIGHTED AND UNWEIGHTED**

The table below compares the unweighted and weighted results. The weighting benchmarks came from the 2009–2011 American Community Survey.

Attribute	Weighted, %	Unweighted, %
<b>Location:</b>		
Shore	56.9	56.8
Not shore	43.1	43.2
<b>Education:</b>		
Less than high school	5.4	2.8
High school graduate	34.4	20.7
Vocational/technical/some college	16.4	14.9
Junior college grade, associate degree	11.1	11.6
Four-year college graduate	19.3	24.7
Graduate work	12.8	24.8
Don’t know/refused	0.5	0.3
<b>Age group:</b>		
18–34	25.2	17.0
35–54	38.6	37.5
55–74	26.8	36.1
75+	8.7	8.6
Don’t know/refused	0.8	0.8
<b>Race:</b>		
Latino	14.0	10.1
White	68.6	73.9
Black	13.6	10.5
Asian	5.4	5.9
Native American	2.8	1.7
Don’t know/refused	9.6	8.0

**APPENDIX C: SUPPORT OF RISK MANAGEMENT PRACTICES, GLOBAL CLIMATE CHANGE, TRUST, AND COST—TELEPHONE SURVEY OF NEW JERSEY RESIDENTS, FEBRUARY 15, 2013 TO MARCH 27, 2013**

The following table shows the partial correlations between each of the predictors and support for the mitigation and resilience variables. The step-wise model highlights the strongest predictors.

Variable	Partial Correlations	Partial Correlations
Global climate change indicators model	Model 1	Model 4, stepwise
Concern about global climate change, scale (11–44)	0.193 <sup>a</sup>	0.175
High priority to redevelop areas of New Jersey devastated by Hurricane Sandy (1 = important, 0 = not)	0.093 <sup>a</sup>	0.089
Global climate change is a risk to New Jersey (1 = agree, 0 = disagree)	0.063 <sup>a</sup>	
Global climate change is a risk to me, my family, and friends (1 = agree, 0 = disagree)	0.036	
Recent hurricanes strengthened my belief about global climate change or made me question my views (1 = agree, 0 = disagree) <sup>a</sup>	0.066 <sup>a</sup>	
Number of flashbulb memories of three hurricanes (0–3)	0.028	
Adjusted multiple $r^2$	0.129	
Trust, cost, and worldviews model	Model 2	
Willing to pay personal and state resources to redevelop shore (5–25)	0.208 <sup>a</sup>	0.206
The international scientific community understands the science behind global climate change (1 = agree, 0 = disagree)	0.065 <sup>a</sup>	0.089
Our society would be better off if the distribution of wealth was more equal (1 = agree, 0 = disagree)	0.067 <sup>a</sup>	0.076
Trust federal government the most to manage shore redevelopment (1 = yes, 0 = no)	0.068 <sup>a</sup>	0.066
Discrimination against minorities is still a very serious problem in our country (1 = agree, 0 = disagree)	0.055 <sup>a</sup>	
I trust scientific community to truthfully report its findings related to climate change (1 = agree, 0 = disagree)	0.105 <sup>a</sup>	
Trust state government the most to manage shore redevelopment (1 = agree, 0 = disagree)	0.029	
Our state and local officials understand the implications of global climate change for my region (1 = agree, 0 = disagree)	0.068 <sup>a</sup>	
Too many people expect society to do things for them that they should be doing for themselves (1 = agree, 0 = disagree)	0.006	
The media I rely on communicate honestly with us about global climate change (1 = agree, 0 = disagree)	0.002	
Trust local government the most to manage shore redevelopment (1 = yes, 0 = no)	0.008	
Adjusted multiple $r^2$	0.153	
Demographic and other attributes	Model 3	
Latino respondent (1 = yes, 0 = no)	–0.119 <sup>a</sup>	
Respondent identifies as Democrat (1 = yes, 0 = no)	0.104 <sup>a</sup>	
Respondent age (1 = 18–34, 2 = 35–54, 3 = 55–74, 4 = 75+)	–0.103 <sup>a</sup>	–0.087
Perceive that local environment will be worse in 25 years (1 = yes, 0 = no)	0.090 <sup>a</sup>	0.075
Respondent did not graduate from high school (1 = yes, 0 = no)	0.079 <sup>a</sup>	
Respondent identifies as white (1 = yes, 0 = no)	0.074	0.102
Female respondent (1 = yes, 0 = no)	0.068 <sup>a</sup>	
Respondent has a college degree (1 = yes, 0 = no)	0.055	
Respondent lives in one of the shore counties (1 = yes, 0 = no)	0.053	
Respondent lives in South New Jersey (1 = yes, 0 = no)	–0.069 <sup>a</sup>	
Respondent annual family income >\$100,000 (1 = yes, 0 = no)	0.012	
Adjusted multiple $r^2$	0.051	0.209

<sup>a</sup>Bivariate correlation statistically significant at  $p < 0.05$ .

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