

Stakeholder Engagement Report: Agriculture

Climate Change Preparedness in New Jersey

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Introduction

This report documents work on behalf of the New Jersey Climate Adaptation Alliance to understand climate change preparedness in New Jersey's agriculture sector. The New Jersey Climate Adaptation Alliance (the Alliance) is a network of private sector practitioners, academics, non-governmental organizations and business leaders working to build climate change preparedness capacity in New Jersey. Stakeholder engagement in various sectors (e.g., public health, natural resources, water resources, built infrastructure, coastal communities and so forth), has been conducted on behalf of the Alliance to document the current state of practice in New Jersey regarding climate change adaptation planning and implementation. This outreach process has been conducted to inform development of public policy recommendations to enhance climate change preparedness in New Jersey.

Background: Agriculture in New Jersey

The agricultural community in New Jersey consists of farmers, service providers, regulators and other organizations responsible for growing crops, livestock, and nursery plantings. In addition, the agricultural community considered here includes those entities involved in aquaculture (e.g. shellfish growing and harvesting) and commercial fishing. Agencies supporting agriculture in the state include agencies that are responsible for the optimal use and preservation of farmland. Each stakeholder group has a unique perspective on climate change adaptation and the policies that could be set forth to improve preparedness in New Jersey.

Traditional agricultural products in New Jersey include crops that are farmed for commercial sale, such as tomatoes sold at a farmer's market or grain sold to a feed mill. Farmers produce more than 100 different kinds of fruits and vegetables. New Jersey ranks among the top ten states for production of blueberries, cranberries, peaches, tomatoes, bell peppers, snap beans, cucumbers, spinach, and squash. In 2012, 10,300 farms generated cash receipts totaling \$1.12 billion, with the nursery/greenhouse/sod industry generating cash receipts of \$453.6 million. Cash receipts for fruits and vegetables totaled \$428.8 million, followed by field crops with \$112.2 million. Equine brought in \$46 million, while the sale of poultry and eggs generated \$30.7 million. Dairy industry sales were valued at \$27.5 million. In addition, growers produced hundreds of thousands of dollars of specialty crops, including the state's 46 vintners. Fish and seafood are also a valuable commodity adding another \$211.7 million to the value of agriculture in New Jersey. ¹

¹ New Jersey Department of Agriculture. 2012. Overview of Agriculture in the Garden State. Available at: <http://www.state.nj.us/agriculture/about/overview.html>

Farms in New Jersey cover 800,000 acres in fertile areas such as the Wallkill and Delaware Valleys, the Highlands region, and the Pinelands bogs. Agricultural practices are governed by a number of state agencies in New Jersey. The New Jersey Department of Agriculture's (NJDA) Division of Agricultural and Natural Resources (DANR) is responsible for a variety of services and programs for agriculture and related agribusinesses. The DANR also coordinates between various state and federal agencies and provides assistance in the development of policy positions on land use planning issues on the State Planning Commission. It administers programs to conserve soil, water and related natural resources through the State Soil Conservation Committee and the 15 local soil conservation districts, and provides and oversees the administration of financial cost-share assistance to farmers for soil and water conservation projects. Federal agency involvement includes the United States Department of Agriculture and United States Environmental Protection Agency (USEPA), while additional support and regulation at the state level is provided by the New Jersey Department of Environmental Protection (NJDEP), particularly for management of water quality and resources.

Fisheries off the coasts of New Jersey are regulated under the National Marine Fisheries Service through the Mid-Atlantic Fishery Management Council. The council, along with NJDEP and NJDA are responsible for managing different aspects of the fisheries population, habitat, commercial fleet operations, and other aspects. The NJDEP also works to protect habitats for aquatic species, in conjunction with regional and federal fisheries management agencies and the USEPA.

Aquaculture is viewed and regulated as an agricultural pursuit, as opposed to a natural resource in the way wild fisheries are managed. The NJDA is the lead state agency responsible for aquaculture. In 2004, the NJDA initiated the New Jersey Aquatic Farmer License (AFL) program. The NJDEP is responsible for the leasing of shellfisheries and permitting for aquaculture operations along the New Jersey coast in conformance with the Coastal Zone Management Program. The New Jersey Department of Health and Social Services is responsible for guidance for processors, along with the NJDEP who jointly monitor shellfisheries for food safety. Federal oversight and support for aquaculture comes from the USDA through various sources such as the Conservation Loans, Beginning Farmers Loans, or other funding vehicles.

Approach

Stakeholders were engaged via multiple modalities: electronic surveys, one-on-one interviews, and a focus group. This report summarizes the stakeholder feedback received through these various methods.

An online survey instrument was administered to representatives of the agriculture community including NJ Farm Bureau Board members and staff; Rutgers Agriculture Resource Management Agents; Rutgers Agricultural Extension Specialists; Northeast Organic Farming Association-New Jersey Board and staff; U.S.D.A. Natural Resources Conservation Service (NRCS) – New Jersey Office professionals; and representatives of the State of New Jersey Department of Agriculture and State Board Of Agriculture. Fifty-five responses to this survey were received. In addition, an online survey of participants of the New Jersey Land Conservation Rally was conducted that included questions related to farmland and agriculture, as the Land Conservation Rally has farmland preservation as a key focus area. Thirty-five responses to this survey were received. Attachments A and B provide the survey questions and data received from the agriculture sector and Land Conservation Rally surveys, respectively. A full report of all surveys developed on behalf of the NJ Climate Adaptation Alliance as of this writing, is also provided in “*Surveys of Stakeholder Groups. Climate Change Preparedness in New Jersey, November 2013*”.²

To complement these surveys, in-depth one-on-one interviews were conducted with representatives of the following groups: New Jersey Farm Bureau; Rutgers Agriculture Resource Management Agents; and Rutgers Agriculture Extension Specialists. In addition, NRCS District Conservationists participated in a separate focus group. This report is a summary of stakeholder perceptions, observations, needs and recommendations based on these surveys, interviews and focus groups.

It should be noted that a concurrent stakeholder engagement process was undertaken for the natural resources sector, which also included outreach to both recreational and commercial fishing and shellfish constituencies. Pertinent information regarding these two sectors as pertaining primarily to the commercial industries, has been incorporated from “*Stakeholder Engagement Report: Natural Resources, November 2013*”³ and is included in this report as well, to provide a complete picture of the New Jersey agriculture sector.

² New Jersey Climate Adaptation Alliance (NJCAA). 2013. *Surveys of Stakeholder Groups. Climate Change Preparedness in New Jersey*. Edited by Raimy Cheyne. New Brunswick, New Jersey: Rutgers University.

³ New Jersey Climate Adaptation Alliance (NJCAA). 2013. *Stakeholder Engagement Report Natural Resources. Climate Change Preparedness in New Jersey*. Edited by Patty Doerr. New Brunswick, New Jersey: Rutgers University.

Perceptions of Climate Change Impacts

The online survey for the agriculture community included results from 55 participants. The agriculture survey presented a range of climate change impacts and respondents were asked to rank whether each impact was of great concern, some concern, little concern, or no concern. For every impact presented, a majority of respondents selected either 'some' or 'great' concern.

Of impacts related to water, agriculture survey respondents had the greatest concern about increased occurrence and severity of flooding (37 respondents, or 71% selected 'great concern'), followed by reduced water availability (62%), more and longer droughts (58%), and salt water intrusion (41%). Of impacts related to land, soil erosion/loss (47%) and tidal wetland erosion/loss (46%) were selected as great concerns by the most respondents. Of impacts related to farming, crop damage/loss was the primary concern (58% selected as a great concern). Other farming-related impacts of concern include increased water demand for crops (46%) and reduced crop yield (43%). Of impacts related to flora and fauna, the impacts of greatest concern were increased occurrence/spread of pathogens, pests, and vector-borne diseases (58%) and increased spread of invasive species (55%).

The online survey of Land Trust Rally participants, which included 35 respondents, yielded somewhat similar results. Respondents expressed 'great concern' or 'some concern' about nearly all of the water-related impacts presented in the survey. More and longer droughts was the issue of the greatest concern, with 89% expressing 'great concern'. The next most concerning water-related issue was the opposite climate extreme, increased occurrence and severity of flooding (74% expressing great concern). Other water issues of great concern include increased algal blooms (71%) and reduced water availability (69%). Of impacts related specifically to farmland, respondents expressed great concern about increased water demand for crops (74%), reduced crop yield (68%) and crop damage/loss (62%).

In-depth interviews revealed that stakeholders have concerns related to fluctuations in water availability (too much or too little) and water quality as well as shifts in the timing of rainfall and rising temperatures. Increased disease and insect pressure is also a concern to the agriculture community. Specific to coastal agriculture, stakeholders expressed concerns related to sea level rise (salinity impacts and exacerbated flooding). Fishing and shellfishing concerns include increasing water temperatures and ocean acidification. Extreme weather damage to crops, nurseries, structures and marine vessels is also of concern.

Stakeholders consistently mentioned impacts to water as being a key vulnerability for the agriculture community. These include concerns about assuring adequate water supply and water quality that are affected by droughts, extreme flooding and increased heavy precipitation events. Flooding not only damages crops, but can also bring increased contaminants and pathogens and in coastal areas, increased salinity.

Excessive rain early in the season after vegetables have been transplanted can lead to development of shallow root systems, since roots will grow very shallow when there is abundant water in the upper few inches of soil. If rainfall is not evenly distributed for the remainder of the growing season those plants with shallow roots will become stressed and more susceptible to pest and disease pressure, which will increase the need for fertilizer, pesticide, irrigation and increase crop production cost and ultimately commodity prices.

Not enough rainfall was also cited as a significant concern because a significant portion of New Jersey is considered “dry land” without irrigation infrastructure. Farmers with water allocation permits might need to exceed their permits, particularly if they have to compete with residential users during times of drought. Stakeholders have seen the acreage of the state in irrigation increasing as a result of increased need for water from higher temperatures.

In coastal areas, salt water contamination of fresh water supplies is viewed as a risk to farming operations. Salt water inundation that would dehydrate crops and contaminate farm ponds that are important for water supply is also a concern, particularly in areas already at risk of saltwater intrusion into groundwater supplies. Some stakeholders have already observed trees dying because of saltwater exposure. Such concerns will be exacerbated in times of drought as temperatures continue to rise. The Delaware Bayshore area is particularly at risk of saltwater intrusion because of heavy pumping of groundwater. Farmers have to pump directly from fresh water streams in dry years which can be further at risk as the salt line moves up. Rising sea levels which bring more frequent flooding also impact farmers’ ability to access their fields or to get their commodities to market. Stakeholders have observed that some farmland (e.g., sod farms, woody ornamental nurseries, and vegetable crops) is being converted to salt marsh because of rising sea level and increased flooding.

Fisheries stakeholders, including recreational and commercial fishermen and agriculture resource managers, are concerned about how changes in water temperature and salinity will impact the distribution of species important to their sectors. Of concern is how increases in water temperature will impact coastal estuaries which are key to the life cycle of commercially important fish and shellfish. Many coastal fish species spend some component of their lifetime in coastal estuaries. Stakeholders expressed concern about impacts to zooplankton that would then affect juveniles and young of the year age classes of fish and shellfish. In addition to temperature effects on coastal estuaries, stakeholders expressed concerns about nursery habitat degradation (changes in salinity, sediment load, and contaminants) from increased stormwater runoff exacerbated by increased heavy precipitation. Large storms can also be particularly devastating if they occur during critical life stages. For example, in bay areas, an intense springtime storm can result in a large influx of fresh water, which if combined with cold oceanic water and cloud cover, can disrupt phytoplankton which are feed for clam seed.

Saltwater fishermen, both commercial and recreational, have observed a northerly shift of species in the region, like mackerel and bass. These shifts, while not fully understood by managers or fishermen (e.g., are they permanent?), require fishermen to travel further for the opportunity to harvest, which has financial and safety implications, and can create management challenges as they cross jurisdictional boundaries (e.g., state-by-state quota cannot be landed in a state other than the fishermen's home state). Shellfish managers and harvesters interviewed for either or both the agriculture sector interviews and the natural resources engagement process⁴ are concerned about the impact of ocean acidification, increase in water temperatures and salinity changes on oyster and surf clam populations.

Hurricanes Sandy and Irene Impacts

Thirty-two of the 35 respondents (91%) who answered this question in the agriculture survey reported that their farming operation or agricultural area of responsibility was impacted by Hurricane Irene in 2011, and 32 of 38 (84%) reported that they were impacted by Hurricane Sandy in 2012. Due to a glitch in the questionnaire, survey data on specific impacts of these events is inaccurate, but respondents reported impacts such as downed trees, wind damage to crops, power outages, gasoline shortages, property damage, nursery stock that was killed as a result of being saturated too long, mudslides, salt-water inundation, flooding, and market loss due to hurricane impacts on NYC and the need to clean up downed trees after the storm.

Respondents to the Land Trust Rally survey had similar responses. The open lands/farmlands of 81% of respondents were impacted by Irene in 2011, with common impacts including severe flooding (33%) and short-term land/property damage (33%). Eighty-one percent of the respondents' open spaces and farmlands were affected by Hurricane Sandy in 2012, with 32% reporting short term land/property damage and 28% reporting long term or permanent land/property damage. Only 12% of respondents reported severe flooding from Hurricane Sandy, compared with 33% from Irene.

Interviews with representatives of the agriculture community provided additional details regarding impacts from these two events. Farms in coastal communities were inundated with salt water from the storm surge as a result of Hurricane Sandy which also contaminated farm ponds. Hurricane Sandy and Irene exceeded the design standards for conservation practices such as erosion controlled grassed waterways which are used for getting water off farm fields. Interviewees provided insight as to whether these two recent events may have impacted perceptions about climate change in the agriculture sector. These perceptions were not uniform in response. Several felt that there is increased acceptance within the

⁴ From: New Jersey Climate Adaptation Alliance (NJCAA). 2013. *Stakeholder Engagement Report: Natural Resources. Climate Change Preparedness in New Jersey*. Edited by Patty Doerr. New Brunswick, New Jersey: Rutgers University.

agriculture community that climate change is real. Some felt farmers may acknowledge that the climate is changing but may not recognize its severity, or they may believe it will not affect them in their lifetime and is not a concern since their children are not following in their footsteps as farmers. Some noted that farmers are more concerned with addressing acute impacts to get them through any one event. In general, respondents observed that for some farmers these events have changed perceptions about climate change but for others, they see these as extreme events that happen infrequently.

Vulnerable Populations

A discussion of vulnerable populations has been included in many of the NJCAA stakeholder reports, usually with respect to human populations. However, in the case of the agriculture sector, particularly vulnerable populations were cited with respect to the commercial fishing sector. These were identified as young of the year and juvenile classes of fish species that could be impacted by warming water temperatures and salinity changes. In addition, impacts to nursery habitat from excessive flooding can increase sediment and contaminant loading into coastal estuaries impacting juvenile fish populations. As previously mentioned, there is concern about spring storms that can disrupt phytoplankton production which are feed for clam seed.

Perceptions of Sectoral Preparedness

The agriculture sector has some preparedness activities underway. The interviews revealed that due to the nature of farming, several of these 'preparedness' practices are activities farmers already undertake, but they have not necessarily thought about them through the lens of climate change preparedness or how they might need to tailor some of these practices to be better prepared. Many respondents cited the need for education as key to having the issue of climate change more broadly recognized by their sector in order to increase preparedness planning and practice.

Respondents to the online surveys were presented with a list of climate change adaptations and asked whether they are 'In Place', 'Planned', 'Not Planned but Needed', or 'Not Needed' for their program or properties. For the agriculture sector survey, several of the climate change adaptation actions listed in the survey are already in place or planned in many respondents' programs or properties. Of the options presented, emergency preparedness plans are the most common (44% in place, 31% planned), followed by water conservation measures such as drip irrigation, water efficiency, or a change to less water intensive crops (43% in place, 35% planned), and crop diversification (42% in place, 30% planned). Similarly, the survey of Land Trust Rally Participants found that of the adaptation options presented, emergency preparedness plans are the most common (24% in place, 35% planned), followed by surveillance of diseases (23% in place, 15% planned) and green infrastructure (14% in place, 23% planned, 59% not planned but needed).

Interviews and focus groups provide additional details that complement the survey results. These revealed that there has not been a concerted effort in New Jersey to address or communicate issues regarding climate change preparedness in the agriculture community. Farmers do practice adaptation actions for events they have experienced in the past such as using fans to prevent frost from killing buds on trees or moving bee colonies to higher ground if a large rain event is expected. Rain garden initiatives are also actions underway that can help mitigate runoff. Organizations that work with farmers are assessing the needs of farmers with respect to climate change preparedness.

Commercial fisheries stakeholders felt there was little readiness on this front. Interviewees cited the need for fisheries management professionals to become better aware of the climate change impacts from ocean acidification on impacts to hatcheries, fish species and shellfisheries. There is a sense that we are only just becoming aware of these impacts on the East Coast and public education and education of the fishermen is needed.

All those interviewed consistently agreed that improving preparedness requires better information, outreach, communication, and education within the agriculture community so that farmers and fishermen understand that climate change is an issue that needs attention. Interviewees cited the need for better information from researchers and agriculture extension programs about best practices and options for adaptation that can be communicated to practitioners (farmers and commercial fisheries).

Challenges and Obstacles

The highest priority action, as measured by the percentage of respondents in the agriculture survey choosing it as a high need, is enhanced vector and disease surveillance programs (52%/26 respondents). Research on the vulnerability of economically important agricultural species and development of adaptive plant/agricultural species and varieties including species adapted to reduced water quality (increased salinity) was also identified as a high need by 24 respondents (47%).

Major needs identified by agriculture survey respondents, as measured by the percentage of respondents reporting that the activity is not planned but needed, include property and resource vulnerability assessments (17, or 63%), surveillance for diseases (14/48%), drilling new wells or seeking alternative water sources (12/43%), protection of connective corridors between ecosystems (11/43%), and green infrastructure such as riparian buffers, living shorelines, wetland restoration, etc. (13/39%).

Priority actions at the regional, state, or federal level identified by the agriculture survey include water supply planning and conservation programs to account for a changing climate (23, or 45% selected as a high need), development of improved and low-cost weed/vector control approaches (21/42%), research on innovative and cost effective strategies for improved water systems management and design (21/41%), enhanced Best Management

Practices to reduce stormwater runoff (20/39%), and incentive programs to preserve, increase, or improve climate-resilient agricultural land (20/39%). Other needs identified by respondents include agricultural pest management and invasive species management, coordination of grant programs, and scientific evaluation of strategies for agriculture to reduce carbon emissions.

When agriculture survey respondents were asked “what does your agriculture program most need to prepare and be ready to respond to climate change impacts over the coming decades”, several responses focused on the need for better science regarding climate change trends and their impacts on agriculture. Responses included “more research on the impacts on pest species”, “better assessment of risk”, “enhanced monitoring to establish baselines and monitor changes to crop yield/health”, more flexibility from the NJDEP to irrigate during droughts and install and maintain erosion control and drainage systems without getting a permit first, “willingness to diversify ag products”, “flooding and power outage support”, “valid information on anticipated change in ten year increments”, “adapting forage and feed needs for livestock”, and “better understanding of long term trends”. Respondents also noted that the ability to adapt to a changing climate may be limited by the nature of the agriculture industry in that farming is seasonal and farmers are not accustomed to planning for 10 or 20 years.

Consistent with the agriculture survey respondents, Land Trust Rally survey participants identified property and resource vulnerability assessments as a major need, with 89% of respondents reporting that the activity is not planned but needed. Also identified as needed activities by Land Trust Rally respondents, as measured by the percentage of respondents reporting that the activity is not planned but needed, include: collaborative regional approaches to manage ecosystems (79%), protection of representative ecosystems of sufficient size (72%), water conservation (71%), farming for biodiversity (69%), and protection of connective corridors between ecosystems (68%).

Land Trust Rally participants identified incentive programs to preserve climate resilient open space and farmland as one of the highest priority needs at the local, state, or federal level, with 75% of respondents selecting this as a ‘high need’. Improved coordination and training between the conservation community and regional, state, and federal resource agencies was a close second, identified as a high need by 74% of respondents, followed by water supply planning and conservation programs to account for a changing climate, selected by 73% of respondents.

Other state, regional, or federal actions and programs identified by Land Trust Rally participants as ‘high need’ include support for habitat restoration projects (72%), development of land conservation targets based on likely climate change scenarios (71%), enhanced best management practices to reduce stormwater runoff (67%), and research on

innovative and cost effective strategies for improved water systems management and design (66%).

Other programs or activities that Land Trust Rally respondents identified there was 'some' or 'great' need for include enhanced monitoring to establish baselines and monitor changes in species health and crop yield, improved climate modeling capacity for local scale assessments, research on the vulnerability of economically important agricultural species and development of adaptive species and varieties, and implementation of appropriate fire management strategies in forested areas.

When asked "what does your open space or farmland preservation program most need to prepare and be ready to respond to climate change impacts over the coming decade", many of the responses of the Land Trust Rally participants focused on the need for more preserved open space and for sustainable funding mechanisms to enable more land preservation. Other needs identified include deer control, ability to model and predict climate change scenarios at the local and regional level, more public awareness, better understanding of the effects of climate change on specific crops and land types, and prohibition of development in flood plains.

Land Trust Rally respondents identified the biggest challenges to achieving preparedness for climate change in New Jersey as lack of political will and lack of public awareness of climate change issues. Other barriers identified include development pressures, local regulations that allow for development in environmentally sensitive areas, the fragmented nature of local zoning rules, and the inherent complexity and long-term timescale of climate issues.

Focus groups and targeted interviews were consistent with the survey results. An obstacle noted by many stakeholders is the challenge within the agriculture community in understanding that climate change is a real threat to agriculture.

A challenge noted by multiple stakeholders is the need to build capacity within local organizations that assist the agriculture sector. These groups need to conduct research, develop guidance, and develop best practices and communication tools and programs so they can educate their constituents about the issues surrounding climate change impacts and about steps they can take to become better prepared. This information would also help the subset of these organizations that lobby on behalf of their constituents to develop scientifically sound policy that they can work from on behalf of their constituents.

Decisions about what types of adaptation practices to implement are influenced by other factors such as commodity prices, markets, fuel prices, labor costs, seed costs and so forth. Thus, implementing adaptation practices may be put on the back burner depending upon short-term needs. Many farmers in New Jersey are tenant farmers; therefore, it is harder to instill long-term planning and a stewardship ethic if a farmer is not certain he or she will be farming the same property in the coming year or for many years to come.

Farmers of high value fruit and vegetable crops are ineligible for a price safety net from the federal government that exists for commodity crops (such as corn, soybeans and wheat) and therefore these farmers face increased costs from insurance or for implementing adaptation strategies such as installing expensive irrigation systems that would be needed for addressing impacts such as droughts.

Farmers are concerned about increasing competition from residential users for water which can become scarcer in times of drought or from increased saltwater intrusion.

Another challenge identified is the lack of time in New Jersey between harvesting a crop and seeding a cover crop in the fall. Cover crops are important for a number of reasons, including soil erosion control, providing mulch in no-till agriculture and improving soil health.

State permit restrictions prevent conservation practices in flood hazard areas and wetlands on farms where those projects could address erosion control and water quality impacts, such as allowing grassed waterways or putting in a stream crossing to keep livestock out of a stream.

Farms in coastal areas are faced with unique challenges. In areas such as Cape May County, farmers are prevented by legislation known as the Gibson bill from pumping above a certain amount of water if they cannot prove such pumping will not result in saltwater intrusion. Individual farmers do not have the resources to conduct such an analysis and there are concerns that with rising temperatures and the need for more water to irrigate high value crops, farmers will not have access to the water they need to sustain their operations. This can be particularly difficult for farms that have sold their development rights and thus the land must stay as an agriculture-related use.

Local officials and leaders set the tone for their communities. For example, when local freeholders challenge the Federal Emergency Management Agency (FEMA) flood maps because of the burden placed on their coastal communities, this presents a challenge in having property owners, including farmers, recognize the need to address climate preparedness. Land valuation is another challenge mentioned by stakeholders. Farmers may have difficulty selling their property for agricultural use if these properties will continue to be at risk from coastal flooding exacerbated by sea level rise and ultimately under water.

Stakeholders interviewed for both the agriculture and natural resources sectors⁵ noted that climate impacts are not a top priority for saltwater fishermen. Fishery stakeholders identified management plans and regulations as a challenge that needs to be addressed. Since landing of harvests in different states is restricted, management plans and regulations need to allow for flexibility for fishermen to follow the fisheries that are now changing with

⁵ From: New Jersey Climate Adaptation Alliance (NJCAA). 2013. *Stakeholder Engagement Report: Natural Resources. Climate Change Preparedness in New Jersey*. Edited by Patty Doerr. New Brunswick, New Jersey: Rutgers University

changing water temperatures. As fisheries distribution changes, the fishermen are travelling farther which also presents costs and safety concerns. Some fishermen do caution that managers need to not be too reactive until they fully understand if population shifts are permanent. Others noted that fisherman will adapt year to year and that as long as they have something to fish, they will abide by restrictions.

Communication, awareness, and education amongst fisheries stakeholders came to the fore related to many facets: understanding the basis for changes in fish population patterns, as well as the issue of ocean acidification which is slowly being recognized within the commercial sectors here on the East Coast. These sectors may be starting to think in terms of whether they need to re-evaluate how they anchor their boats or store equipment if storms become more frequent or more powerful.

Another communication challenge relates to the competition between commercial and recreational fisherman. As the size of the fishery shrinks, these two groups may be able to work together to react to potential threats from climate change. For example, they may recognize that increased heavy precipitation and runoff that can impact water quality will have an effect on nursery habitat and long-term viability of fish and shellfish.

There is also the need to overcome perceived risks to the industry: there is concern amongst some of the fishermen that their boat emissions will get regulated because they could be thought of as contributing to ocean acidification.

Regarding commercial fishermen, it was noted that it may be very challenging to conduct any sort of adaptation in terms of the species themselves as opposed to land-based crops that can be genetically altered. This might be possible with shellfish that are raised under aquaculture, but not with pelagic fish which are at risk from changes in water temperature and can migrate to follow water temperatures.

Recommendations

A compendium of recommendations for New Jersey agriculture, based upon needs cited by stakeholders from surveys, one-on-one interviews and focus groups has been developed and identified within the six categories noted below.

Research, Needs Assessment and Data Development

- Support, conduct and disseminate research on climate resilient crops (field, fruit and vegetable crops, nursery, ornamentals, turf, etc.) and adaptive plant and agricultural species and varieties to address the range of climate impacts (heat, drought, exposure to salinity, etc.).
- Conduct and support research to improve certainty estimates of climate change impacts on agriculture in New Jersey.

- Conduct scientific evaluations of strategies for reducing carbon emissions through agriculture.
- Assess the climate vulnerability of agricultural property, land and resources throughout New Jersey.
- Conduct research on alternative methods for cover crop establishment (e.g., developing different types of machinery or retrofitting existing equipment such as using spray rigs for seeding) so that crops can be seeded while primary crops are still standing.
- Conduct research to assess appropriate forest successional species for New Jersey.
- Conduct research on the vulnerability of and impacts of climate change to saltwater fish species.
- Conduct research on development of shellfish species that would be genetically adaptive to climate change impacts.
- Conduct research on innovative and cost-effective strategies for improved water and irrigation systems management and design.
- Commission a statewide study and assessment of climate change vulnerability of economically important agriculture species.
- Assess and develop low-cost weed, pesticide and vector control approaches.
- Assess and develop farm worker comfort and safety practices that would address structures, seasonal housing, and exposure to increased temperatures.

Enhanced Implementation of Existing Data, Tools and Methods

- Drill new wells and seek alternative water sources for areas particularly vulnerable to climate change impacts on agricultural water quality and supply.
- Protect connective corridors on agricultural land that can serve a dual purpose for providing climate resiliency and protecting species that will be at risk from climate change impacts.
- Enhance and improve vector and disease surveillance for diseases in agricultural areas and for agricultural commodities vulnerable to climate change.
- Employ green infrastructure such as riparian buffers, living shorelines, and wetland restoration to protect agriculture land vulnerable to sea level rise and flooding.
- Design and adopt livestock protection structures such as open pole barns equipped with evaporative cooling techniques that are not energy intensive or require expensive technology. These techniques could include micro-misters and fans, and re-examining ventilation design criteria.
- Retain and reuse surface water and manage higher amplitude storm flows through a renewed emphasis on farm pond technical engineering and design from USDA Natural Resource Conservation Service to address drought as well as protection of soil and water quality and community property from damage.

- Review and update engineering design standards for conservation practices such as erosion control of grassed waterways now being impacted by increased storm intensity.
- Enhance management of invasive species and agriculture pests that could increase with climate change.
- Develop enhanced Best Management Practices to reduce increased stormwater runoff and increase soil health to mitigate the effects of drought stress (i.e., improving soil filtration and retaining root available moisture).

Regulation, Policy, and Governance Support

- Update the New Jersey Water Supply Master Plan to incorporate climate change considerations for New Jersey agriculture.
- Conduct enhanced water supply planning and conservation programs across all appropriate levels of government to incorporate climate change considerations and work with the private sector to incorporate climate change considerations into water supply planning and conservation.
- Provide flexibility in federal and state fishery management plans to ensure they address climate change adaptation and take shifting populations into account, for example, to ensure they allow for landing of harvests in different states.
- Enhance farmland protection in especially vulnerable areas, including low-lying areas. This could include improvements to existing dikes.
- Conduct a statewide assessment of farmland that is most suitable for increasing climate resiliency and focus farmland easement purchase programs on areas less vulnerable to sea level rise.
- Ease state permit restrictions for conservation practices in flood hazard areas and wetlands (such as providing for grassed waterways to reduce erosion or providing livestock crossings to prevent livestock from contaminating streams) where those projects address erosion and water quality impacts from farms if they meet federal or state standards through a permit-by-rule.
- Develop and provide incentives or markets for those in the agriculture community who provide climate benefits. These benefits could include practices such as carbon sequestration, municipal pre-treatment benefits for stormwater filtration, or temperature mitigation in streams through soil holding capacity activities or vegetative planting.
- Develop a soil health focus group as a public-private partnership and develop guidance as a result.
- Enhance technical assistance to the agricultural community on adaptation practices including soil health, forest stewardship and management to maintain forest health, practices on agriculture land, and wetland enhancement.

Coordination of Adaptation Planning and Preparedness Actions

These recommendations are pertinent to coordination across and within the public, private and nongovernmental organization sectors. They include the following:

- Address the loss of roads and infrastructure from flood events so the agriculture sector can access farm fields, their agriculture operations, and their fisheries, as well as get their goods to market.
- Improve coordination on outreach, education and training between regional, federal and state resource agencies and nongovernmental organizations.
- Coordinate grant programs across public, private and nongovernmental sectors, as well as research universities, to maximize assessment, research, and outreach for the agriculture sector.
- Establish public-private partnerships for seed mix guidance in cover crop standards; i.e., which seed mixes to plant at specific points in the vegetable or specialty crop rotations. Field practitioners can be an excellent source of information for developing such guidance and testing practices.

Ensuring Suitable Funding

- Develop incentive programs to preserve, increase or improve climate-resilient agricultural land.
- Identify, create or reallocate resources for research on viable adaptation practices and resilient agriculture species (crops, nurseries, forestry, fisheries, etc.).
- Explore options for how to address loss in property values for agriculture properties that are subject to sea level rise.
- Identify, create or reallocate resources to develop climate change preparedness and adaptation educational materials and technical bulletins for agriculture sectors.
- Return the State of New Jersey cost-share funding for soil and water projects on preserved farmland.
- Increase investments in tunnels and greenhouses to mitigate against extreme weather while extending the growing season. These investments could include passive energy to reduce costs.
- Increase investments in low pressure/low volume supplemental irrigation systems to ensure farmers are not missing irrigation needs at critical times during the growing season.
- Identify funding sources to provide capital to implement adaptation practices.

Education and Outreach Efforts

- Develop “how to” guides on conducting a vulnerability assessment for farmers and agriculture practitioners.
- Provide more discernible information on what the most significant climate change impacts are to agriculture and what data are most accurate.
- Sponsor and conduct peer-to-peer demonstration projects to enhance adoption of climate adaptation practices by farmers, including the benefits of conservation practices such as no-till agriculture to improve soil health, innovative ways to plant different families of cover crops earlier in the season or different types of cover crops that are resistant to drought and pests (e.g. Spelt) .
- Educate the public, local officials, farmers, commercial fishermen and shellfishermen on climate change impacts and management practices. Such outreach and education activities should be coupled with research on how to adjust to a changing climate and should be communicated through numerous venues including the NJ Farm Bureau, Rutgers Cooperative Extension, technical bulletins, fact sheets, conferences, etc.
- Integrate data from farmers who are innovating and experimenting with different techniques to adapt to climate change into guidelines and information for New Jersey farmers.

Attachment A: Survey of Agriculture Stakeholders

Preparing for Climate Impacts in New Jersey: Agriculture

Q1 Please read the following information and sign electronically in the box below, indicating your informed consent. Thank you for agreeing to participate in this online survey. This research is being conducted by Rutgers University, in conjunction with the New Jersey Climate Adaptation Alliance. This survey is being administered to representatives of the farming community in New Jersey including the New Jersey Farm Bureau Board of Directors and Alternates, NJ Natural Resources Conservation Service District Conservationists, Rutgers Agriculture Extension Specialists, Rutgers County Agricultural Agents and other representatives of the farming community. The purpose of the survey is to obtain data to assess New Jersey's most pressing planning concerns resulting from climate change, and to help to prioritize a set of program, planning and policy adaptations that are necessary to prepare for and mitigate these impacts. There are no reasonable or discernible risks to your participation in this study. We are not asking for your name on the survey, and will only utilize information collected in summary form to categorize or further explain important differences. If we are able to deduce your identity, the research will be confidential. Confidential means that the research records will include some information about you and this information will be stored in such a manner that there is some linkage between your identity (as deduced but not specified) and the response in the research. The information collected about you includes your opinions about climate change risks, ratings of concern about climate change impacts and your assessment of the needs for various climate adaptation programs. Please note that we will keep this information confidential by not including your name in the data records, limiting individual access to the research data and keeping it in a secure location. The research team and the Institutional Review Board (a committee that reviews research studies in order to protect research participants) at Rutgers are the only parties that will be allowed to see the data, except as may be required bylaw. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated. All study data will be kept for three years. The benefits of completing the survey are that you will contribute to further knowledge and insight about impacts to land conservation from climate change and help to inform the development and prioritization of resources needed to support new or expanded programs or policies to address these impacts. The survey should take about 10-15minutes to complete. Participation is completely voluntary and refusal to participate will result in no penalties. You may opt out of completion of the survey at any time while taking it. If you have questions related to the research, please contact Jeanne Herb, Associate Director of the Environmental Analysis and Communication group, 33 Livingston Ave., New Brunswick, NJ 08901, 848-932-2725, jherb@ejb.rutgers.edu. If you have questions about your rights as a research subject, you may contact the IRB Administrator at Rutgers

University at: Rutgers University Institutional Review Board for the
Protection of Human Subjects Office of Research and Sponsored
Programs 3 Rutgers Plaza New Brunswick, NJ08901-
8559 Tel: 838 932
0150 Email: humansubjects@orsp.rutgers.edu

- I have read and understand the risks and benefits of this research and agree to participate by typing my initials in this box. _____

Q2 What best describes your interest in New Jersey agriculture? Select one:

- Farmer
- Land Manager
- Administrator/Regulator
- Attorney
- Researcher/Scientist
- Other _____
- Land Manager
- Administrator/Regulator
- Attorney
- Researcher/Scientist
- Other _____
- Pre-K
- K - 12
- Consultant
- College/University
- County Cooperative Extension
- Other _____

Q3 If you are a farmer, what commodities do you grow? Check all that apply.

- Grain
- Forage
- Fruit
- Vegetables
- Nursery
- Greenhouse
- Livestock
- Organic (Certified)
- Pasture/Grazing
- Floriculture
- Aquaculture
- Woodland Crops
- Bee-keeping
- Other _____

Q19 If you work in government, what level of government?

- Municipal
- County
- State
- Federal

Q4 Do you live in New Jersey?

- Yes
- No

Q20 Please select the counties where you farm or where you conduct agricultural-related activities.

- Atlantic
- Bergen
- Burlington
- Camden
- Cape May
- Cumberland
- Essex
- Gloucester
- Hudson
- Hunterdon
- Mercer
- Middlesex
- Monmouth
- Morris
- Ocean
- Passaic
- Salem
- Somerset
- Sussex
- Union
- Warren

Q21 Do you live in the New Jersey community where you farm or conduct your agricultural work?

- Yes
- No

Q22 How many acres do you farm in total?

- 10 acres or fewer
- 11 - 50 acres
- 51 - 100 acres
- 101 - 200 acres
- 201 - 1,000 acres
- More than 1,000 acres
- Not Applicable

Q23 How many years have you been farming?

Q24 Is farming your primary source of income?

- Yes
- No
- Not Applicable

Q25 What is the annual market value of the commodities you sell?

- < \$50,000
- \$50,000 - \$100,000
- \$100,000 - \$500,000
- >\$500,000
- Not Applicable

Q5 Do you Strongly Agree, Agree, Disagree or Strongly Disagree (or Don't Know) with the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
Global climate change is not occurring.	<input type="radio"/>				
Global climate change is mostly caused by human activity.	<input type="radio"/>				
Global climate change is a risk to New Jersey.	<input type="radio"/>				
Global climate change is a risk to me, my family, and my friends.	<input type="radio"/>				
The international scientific community understands the science behind global climate change.	<input type="radio"/>				
I trust the scientific community to truthfully report their findings related to climate change.	<input type="radio"/>				

Our state and local officials understand the implications of global climate change for my region.	<input type="radio"/>				
	<input type="radio"/>				
The media I rely on communicate honestly with us about global climate change.	<input type="radio"/>				

Q6 Please rate how concerned you are about the following climate change related impacts to agriculture: IMPACTS RELATED TO WATER

	Great Concern	Some Concern	Little Concern	No Concern	Not Applicable
Higher water temperature	<input type="radio"/>				
Increased algal blooms/eutrophication	<input type="radio"/>				
Reduced water availability	<input type="radio"/>				
Increased sediment volumes	<input type="radio"/>				
Salt water intrusion	<input type="radio"/>				
Increased concentration of pollutants in water	<input type="radio"/>				
More and longer droughts	<input type="radio"/>				
Increased occurrence and severity of flooding	<input type="radio"/>				

Q7 IMPACTS RELATED TO LAND

	Great Concern	Some Concern	Little Concern	No Concern	Not Applicable
Soil erosion/loss	<input type="radio"/>				
Soil compaction	<input type="radio"/>				
Increased concentration of pollutants in soil	<input type="radio"/>				
Reduced carbon storage	<input type="radio"/>				
Tidal wetland erosion/loss	<input type="radio"/>				
More wildfires	<input type="radio"/>				

Q9 IMPACTS RELATED TO FARMING

	Great Concern	Some Concern	Little Concern	No Concern	Not Applicable
Salinity impacts on crops	<input type="radio"/>				
Crop damage/loss	<input type="radio"/>				
Reduced crop yield	<input type="radio"/>				
Reduced livestock productivity	<input type="radio"/>				
Loss of soil fertility	<input type="radio"/>				
Unsuitability for some crop varieties	<input type="radio"/>				
Increased water demand for crops	<input type="radio"/>				
Reduced growing season	<input type="radio"/>				
Delayed spring planting	<input type="radio"/>				
Changes in crop bloom/reproductive timing	<input type="radio"/>				
Increased need for drainage	<input type="radio"/>				
Changes in farm inputs (e.g. fertilizer, Integrated Pest Management, misting fans, equipment changes)	<input type="radio"/>				

Q8 IMPACTS RELATED TO FLORA, FAUNA, AND PEOPLE

	Great Concern	Some Concern	Little Concern	No Concern	Not Applicable
Changes in plant and animal species composition and distribution	<input type="radio"/>				
Increased spread of invasive species	<input type="radio"/>				
Increased occurrence/spread of pathogens, pests, and vector-borne diseases	<input type="radio"/>				
Critical species habitat loss	<input type="radio"/>				
Salinity impacts on vegetation	<input type="radio"/>				
Heat stress/stroke (for visitors and workers)	<input type="radio"/>				
Reduced recreation and tourism	<input type="radio"/>				

Q10 Did Tropical Storm Irene (2011) impact your farming operation, farmland, or agricultural areas you are responsible for?

- Yes
- No
- Not Applicable

Q11 If so, in what ways?

- Severe flooding
- Minor flooding
- Short term land/property damage
- Long term or permanent land/property damage
- Resident or livestock evacuation
- Power outages
- Other _____

Q12 Did Hurricane Sandy (2012) impact your farming operation, farmland, or agricultural areas you are responsible for?

- Yes
- No
- Not Applicable

Q13 If so, in what ways?

- Severe flooding
- Minor flooding
- Short term land/property damage
- Long term or permanent land/property damage
- Resident or livestock evacuation
- Power outages
- Other _____

Q14 Of the following climate change adaptations, which are In Place, Planned or Needed for your program or properties?

	In Place	Planned	Not Planned but Needed	Not Needed	Don't Know	Not Applicable
Property and resource vulnerability assessments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Emergency preparedness plans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Surveillance for diseases	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Livestock shelters and improved ventilation for livestock	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water conservation (e.g., drip irrigation, water efficiency, change to less water intensive crops)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crop diversification	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Altered farm practices (e.g., mulching, intercropping)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drilling new wells or seeking alternative water sources (e.g. on-site farm ponds)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pumping of more water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Farmscaping for biodiversity, pollination, pest and flood control	<input type="radio"/>					
Protection of representative ecosystems of sufficient size	<input type="radio"/>					
Protection of connective corridors between ecosystems	<input type="radio"/>					
Green infrastructure (e.g., riparian buffers, living shorelines, native landscaping, tree planting, wetland restoration, porous pavement, etc.)	<input type="radio"/>					

Q15 What are the most important actions or programs needed at the LOCAL, REGIONAL, STATE, OR FEDERAL level to support efforts by the agricultural community to prepare for and respond to climate change impacts?

	High Need	Some Need	Little or No Need	Don't Know	Not Applicable
Enhanced monitoring to establish baselines and monitor changes to crop yield and/or crop health	<input type="radio"/>				
Enhanced vector and disease surveillance programs	<input type="radio"/>				
Development of improved and low-cost weed/vector control approaches	<input type="radio"/>				
Improved climate modeling capacity for local scale assessments	<input type="radio"/>				
Adaptive measures for worker comfort and safety	<input type="radio"/>				
improved coordination and training between the agriculture community and regional, state, and federal resource agencies regarding climate change issues (e.g. trainings, workshops, technical bulletins)	<input type="radio"/>				

<p>Research on the vulnerability of economically important agricultural species and development of adaptive plant/agricultural species and varieties including species adapted to reduced water quality (increased salinity).</p>	<input type="radio"/>				
<p>Enhanced Best Management Practices to reduce stormwater runoff</p>	<input type="radio"/>				
<p>Programs to assist farmers in changeover to new equipment or for experimenting with new varieties of climate-resistant crops</p>	<input type="radio"/>				
<p>Incentive programs to preserve, increase, or improve climate-resilient agricultural land</p>	<input type="radio"/>				

Water supply planning and conservation programs to account for a changing climate	<input type="radio"/>				
Research on innovative and cost effective strategies for improved water systems management and design	<input type="radio"/>				
Work to identify and implement appropriate fire management strategies in at-risk forested areas	<input type="radio"/>				
Other	<input type="radio"/>				
Enhanced monitoring and assessment of forest health as it related to implications for agriculture	<input type="radio"/>				

Q16 What does your agriculture program MOST NEED to prepare for and be ready to respond to climate change impacts over the coming decades?

Q17 What are the biggest challenges to achieving preparedness for climate change?

Q18 Please rank climate change impacts in importance among these non-climate stressors to agriculture? (Drag and drop to rank 1 to 5 with 1 being most important and 5 being least important):

- _____ Climate Change Impacts
- _____ Encroaching Land Development
- _____ Increased Costs of Operations
- _____ Increases in Contaminants
- _____ Introduced or Invasive Species

Q26 Click on arrows below to submit. Thank you for taking this survey!

Attachment B: Agriculture Survey Results Summary

Summary of Agriculture Survey: Preparing for Climate Change Impacts in New Jersey

Administered to representatives of the agricultural community in New Jersey

Survey conducted online September 13 – October 4, 2013.

Overview of Participants

55 respondents completed this online survey. Of the respondents, 15 (27%) work for county cooperative extensions, 15 (27%) work for the government in other roles, 13 (24%) are in academia, 6 (11%) are farmers, and 5 (9%) are researchers/scientists for non-governmental organizations. The commodities grown by respondents include grain (4), vegetables (4), nursery (4), forage (3), livestock (3), pasture/grazing (2), fruit (1), and greenhouse (1). Despite only 6 respondents identifying as farmers, there were 10 responses to the question “how many acres do you farm in total”, of which 5 reported that they farm a total of 201-1,000 acres, with the rest farming smaller plots of land. There were also 10 responses to the question “what is the annual market value of the commodities you sell”; 3 reported selling >\$500,000 annually, 1 sells \$100,000-\$500,000, 4 sell \$50,000-\$100,000, and 2 sell <\$50,000 worth of commodities annually. Only 4 respondents indicated that farming was their primary source of income.

Views on Climate Change

Respondents were asked whether they agree, strongly agree, disagree, or strongly disagree with the statement “Global climate change is not occurring.” Forty-three (78%) of the respondents believe climate change is occurring, with 27 of the respondents strongly disagreeing and 16 disagreeing with this statement, while 9 respondents agreed or strongly agreed with the statement and 3 responded ‘don’t know’.

The majority of respondents (35, or 64%) believe that climate change is mostly caused by human activity. Forty-five respondents (82%) agreed or strongly agreed with the statement “Climate change is a risk to New Jersey”, and 67% think climate change is a personal risk to family and friends. About half the respondents (30/55%) agree that the international scientific community understands the science behind climate change, while 29% (16 respondents) disagree or strongly disagree and 9 responded ‘don’t know’. 56% (31 respondents) trust the scientific community to truthfully report their findings related to climate change. Confidence in public officials is low, with only 4 respondents agreeing that “state and local officials understand the implications of global climate change for my region”, 38 (69%) disagreeing or strongly disagreeing, and 13 responding “don’t know”. Trust in the media is also low, with 12 (22%) agreeing the media communicate honestly

about global climate change, 28 (51%) disagreeing or strongly disagreeing, and 15 (27%) responding 'don't know'.

Climate Change Impacts

The survey presented a range of climate change impacts and respondents were asked to rank whether each impact was of great concern, some concern, little concern, or no concern. For every impact presented, a majority of respondents selected either 'some' or 'great' concern.

Of impacts related to water, respondents had the greatest concern about increased occurrence and severity of flooding (37 respondents, or 71% selected 'great concern'), followed by reduced water availability (62%), more and longer droughts (58%), and salt water intrusion (41%). Of impacts related to land, soil erosion/loss (47%) and tidal wetland erosion/loss (46%) were selected as great concerns by the most respondents. Of impacts related to farming, crop damage/loss was the primary concern (58% selected as a great concern). Other farming-related impacts of concern include increased water demand for crops (46%) and reduced crop yield (43%). Of impacts related to flora and fauna, the impacts of greatest concern were increased occurrence/spread of pathogens, pests, and vector-borne diseases (58%) and increased spread of invasive species (55%).

Impacts from Irene and Sandy

32 of 35 respondents (91%) reported that their farming operation or agricultural area of responsibility was impacted by Hurricane Irene in 2011, and 32 of 38 (84%) reported that they were impacted by Hurricane Sandy in 2012. Due to a glitch in the questionnaire, survey data on impacts of these events is inaccurate, but respondents reported impacts such as downed trees, wind damage to crops, power outages, gasoline shortages, property damage, nursery stock that was killed as a result of being saturated too long, mudslides, salt-water inundation, flooding, and market loss due to hurricane impacts on NYC and the need to clean up downed trees after the storm.

Climate Change Adaptation and Preparedness Activities

Respondents were presented with a list of climate change adaptations and asked whether they are 'In Place', 'Planned', or 'Not Planned but Needed', or 'Not Needed' for their program or properties. Several of the climate change adaptation actions listed in the survey are already in place or planned in many respondents' programs or properties. Of the options presented, emergency preparedness plans are the most common (44% in place, 31% planned), followed by water conservation measures such as drip irrigation, water efficiency, or a change to less water intensive crops (43% in place, 35% planned), and crop diversification (42% in place, 30% planned).

Major needs identified, as measured by the percentage of respondents reporting that the activity is not planned but needed, include property and resource vulnerability assessments (17, or 63%), surveillance for diseases (14/48%), drilling new wells or seeking alternative water sources (12/43%), protection of connective corridors between ecosystems (11/43%), and green infrastructure such as riparian buffers, living shorelines, wetland restoration, etc. (13/39%).

Policy Priorities

Respondents were asked “what are the most important actions or programs needed at the regional, state, or federal level to support efforts of the agricultural community in preparing for and responding to climate change impacts?” and asked to rank each in a list of options as ‘high need’, ‘some need’, or ‘little or no need’. The highest priority action, as measured by the percentage of respondents choosing it as a high need, is enhanced vector and disease surveillance programs (52%/26). Research on the vulnerability of economically important agricultural species and development of adaptive plant/agricultural species and varieties including species adapted to reduced water quality (increased salinity) was also identified as a high need by 24 (47%) respondents.

Other priority actions at the regional, state, or federal level include water supply planning and conservation programs to account for a changing climate (23, or 45% selected as a high need), development of improved and low-cost weed/vector control approaches (21/42%), research on innovative and cost effective strategies for improved water systems management and design (21/41%), enhanced Best Management Practices to reduce stormwater runoff (20/39%), and incentive programs to preserve, increase, or improve climate-resilient agricultural land (20/39%). Other needs identified by respondents via text-entry include agricultural pest management and invasive species management, coordination of grant programs, and scientific evaluation of strategies for agriculture to reduce carbon emissions.

Critical Needs

When asked “what does your agriculture program most need to prepare and be ready to respond to climate change impacts over the coming decades”, several responses focused on the need for better science regarding climate change trends and their impacts on agriculture. Responses included “more research on the impacts on pest species”, “better assessment of risk”, “enhanced monitoring to establish baselines and monitor changes to crop yield/health”, more flexibility from the NJDEP to irrigate during droughts and install and maintain erosion control and drainage systems without getting a permit first, “willingness to diversify ag products”, “flooding and power outage support”, “valid information on anticipated change in ten year increments”, “adapting forage and feed needs for livestock”, and “better understanding of long term trends”.

Challenges

Primary challenges identified to achieving preparedness for climate change in New Jersey are uncertainty about actual effects of climate change on agriculture, difficulty discerning what information and data is accurate, and lack of funding to implement certain practices. Responses included “it is somewhat of an unknown what weather change will bring. Wait and see what happens and then adjust. The change may not be all bad.”, “credible science and forecasts of impacts”, “uncertainty of actual effects; lack of capital for business alterations”, and “too many unknowns”. One respondent pointed out that farmers plant season to season and very few plan or plant with a 10 or 20 year eye to the future.

Issue Prioritization

When presented with a list of five stressors to agriculture and asked to rank them in order of importance, with 1 being most important and 5 being least important, the average rank order selected was 1) Increased Costs of Operations; 2) Encroaching Land Development; 3) Climate Change Impacts; 4) Introduced or Invasive Species; and 5) Increases in Contaminants.

Attachment C: Survey of NJ Land Conservation Rally Participants

Climate Change Preparedness in New Jersey: Land Conservation Rally Participants

Q1 Please read the following information and sign electronically in the box below, indicating your informed consent. Thank you for agreeing to participate in this online survey. This research is being conducted by Rutgers University, in conjunction with the New Jersey Climate Adaptation Alliance. All participants from the 2013 New Jersey Land Conservation Rally are being asked to participate. The purpose of the survey is to obtain data to assess New Jersey's most pressing land conservation and farmland preservation concerns resulting from climate change, and to help to prioritize a set of program, planning and policy adaptations that are necessary to prepare for and mitigate these impacts. There are no reasonable or discernible risks to your participation in this study. We are not asking for your name on the survey, and will only utilize information collected in summary form to categorize or further explain important differences. If we are able to deduce your identity, the research will be confidential. Confidential means that the research records will include some information about you and this information will be stored in such a manner that there is some linkage between your identity (as deduced but not specified) and the response in the research. The information collected about you includes your opinions about climate change risks, ratings of concern about climate change impacts and your assessment of the needs for various climate adaptation programs. Please note that we will keep this information confidential by not including your name in the data records, limiting individual access to the research data and keeping it in a secure location. The research team and the Institutional Review Board (a committee that reviews research studies in order to protect research participants) at Rutgers are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated. All study data will be kept for three years. The benefits of completing the survey are that you will contribute to further knowledge and insight about impacts to land conservation from climate change and help to inform the development and prioritization of resources needed to support new or expanded programs or policies to address these impacts. The survey should take about 10-15 minutes to complete. Participation is completely voluntary and refusal to participate will result in no penalties. You may opt out of completion of the survey at any time while taking it. If you have questions related to the research, please contact Jeanne Herb, Associate Director of the Environmental Analysis and Communication group, 33 Livingston Ave., New Brunswick, NJ 08901, 848-932-2725, jherb@ejb.rutgers.edu. If you have questions about your rights as a research subject, you may contact the IRB Administrator at Rutgers University at:

Subjects	Rutgers University Institutional Review Board for the Protection of Human Office of Research and Sponsored Programs	3 Rutgers
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Plaza
0150

New Brunswick, NJ08901-8559
Email: humansubjects@orsp.rutgers.edu

Tel: 838 932

- I have read and understand the risks and benefits of this research and agree to participate by typing my initials in this box. _____

Q2 What BEST describes your interest in open space and farmland in New Jersey. Select one:

- Government Land Manager
- Land Manager for Nonprofit Organization
- Educator
- Private Property Owner
- Consultant
- General Interest/Citizen
- Local Volunteer
- Other _____

Q3 Do you work in New Jersey?

- Yes
- No

Q4 Do you live in New Jersey?

- Yes
- No

Q5 Do you Strongly Agree, Agree, Disagree or Strongly Disagree (or Don't Know) with the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
Global climate change is not occurring.	<input type="radio"/>				
Global climate change is mostly caused by human activity.	<input type="radio"/>				
Global climate change is a risk to New Jersey.	<input type="radio"/>				
Global climate change is a risk to me, my family, and my friends.	<input type="radio"/>				
The international scientific community understands the science behind global climate change.	<input type="radio"/>				
I trust the scientific community to truthfully report their findings related to climate change.	<input type="radio"/>				

<p>Our state and local officials understand the implications of global climate change for my region.</p> <p>The media I rely on communicate honestly with us about global climate change.</p>	<input type="radio"/> <input type="radio"/>				
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Q6 Please rate how concerned you are about the following climate change related impacts to open space and farmland: IMPACTS RELATED TO WATER

	Great Concern	Some Concern	Little Concern	No concern	Not applicable
Higher water temperature	<input type="radio"/>				
Increased algal blooms/eutrophication	<input type="radio"/>				
Reduced aquatic flow	<input type="radio"/>				
Reduced water availability	<input type="radio"/>				
Increased sediment volumes	<input type="radio"/>				
Salinity changes to water resources	<input type="radio"/>				
Concentration of pollutants in water	<input type="radio"/>				
More and longer droughts	<input type="radio"/>				
Increased occurrence and severity of flooding	<input type="radio"/>				
Reduced flood attenuation	<input type="radio"/>				

Q7 Please rate how concerned you are about the following climate change related impacts to open space and farmland: IMPACTS RELATED TO LAND AND AIR

	Great Concern	Some Concern	Little Concern	No concern	Not applicable
Soil erosion/loss	<input type="radio"/>				
Soil compaction	<input type="radio"/>				
Concentration of pollutants in soil	<input type="radio"/>				
Reduced carbon storage	<input type="radio"/>				
Reduced water filtration	<input type="radio"/>				
Reduced air purification	<input type="radio"/>				
Beach/dune loss	<input type="radio"/>				
Tidal wetland erosion/loss	<input type="radio"/>				
More wildfires	<input type="radio"/>				

Q8 Please rate how concerned you are about the following climate change related impacts to open space and farmland: IMPACTS RELATED TO FLORA, FAUNA AND PEOPLE

	Great Concern	Some Concern	Little Concern	No Concern	Not applicable
Changes in plant and animal species composition and distribution	<input type="radio"/>				
Species lifecycle changes (e.g., bloom time, reproductive timing)	<input type="radio"/>				
Increased spread of invasive species	<input type="radio"/>				
Increased occurrence/spread of pathogens, pests, vector-borne diseases	<input type="radio"/>				
Critical species habitat loss	<input type="radio"/>				
Salinity impacts on vegetation	<input type="radio"/>				
Heat stress/stroke (for visitors and workers)	<input type="radio"/>				
Reduced recreation and tourism	<input type="radio"/>				

Q9 Please rate how concerned you are about the following climate change related impacts to open space and farmland: IMPACTS RELATED TO FARMLAND

	Great Concern	Some Concern	Little Concern	No Concern	Not applicable
Salinity impacts on crops	<input type="radio"/>				
Crop damage/loss	<input type="radio"/>				
Reduced crop yield	<input type="radio"/>				
Reduced livestock production	<input type="radio"/>				
Loss of soil fertility	<input type="radio"/>				
Unsuitability for crop varieties	<input type="radio"/>				
Increased water demand for crops	<input type="radio"/>				
Reduced growing season	<input type="radio"/>				
Delayed spring planting	<input type="radio"/>				
More root disease	<input type="radio"/>				

Q10 Were the open spaces/farmlands you are responsible for impacted by Tropical Storm Irene (2011)?

- Yes
- No
- Not Applicable

Q11 If the open spaces/farmlands you are responsible for were affected by Tropic Storm Irene, what were the types of impacts?

- Severe flooding
- Minor flooding
- Short term land/property damage
- Long term or permanent land/property damage
- Resident or livestock evacuation
- Other _____

Q12 Were the open spaces/farmlands you are responsible for impacted by Hurricane Sandy (2012)?

- Yes
- No

Q13 if the open spaces/farmlands you are responsible for were affected by Hurricane Sandy, what were the types of impacts?

- Severe flooding
- Minor flooding
- Short term land/property damage
- Long term or permanent land/property damage
- Resident or livestock evacuation
- Other _____

Q14 Of the following climate change adaptations, which are In Place, Planned or Needed for YOUR program or properties?

	In Place	Planned	Not Planned but Needed	Not Needed	Don't Know	Not Applicable
Property and resource vulnerability assessments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Risk maps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Emergency preparedness plans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Protection of representative ecosystems of sufficient size	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Protection of connective corridors between ecosystems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collaborative regional approaches to manage ecosystems to respond to climate change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Green infrastructure (e.g., riparian buffers, living shorelines, native landscaping, tree planting, wetland restoration, porous pavement, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Surveillance for diseases	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Livestock shelters	<input type="radio"/>					
Water conservation (e.g., drip irrigation, water efficiency, change to less water intensive crops)	<input type="radio"/>					
Crop diversification	<input type="radio"/>					
Altered farm practices (e.g., mulching, intercropping)	<input type="radio"/>					
Moving of livestock to irrigated pastures earlier	<input type="radio"/>					
Drilling new wells or seeking alternative water sources	<input type="radio"/>					
Pumping of more water	<input type="radio"/>					
Farmscaping for biodiversity, pollination, pest and flood control	<input type="radio"/>					
Other	<input type="radio"/>					
Other	<input type="radio"/>					

Q15 What are the most important actions or programs needed at the REGIONAL, STATE, OR FEDERAL levels to support efforts by members of the open space and farmland preservation community to prepare for and respond to climate change impacts?

	High Need	Some Need	Little or No Need	Don't Know	Not Applicable
Enhanced monitoring to establish baselines and monitor changes to species health, crop yield and other measures that could trigger a need for action	<input type="radio"/>				
Enhanced vector and disease surveillance programs	<input type="radio"/>				
Development of improved and low-cost weed/vector control approaches	<input type="radio"/>				
Improved climate modeling capacity for local scale assessments	<input type="radio"/>				
Development of land conservation targets based on likely climate change scenarios	<input type="radio"/>				
improved coordination and training between the conservation community and regional, state,	<input type="radio"/>				

<p>federal resource agencies regarding climate change issues</p>					
<p>Research on the vulnerability of economically important agricultural species and development of adaptive plant/agricultural species and varieties</p>	○	○	○	○	○
<p>Enhanced Best Management Practices to reduce stormwater runoff</p>	○	○	○	○	○
<p>Programs to assist property owners in changeover to new equipment or for experimenting with new varieties of climate-resistant crops</p>	○	○	○	○	○
<p>Incentive programs to preserve climate resilient open space and farmland</p>	○	○	○	○	○
<p>Water supply planning and conservation programs to account for a changing climate</p>	○	○	○	○	○

Research on innovative and cost effective strategies for improved water systems management and design	<input type="radio"/>				
Support for habitat restoration projects to enhance resiliency and survival of endangered and threatened species and critical habitat	<input type="radio"/>				
Work to identify and implement appropriate fire management strategies in at-risk forested areas	<input type="radio"/>				
Other	<input type="radio"/>				
Other	<input type="radio"/>				

Q16 What does your open space or farmland preservation program MOST NEED to prepare for and be ready to respond to climate change impacts over the coming decades?

Q17 What are the most biggest challenges to achieving preparedness for climate change in New Jersey?

Q18 Please rank climate change impacts in importance among these non-climate stressors to land and farmland conservation/preservation? (Drag and drop to rank 1 to 6 with 1 being most important and 6 being least important):

- _____ Climate Change Impacts
- _____ Encroaching Land Development
- _____ Increases in Contaminants
- _____ Alterations to Hydrology (channelization, etc.)
- _____ Introduced or Invasive Species
- _____ Overuse of Trails/Multi-use conflicts

Attachment D: NJ Land Conservation Rally Survey Results Summary

Summary of Land Trust Survey: Preparing for Climate Change Impacts in New Jersey

Administered to attendees of the New Jersey Land Conservation Rally on March 9, 2013
Survey conducted online May 1 – June 12, 2013.

Overview of Participants

35 respondents completed this online survey. Of the respondents, 17% are government land managers, 20% are land managers for nonprofit organizations, 17% are citizens with a general interest in land conservation, and 11% are local volunteers, with the remainder responding “other”.

Views on Climate Change

89% of respondents believe climate change is occurring, with 30 of the respondents strongly disagreeing and 1 disagreeing with the statement “global climate change is not occurring”. 11% do not think that climate change is occurring. The overwhelming majority of respondents (89%) believe that climate change is mostly caused by human activity, with 51% strongly agreeing on this point, 37% agreeing, 6% disagreeing and 6% responding “don’t know”. Nearly all respondents (94%) feel climate change is a risk to New Jersey, and 91% think climate change is a personal risk to family and friends. 80% agree that the international scientific community understands the science behind climate change and 86% trust the scientific community to truthfully report their findings related to climate change. Opinion on the media is divided, with 46% agreeing that the media communicate honestly about global climate change, 31% disagreeing, and 23% responding “don’t know”. Most respondents expressed little faith in state and local officials’ comprehension of climate issues, with 80% disagreeing or strongly disagreeing with the statement “our state and local officials understand the implications of global climate change for my region.”

Climate Change Impacts to Open Space and Farmland

Respondents expressed ‘great concern’ or ‘some concern’ about nearly all of the water-related impacts presented in the survey. More and longer droughts was the issue of the greatest concern, with 97% expressing concern (89% great/8% some). The next most concerning water-related issue was the opposite climate extreme, increased occurrence and severity of flooding (97% overall - 74% great/23% some). Other water issues of major concern include increased algal blooms (97% - 71%/26%) and reduced water availability (94% - 69%/26%).

Tidal wetland erosion and loss was a major concern, with 97% of respondents expressing great (80%) or some (17%) concern about this issue, as was beach and dune loss (91% -

66% great/25% some). 94% of respondents identified critical species habitat loss as a concern, with 69% of respondents expressing great concern and 26% expressing some concern. Species lifecycle changes such as bloom time and reproductive timing was also a major concern (97% - 60%/37%), as was the risk of changes in plant and animal species composition and distribution (94% - 66%/29%) and an increased spread of invasive species (91% - 63%/29%). Other impacts of concern include reduced water filtration, reduced air purification, reduced carbon storage, and soil erosion and loss.

Of impacts related specifically to farmland, respondents were most concerned about increased water demand for crops (91% - 74% great/18% some), reduced crop yield (91% - 68% great/24% some) and crop damage/loss (94% - 62%/32%).

Impacts from Irene and Sandy

The open lands/farmlands of 81% of respondents were impacted by Tropical Storm Irene in 2011, with common impacts including severe flooding (33%) and short-term land/property damage (33%).

81% of the respondents' open spaces and farmlands were affected by Hurricane Sandy in 2012, with 32% reporting short term land/property damage and 28% reporting long term or permanent land/property damage. Only 12% of respondents reported severe flooding from Hurricane Sandy, compared with 33% from Irene.

Climate Change Adaptation and Preparedness Activities

Very few of the climate change adaptation options listed in the survey were identified as already in place or planned. Of the options presented, emergency preparedness plans are the most common (24% in place, 35% planned), followed by surveillance of diseases (23% in place, 15% planned) and green infrastructure (14% in place, 23% planned, 59% not planned but needed).

Major needs identified, as measured by percentage of respondents reporting that the activity is not planned but needed, include property and resource vulnerability assessments (89%), collaborative regional approaches to manage ecosystems (79%), protection of representative ecosystems of sufficient size (72%), water conservation (71%), farming for biodiversity (69%), and protection of connective corridors between ecosystems (68%).

Regional, State, and Federal Actions

Incentive programs to preserve climate resilient open space and farmland were identified as one of the highest priority needs at the local, state, or federal level, with 75% of respondents selecting this as a 'high need'. Improved coordination and training between the conservation community and regional, state, and federal resource agencies was a close second, identified as a high need by 74% of respondents, followed by water supply planning

and conservation programs to account for a changing climate, selected by 73% of respondents.

Other state, regional, or federal actions and programs identified as ‘high need’ include support for habitat restoration projects (72%), development of land conservation targets based on likely climate change scenarios (71%), enhanced best management practices to reduce stormwater runoff (67%), and research on innovative and cost effective strategies for improved water systems management and design (66%).

Other programs or activities that respondents identified there was ‘some’ or ‘great’ need for include enhanced monitoring to establish baselines and monitor changes in species health and crop yield, improved climate modeling capacity for local scale assessments, research on the vulnerability of economically important agricultural species and development of adaptive species and varieties, and implementation of appropriate fire management strategies in forested areas.

Critical Needs

When asked “what does your open space or farmland preservation program most need to prepare and be ready to respond to climate change impacts over the coming decade”, many of the responses focused on the need for more preserved open space and for sustainable funding mechanisms to enable more land preservation. Other needs identified include deer control, ability to model and predict climate change scenarios at the local and regional level, more public awareness, better understanding of the effects of climate change on specific crops and land types, and prohibition of development in flood plains.

Challenges

The biggest challenges identified to achieving preparedness for climate change in New Jersey were lack of political will and lack of public awareness of climate change issues. Other barriers identified include development pressures, local regulations that allow for development in environmentally sensitive areas, the fragmented nature of local zoning rules, and the inherent complexity and long-term timescale of climate issues.

Issue Prioritization

When presented with a list of six challenges to land and farmland preservation and asked to rank them in order of importance, with 1 being most important and 5 being least important, the overall rank order was: 1) Encroaching Land Development, which was clearly identified as the primary challenge, followed by 2) Climate Change Impacts; 3) Alterations to Hydrology; 4) Increases in Contaminants; 5) Introduced or Invasive Species; and 6) Overuse of Trails/Multi-use conflicts.