2021

NATURAL AND WORKING LANDS STRATEGY

SCOPING DOCUMENT

TABLE OF CONTENTS

BACKGROUND

Basis for a Natural & Working Lands Strategy (NWLS)

Overwhelming scientific consensus states that human activity is substantially warming the global climate. The results of global climate change, such as rising temperatures, sea-level rise, increased intensity and frequency of precipitation, and a higher frequency of severe storms, are significantly impacting our communities, infrastructure, natural ecosystems, and economy. New Jersey is particularly vulnerable to these impacts due to its coastal location and high population density and must act swiftly and deliberately to be a local leader in addressing this global problem.

In furtherance of this duty, the State of New Jersey is working to lower annual greenhouse gas (GHG) emissions. In 2007, New Jersey passed the Global Warming Response Act (GWRA), which set specific targets for carbon emission reductions by 2020 and 2050. By rapid transition to cleaner energy generation, New Jersey was able to exceed its 2020 reductions goal; however, broader strategies across multiple sectors of society are necessary to reach our "80x50 Goal" to reduce emissions to 24.1 million metric tons CO_2e by 2050. One key strategy is a focus on carbon sequestration in New Jersey's natural and working lands. Following the emission reduction pathways set forth in the Global Warming Response Act 80x50 Report, including policies detailed in the 2019 Energy Master Plan, clean energy alone will not be enough to reduce GHG emissions by the amount necessary to meet the 2050 goal without the additional reduction of 6 to 10.8 million metric tons of CO_2e due to carbon sequestration.

Natural and working lands, including forests, wetlands, and agricultural lands, can play a major role in climate change mitigation by removing carbon dioxide (CO_2) from the atmosphere through long-term accumulation in vegetation and soils. Over the past few decades, continuous loss of New Jersey's agricultural lands, wetlands, and forests due to development has led to higher annual carbon emissions. Despite this loss, according to the Global Warming Response Act 80x50 Report, New Jersey's land sector still sequestered about 8 percent of the state's net carbon emissions in 2018.

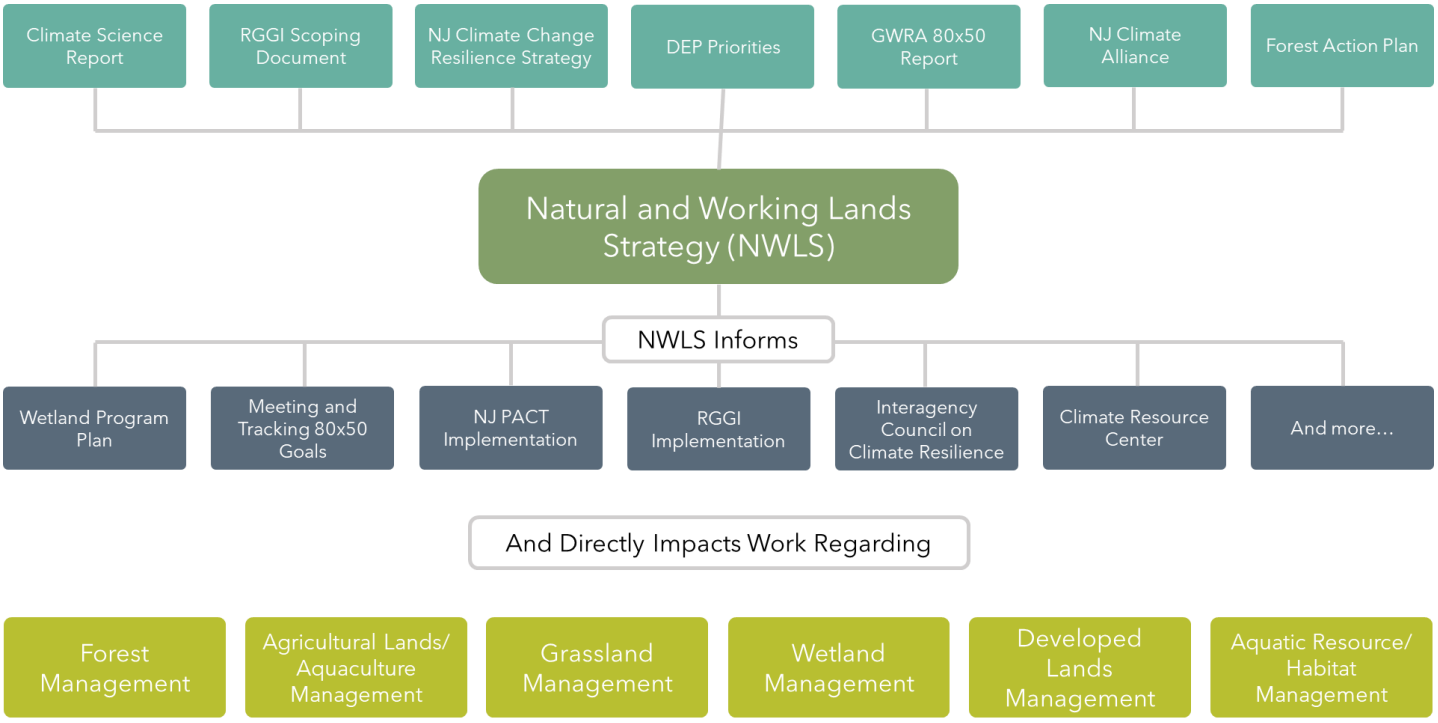
According to preliminary calculations by the US Climate Alliance (2018), utilized in the Global Warming Response Act 80x50 Report (2020), New Jersey could store and sequester an additional 2 to 3 million metric tons of CO_2 by actively managing, enhancing, and protecting its natural and working lands. Properly managed natural and working lands also contribute to climate change adaptation by providing protection from storms and flooding and delivering a variety of ecosystem services such as providing habitat for wildlife, contributing to the health and resilience of communities, and strengthening our economy. A 2007 study found that the ecosystem services provided by the whole of New Jersey's natural and working lands are, at a minimum, worth between $11.8 billion and $27.2 billion annually, after adjusting to 2020 dollars (Costanza et al. 2007). In addition, the avoided damage to the climate that would have been caused by sequestered carbon is valued at over 15 billion dollars, using current social cost of carbon estimates (IWG 2021).

By protecting New Jersey's existing carbon sinks, as well as enacting well-informed, scientifically backed land restoration and management strategies, the State can achieve the reduction of 10.8 million metric tons of CO_2e due to carbon sequestration necessary to meet the 80x50 Goal. Therefore, the Natural and Working Lands Strategy (NWLS) aims to access the expertise of subject matter experts and the best available science to develop recommendations, actions, and targets to most effectively bring New Jersey's climate goals to fruition. Ultimately, the NWLS will present a set of statewide policies and recommendations for the management of natural and working lands, the actions necessary to implement those recommendations within a proposed timeframe, and the associated carbon sequestration benefits. The implementation of these actions will sequester carbon, build ecosystem and community resilience, and protect and enhance our economy. The New Jersey Department of Environmental Protection (NJDEP) and the New Jersey Department of Agriculture (NJDA) intend to release the first version of the NWLS in 2022 after input from stakeholders is gathered, but it is expected to evolve over time as new science emerges.

Nexus to Existing State Initiatives

The NWLS will build off the work already done by state entities to reduce and respond to climate change. Specifically, the Strategy will bring together recommendations, modeling, and planning efforts to holistically center statewide land use management decisions on carbon sequestration, climate resilience, and other complimentary environmental and economic benefits. Ultimately, the NWLS will guide and impact the governance of natural lands across the state.

Figure 1: Development and Use of the NWLS



Key initiatives influencing the development of the NWLS include the following:

New Jersey's GWRA 80x50 Report, 2020

In 2007, the Global Warming Response Act directed the State of New Jersey to develop plans and recommendations that would help New Jersey mitigate the impacts of climate change by reducing carbon dioxide emissions to 80 percent below 2006 levels by 2050. Governor Murphy reaffirmed this commitment in Executive Order 100 by calling on the NJDEP to write the Global Warming Response Act 80x50 Report (80x50 Report). In 2020, New Jersey released the 80x50 Report detailing the strategies needed to meet the 80x50 goal, highlighting the need for coordination across sectors and including carbon sequestration as an essential factor for success.

To that end, the 80x50 Report recommended the development of a statewide carbon sequestration plan that: 1) expands upon existing State plans that address climate resilience in natural and working lands 2) establishes 2030 and 2050 sequestration targets, and 3) improves current carbon sequestration estimates through additional research and monitoring. The NWLS strives to further this recommendation while detailing what additional research will be required to advance understanding of carbon sequestration in New Jersey.

Executive Order #7 – January 29th, 2018 – New Jersey re-enters the Regional Greenhouse Gas Initiative

As directed by Governor Murphy's Executive Order (EO) #7, New Jersey rejoined the Regional Greenhouse Gas Initiative (RGGI) in 2020. The RGGI is a multi-state, market-based program that establishes a regional cap on CO_2 emissions from participating states' collective electric power sectors. Fossil fuel electricity-generating units are required to purchase allowances equivalent to the amount of CO_2 they emit annually. Funding collected from the purchase of allowances is transferred to the state to reinvest in climate, clean energy, and equity programs, as per P.L. 2008, c. 340, commonly referred to as the Global Warming Solutions Fund Act.

The Global Warming Solutions Fund Act requires that 10 percent of the funds from RGGI auction proceeds are allocated to carbon sequestration projects in forests and tidal marshes; these funds can potentially be leveraged for certain projects that result from NWLS recommendations. Significant public feedback was collected during the RGGI stakeholder process, elevating the need for the state to critically assess its natural and working lands through the lens of carbon sequestration.

Executive Order #89 – October 29th, 2019 – New Jersey Climate Change Resilience Strategy

This EO mandated the development of a statewide Climate Resilience Strategy, with the purpose of identifying recommendations for climate mitigation and adaptation that will increase the resilience of communities, infrastructure, economies, and natural resources. The NWLS will directly build upon the recommendations set forth in the New Jersey Climate Change Resilience Strategy drafted in Spring 2021.

Executive Order #100 – January 27th, 2020 – NJPACT

In response to EO #100, New Jersey has begun to develop a set of regulatory reforms known as New Jersey Protecting Against Climate Threats (NJPACT). These regulations require the monitoring of New Jersey's greenhouse gas emissions and the establishment of criteria that will help reduce those emissions. The NWLS will work synergistically with NJPACT to track the carbon benefits of climate mitigation efforts spurred by NWLS.

Strategy Goals

The Department of Environmental Protection is working in partnership with the NJ Department of Agriculture (NJDA) to prepare a Natural & Working Lands Strategy (NWLS) that identifies and prioritizes detailed strategies to mitigate the impacts of climate change through carbon storage and sequestration on New Jersey's natural and working lands. The NWLS will identify and prioritize near-term recommendations that are most immediately cost-effective and pragmatic, such as natural resource stewardship and management, as well as longer-term goals that may require more detailed planning, identification of funding sources, or policy and social changes. Each recommendation will be developed with consideration to many co-benefits to carbon sequestration, such as ecological, economic, and community resilience.

For each recommendation, near-term actions will be developed for implementation by State agencies. These actions will outline the next steps required to carry out the recommendation, as well as specific targets that address how much progress should be made within a certain timeframe (e.g., protect X acres by X year). These will be derived based on current scientific data/projections and input from experts.

The recommendations in the NWLS are expected to be broadly applicable to land managers; thus, state and local government agencies, non-profits, universities, private landowners, and associated policymakers from all jurisdictions are also key audiences for the Strategy.

Alongside the NWLS recommendations, another goal of the Strategy will be to advance scientific understanding of carbon storage and sequestration in New Jersey's natural and working lands. After consulting with carbon modeling experts and completing an analysis using the best available science, the NWLS will develop a carbon inventory for each natural and working land type, quantify the carbon benefits of each NWLS recommendation, and establish a means of supporting decisions and tracking the expected progress of each effort implemented due to the Strategy.

The NWLS aims to improve carbon sequestration across a variety of natural and working land types and will develop separate recommendations for each land type. Six land types will be evaluated, including forests, agricultural lands/aquaculture, grasslands, wetlands, developed lands, and aquatic resources/habitats. In addition to their high potential for increased carbon storage and sequestration, each of these land types was chosen due to ecological significance, importance to New Jersey economies, or value to New Jersey communities. Further details on the importance of each individual natural and working land type is discussed in the Strategy Recommendations section below.

WHO WILL USE THE NWLS?

Public and Private Landowners & Managers

Universities, Nonprofit Organizations, Corporations, Land-use Consultants, & Investors

Federal, State and Local Planners, & Policymakers

NWLS LAND TYPES

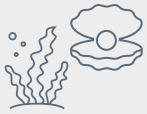
Forests

Agriculture & Aquaculture

Grasslands

Wetlands

Developed Lands



Aquatic Resources & Habitats

BUILDING A STRATEGY

Information-gathering and Literature Review

In order to ensure that the NWLS does not overlook any existing strategies that have already been developed or efforts that are already underway, an exhaustive literature review will be conducted to locate any plans or reports that address carbon sequestration in natural and working lands. This will include a broad review of state, federal, and international plans developed by jurisdictions outside New Jersey (listed in Appendix 1). In particular, the natural and working lands plans developed by North Carolina[1], California[2], and Maine[3] all exhibit structural elements or data outputs that are in line with the vision for the New Jersey NWLS. As a result, those plans will be used as references throughout the Strategy development process.

In preparation of this scoping document, a preliminary review of New Jersey-specific literature was conducted. After an assessment of New Jersey-specific climate resilience reports, plans, and initiatives, five of them were found to be the most relevant to the NWLS and contained ideas or strategies that could be used to inform the development of NWLS recommendations. The example recommendations listed in the "Strategy Recommendations" section of this scoping document were retrieved from the following plans and reports:

Global Warming Response Act 80x50 Report, 2020

In response to the carbon emissions goal set forth in the Global Warming Response Act (reducing carbon dioxide emissions to 80 percent below 2006 levels by 2050), the GWRA 80x50 Report details the strategies needed to meet this goal, suggesting that carbon sequestration will be one of the necessary factors. The GWRA 80x50 Report recommended the development of a statewide carbon sequestration plan, detailing: 1) a set of broad carbon sequestration pathways associated with a variety of natural and working land types, and 2) a series of recommendations for initiatives that could help the state follow those pathways.

2020 New Jersey Scientific Report on Climate Change

This report is meant to increase New Jersey's understanding of how climate change will impact the State environment. It describes the value of multiple natural and working land types as carbon sinks, discusses how threats such as land use conversion and invasive species may be placing those sinks at risk, and acknowledges the need for more information on carbon sequestration potential and improved monitoring of carbon in NJ state lands.

Regional Greenhouse Gas Initiative (RGGI) Strategic Funding Plan, Years 2020-2022

The RGGI Strategic Funding Plan expands upon the example initiatives detailed in the RGGI Scoping Document and prioritizes the RGGI objectives with respect to each initiative. It also describes the co-benefits that are likely to occur alongside the implementation of the RGGI objectives.

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[1] North Carolina Department of Environmental Quality. 2020. North Carolina Natural and Working Lands Action Plan. 116 pp. Available at https://deq.nc.gov/energy-climate/climate-change/adaptation-and-resiliency/natural-working-lands.

[2] California Environmental Protection Agency, California Natural Resources Agency, California Department of Food and Agriculture, California Air Resources Board, California Strategic Growth Council. 2019. January 2019 Draft: California 2030 Natural and Working Lands Climate Change Implementation Plan. 87 pp. Available at https://ww2.arb.ca.gov/resources/documents/nwl-implementation-draft.

[3] Natural and Working Lands Work Group. 2020. Maine Climate Council Natural and Working Lands Work Group Final Strategy Compilation. 41 pp. Available at https://www.maine.gov/future/initiatives/climate/climate-council/reports.

New Jersey Climate Change Resilience Strategy

As directed by Executive Order #89, the Climate Change Resilience Strategy was developed by NJDEP in 2021 to set forth recommendations for climate mitigation, adaptation, and resilience in New Jersey. The recommendations span six priority areas that address community, ecosystem, coastal, and economic resilience as well as increased scientific research and coordinated government efforts.

New Jersey State Forest Action Plan, December 2020

The Forest Action Plan was developed by the New Jersey Forest Service in collaboration with the USDA Forest Service, setting forth a series of criteria and national priorities for forest conservation and management in a changing climate. Each criterion addresses factors such as forest ecosystem health and diversity, forest carbon cycles, social value of forests, and ways to protect forests from climate threats by increasing their capacity for carbon storage and sequestration.

Recommendation Development with Subject Matter Experts

In order to identify the most effective and practical recommendations for inclusion in the final NWLS, recommendations for each natural and working land type will be developed by NJDEP and NJDA-led workgroups with input from external subject matter experts (e.g., federal partners, NGOs, universities, NJDEP Scientific Advisory Board). After reviewing all relevant plans and reports, each workgroup will identify the highest-value recommendations that may be implemented in New Jersey. For each recommendation, workgroups will: 1) develop reasonable and practical actions that describe in detail the steps and resources required for implementation, 2) specify targets for tracking progress (e.g., protect X acres by X year), and 3) identify the expected benefits, costs, or potential complications to accomplishing each recommendation.

Carbon Accounting Methodologies and Tracking

To comprehensively and accurately account for carbon storage and sequestration, all available data on carbon sequestration and existing carbons sequestration estimates by land type will be compiled and reviewed. These will be used to create the following products:

1) a carbon inventory detailing the current storage and sequestration rates per unit area for each of the natural and working land types,

2) quantified carbon benefits of each NWLS target, and

3) standardized calculations and methodologies that can be used to make decisions and track annual progress related to NWLS recommendations, actions, and targets.

NJDEP is exploring a dynamic representation of this progress in the form of a public-facing web viewer that will be updated regularly. Scientific analysis done as part of the NWLS will be peer-reviewed by the NJDEP Scientific Advisory Board.

Public Stakeholder Process

NJDEP and NJDA intend to begin a formal, external stakeholder process to inform the final NWLS in the Spring/Summer of 2022 by convening an initial information session, followed by a series of smaller, focused workgroup meetings with external experts and interested parties to gather input on preliminary recommendations, actions, and targets. These small workgroups will be separated by natural and working land type, and they may include entities such as local land managers and governments, regional planning groups and commissions, academic institutions, and various non-governmental organizations.

If one or more of the land types addressed in the NWLS interests you, and you would like to participate in any of these sessions, please provide your contact information through the webform found on the NWLS webpage. You will be contacted once the sessions are scheduled.

The release date of the final NWLS is dependent on the length of the public stakeholder process noted above, but it's release is anticipated by the end of 2022.

All comments regarding this NWLS *Scoping Document* should be submitted via the webform on the NWLS webpage within **60 days** from the release of the *Document*.

December 2021

Scoping Document Released, 60-Day Public Comment Period

Spring/Summer 2022

Strategy Development, Targeted Stakeholder Sessions

TBD 2022*

Based on Stakeholdering

Natural and Working Lands Strategy Released

STRATEGY RECOMMENDATIONS

The following section describes each natural and working land type that will be covered in the Natural and Working Lands Strategy and explains its importance to New Jersey's ecosystems, communities, and economy. Along with each natural and working land type is:

1) a list of the New Jersey plans and reports that address carbon sequestration strategies for that natural and working land type,

2) examples of existing recommendations that may be included or expanded upon in the final NWLS, and

3) examples of current New Jersey or US federal programs or initiatives that may be informed by the NWLS or can be expanded upon with consideration to NWLS goals.

Forests

Overview

New Jersey's forests cover approximately 40 percent of the state's total land area, making up the largest land area of any ecosystem type in New Jersey. Forests provide a variety of ecological, social, and cultural services, including habitat for wildlife, public recreation, water filtration, and carbon sequestration and storage. In 2004, the ecosystem services of New Jersey's forests were valued at $2,025 per acre per year or $2.96 billion per year, after adjusting to 2020 dollars (Costanza et al. 2006). Including live and dead biomass and soil organic carbon, the forests of New Jersey currently store about 141,320,375 metric tons of carbon, and they sequester more and more every year.

While historic trends show significant deforestation beginning in the 1800s, the State's total forested area has largely stabilized in recent years, with only a 6.9% loss between 1986 and 2012 (Lathrop, Bognar, and Hasse 2016). However, the percent forest cover is expected to decrease once again in the coming decades due to additional development pressures, shifting forest age class diversity, and the impacts of invasive species (Shifley et al. 2016).

Managing New Jersey's forests in a sustainable and resilient manner is of utmost importance. Helping to ensure safe drinking water supplies, enhance and maintain ecosystem services and boost carbon storage, forest conservation and management can increase above ground carbon storage by accelerating the growth rates and survival of trees and also enhance below ground carbon storage through the conservation of older forest age classes, including management to increase woody debris and carbon sequestered in soils (Swanston et al. 2016.). By enacting conservation strategies to maximize a forest's ability to sequester carbon (e.g., afforestation, reforestation, deforestation avoidance, improved forest management), United States forests have the capacity to increase carbon sequestration by 370-740 million metric tons of CO_2e per year (Post et al. 2012).

Reports & Plans Consulted

- New Jersey State Forest Action Plan, December 2020
- Regional Greenhouse Gas Initiative (RGGI) Strategic Funding Plan, Years 2020-2022
- New Jersey Climate Change Resilience Strategy

Example Strategies & Recommendations

- Preserve forested areas through fee and easement acquisition to avoid conversion of these lands to other uses and increase areas utilizing active forest management best management practices.
- Afforestation and reforestation activities to establish forest on sites that were never forested or were previously or historically forested.
- Forest restoration – enhance the ecology and ecosystem function of a forest system to optimize and/or restore carbon sequestration potential.
- Proforestation – Allow forests to grow into old age to maximize ecological potential and carbon sequestration ability.
- Develop a reliable wildfire tracking system and implement hazard fuel reduction treatments, including prescribed burns.
- Develop appropriate best management practices and decision-support methodologies for active forest management to maintain and enhance age and structural diversity of forests in a manner that furthers carbon sequestration potential and bolsters forest resilience and biodiversity.
- Enhance New Jersey's Forest Stewardship and Urban Forestry programs to increase participation, and involvement and thereby add to New Jersey's forest system, including the urban forest.

Example Initiatives

NJDEP Forest Stewardship Program – participation in this program allows landowners to be actively involved in the management of New Jersey's forest resources to increase forest carbon sequestration potential by improving overall forest health and diversity.

Agricultural Lands and Aquaculture

Overview

Agricultural croplands and grasslands in New Jersey cover about 543,469 acres, or about 12 percent of the land area. These important working lands provide a significant boost to the New Jersey economy, with agricultural products contributing over $1.2 billion in 2020 (ERS 2021). These products are not the only factor that makes agricultural lands important; after adjusting to 2020 dollars, habitat services provided by cropland have also been valued at $188 per acre annually, or $102.9 million per year (Costanza et al. 2006).

While agricultural lands are often sources of atmospheric carbon, implementing management practices that improve soil health has the potential to convert them to carbon sinks. Potential for soil carbon sequestration associated with agriculture lies with a variety of practices that minimize disturbance to the soil. It has been found that tilling the soil releases carbon stored in soils back into the atmosphere; moving away from these long-standing practices could remove an average of 1.22 metric tons of CO_2e per hectare per year, totaling over 110 million metric tons of CO_2e per year throughout the United States (Post et al. 2012). Out of the over 500,000 acres of agricultural land in New Jersey, 411,000 of them could benefit from better land management practices (NJDEP 2020).

Aquaculture, or the farming of aquatic organisms such as fish, shellfish, and plants is another important part of the New Jersey economy. New Jersey's aquaculture resources contributed over $7.2 million to the state's economy in 2018 (NASS 2021). The vast majority of New Jersey's aquaculture consists of shellfish production. Oyster farming is thought to be a contributor to carbon sequestration, but more research is needed to elucidate the precise carbon benefits in New Jersey.

Reports & Plans Consulted

- Global Warming Response Act 80x50 Report, 2020
- New Jersey Climate Change Resilience Strategy
- Janowiak M et al. 2017. Considering Forest and Grassland Carbon in Land Management. 68 pp. US Department of Agriculture, US Forest Service.

Example Strategies & Recommendations

- Provide additional incentives and technical tools to assist farmers in implementing climate-friendly agricultural practices.
- Create landowner assistance programs to encourage farmers, foresters, and other resource managers to incorporate practices that help to address the changing climate.
- Reduce tillage practices and other soil disturbances in agricultural fields to limit carbon loss.
- Plant carbon-sequestering cover crops to minimize the time soils are left bare.
- Amplify promotion of USDA/NRCS incentive programs such as the Conservation Reserve Enhancement Program, which pays farmers, ranchers, and agricultural landowners an annual rental rate in exchange for removing environmentally sensitive land from production and planting natural buffers.
- Encourage precision agriculture and other technologies that provide essential data to minimize the number of inputs needed on farmlands.
- Adopt aquaculture practices that consider ocean acidification, including increased monitoring of ocean and bay conditions.
- Expand the technical assistance and support of NJDA's Office of Aquaculture Coordination and the Aquaculture Advisory Council. Implement the policies and the recommendations of the Aquaculture Development Plan Update (2021).

• Continue to provide State cost-share assistance to farmers enrolled in preservation programs to encourage the implementation of conservation practices on farms. Identify additional eligible practices that address soil health.

Example Initiatives

USDA-NRCS Conservation Innovation Grant-On Farm Trial – North Jersey Resource Conservation and Development (RC&D) will distribute $640,000 in incentives to 25 New Jersey farmers to promote the use of cover crops and no-till practices with the goal of sequestering more carbon while increasing agricultural sustainability.

Grasslands

Overview

Combined with agricultural cropland, grasslands cover about 12 percent of New Jersey's total land area. Natural grasslands provide important habitat to a variety of wildlife such as grassland nesting birds; however, much of the grassland habitat in New Jersey consists of grazing or pasture lands. As a result, many management strategies for carbon sequestration may overlap with those of agricultural lands.

While land types such as forests and wetlands may have a larger sequestration potential, grasslands can still sequester a great deal of carbon, especially in their belowground biomass and soils. Grasslands are characterized by deep, fertile soils with high organic matter content, and thus high carbon content, due to their extensive fibrous root systems (Janowiak et al. 2017). Based on the carbon sequestration potential of different vegetation types, global estimates suggest that grasslands likely contribute over 10 percent of the total biosphere store of carbon (Jones and Donnelly 2004). Global restoration of degraded grasslands has a carbon sequestration potential of approximately 3 billion metric tons of carbon per year (Janowiak et al. 2017).

Reports & Plans Consulted

- Global Warming Response Act 80x50 Report, 2020
- Janowiak et al. 2017. Considering Forest and Grassland Carbon in Land Management. 68 pp. US Department of Agriculture, US Forest Service.

Example Strategies & Recommendations

- Preserve grassland areas through acquisition and easements to avoid conversion to other uses.
- Encourage grassland creation and enrollment of grasslands into federal habitat protection programs.
- Minimize soil disturbances in grassland pastures to reduce carbon loss.
- Restore degraded grasslands by increasing grassland plant diversity and planting productive grassland species to increase carbon capture and storage rates.
- Increase production of forage (plant leaves and stems grazed on by livestock) through management strategies such as irrigation, interspersing of grasslands and legumes, grazing intensification, and introduction of earthworms.

Example Initiatives

USDA Farm Service Agency's Grasslands Conservation Reserve Program (CRP) – Grasslands CRP is a voluntary program that helps landowners protect grasslands, including rangelands and pasturelands, while continuing to allow grazing. This effort increases plant and animal biodiversity and allows farmers to increase land sustainability while keeping the land in production. Increases in grassland biodiversity and sustainability have the potential to increase carbon sequestration potential as well.

Wetlands

Overview

New Jersey's wetlands cover approximately 986,462 acres, about 21% total land area. Out of all New Jersey's natural and working lands, the ecosystem services of wetlands provide the largest economic value, at $15,869 per acre annually or $12.9 billion per year and $8,411 per acre annually or $1.6 billion per year respectively for freshwater and saltwater wetlands (Costanza et al. 2006, values adjusted to 2020 dollars). Both tidal and non-tidal wetlands can buffer communities from flooding, protect from storm surge and damage, and filter water quality. Narayan et al. 2017 found that $625 million in storm damage was prevented by tidal marshes during Hurricane Sandy. Tidal wetlands also provide essential nursery habitat for over 75% of New Jersey's important fisheries species (NOAA 2018).

The greenhouse gas dynamics of non-tidal wetlands are not yet fully understood, but recent assessments suggest that terrestrial wetlands in North America account for approximately 36 percent of global wetland carbon stock (Kolka et al. 2018). Tidal wetlands are known to be some of the most effective carbon sinks in the world. Due to continuous soil saturation and accretion of sediments and organic materials, tidal wetlands can store carbon in soils for millennia, and are over ten times more efficient at carbon burial than the most productive forests (McLeod et al. 2011). Despite covering less than 1% of the ocean's area, tidal wetlands store over 50% of the seabed's carbon reserves; collectively, global salt marshes have an estimated carbon burial rate of approximately 4.8 million metric tons of carbon per year (McLeod et al. 2011).

Reports & Plans Consulted

- Global Warming Response Act 80x50 Report, 2020
- 2020 New Jersey Scientific Report on Climate Change
- Regional Greenhouse Gas Initiative (RGGI) Strategic Funding Plan, Years 2020-2022
- New Jersey Climate Change Resilience Strategy

Example Strategies & Recommendations

- Create, enhance, and restore tidal marshes and Atlantic white cedar wetlands to increase coastal resilience and carbon sequestration potential.
- Protect and rebuild eroding salt marsh edge with living shorelines.
- Remove tidal restrictions to increase saltwater flow into a tidal wetland; this will decrease the release of methane into the atmosphere while creating additional marsh habitat.
- Preserve upland areas that are expected to become salt marshes as sea levels rise and marsh migration occurs.
- Preserve tidal marshes through fee and easement acquisition to avoid conversion of these lands to other uses and allow for restoration.
- Research the carbon dynamics of freshwater wetlands.
- Transform closed solid waste landfills on tidal salt marshes to restore tidal marsh systems and create new public access and waterfront parks.
- Develop blue carbon best management practices based on pilot projects and lessons learned from projects in other states.

Example Initiatives

- Coastal Ecological Restoration and Adaptation Plan (CERAP) – The goal of this Plan is to enact site-specific restoration and protection of coastal wetlands based on ecosystem health, community resilience, and carbon sequestration potential. CERAP is processing nominations for coastal wetland restoration projects, and they are developing methods for estimating the carbon benefits of these projects.

• NJ Tidal Wetlands Monitoring Network (NJTWMN) – Partnered with NRCS, the NJTWMN mission is to identify current conditions and trends of tidal wetlands in New Jersey to improve resilience of coastal communities and ecosystems by providing data to prioritize restoration efforts and support informed management decisions and better understand carbon sequestration.

Developed Lands

Overview

34 percent of New Jersey's land area is covered by urban or developed lands. While much of that land area is occupied by buildings, roads, and other infrastructure, the shade trees, vegetated green spaces and green stormwater infrastructure mixed among the built structures have an outsized benefit for their relatively small area providing important services for communities and the environment. Benefits include decreased temperatures, improved aesthetics, and access to recreation. After adjusting to 2020 values, these urban and developed spaces are valued at $388 per acre annually or $575 million per year in 2004 (Costanza et al. 2006) by improving air and water quality, mitigating runoff from rainfall and flooding, reducing noise impacts, providing shade and cooler temperatures for communities, mitigating the impacts of urban heat island effect, and enhancing overall human health and well-being. These services can provide help provide essential relief to communities disproportionately impacted by climate change and mitigate other environmental justice concerns such as air and water pollution.

The 178.7 million trees located within New Jersey's urban areas store approximately 26.9 million metric tons of carbon, and urban forests alone sequester about 1.03 million metric tons of carbon every year. As a result, the US Climate Alliance rates urban and community forests within the top five natural climate solutions in New Jersey when it comes to carbon sequestration potential.

Reports & Plans Consulted

- New Jersey State Forest Action Plan, December 2020
- Regional Greenhouse Gas Initiative (RGGI) Strategic Funding Plan, Years 2020-2022
- New Jersey Climate Change Resilience Strategy

Example Strategies & Recommendations

- Adopt and prioritize funding for good forest management strategies (i.e., afforestation, reforestation, restoration, proforestation, preservation/avoided conversion) in urban forests.
- Promote urban greening, and reduction of impervious surfaces to mitigate urban heat island effect and avoid emissions through energy savings in built environments.
- Expand the Urban & Community Forestry Program to encourage people living in New Jersey communities to plant, protect, and maintain their urban and community trees, forests and grasslands. This could include providing more resources (e.g., access to urban forest management software such as iTree, funding for tree maintenance) to communities already participating in the Program.
- Target preservation of forested and grassland areas in urbanized and developed areas to avoid conversation to other uses and leverage funding opportunities to maintain and enhance areas to maximize sequestration and mitigate related climate impacts.
- Encourage and facilitate green infrastructure and nature-based solutions based on the NJDEP green infrastructure standards.

Example Initiatives

NJFS Urban & Community Forestry Program – The goal of the Urban & Community Forestry Program is to encourage all people living in New Jersey communities to manage programs that plant, protect, and maintain their urban and community trees and forests. These efforts are in place not only through the program, but also through many NJ state governmental and non-profit partners, and they can maximize the health of urban trees and forests while also maximizing carbon sequestration potential.

Aquatic Resources and Habitats

Overview

Aquatic resources and habitats in New Jersey may include rivers and lakes, oyster reefs, freshwater and saltwater aquatic vegetation, and more. Submerged aquatic vegetation (SAV) in coastal New Jersey is predominantly characterized by seagrass beds consisting of eelgrass (*Zostera marina*) and widgeongrass (*Ruppia maritima*). Seagrass meadows provide an essential refuge for shellfish and finfish, and they also play an important role in sediment stabilization in coastal waters (Lathrop & Haag 2011). While New Jersey's seagrass habitat has been declining in size and density in recent decades due to human impacts, including physical alteration and excess nutrient input, it still provides one of the most efficient carbon burial rates of any ecosystem type (Lathrop and Haag 2011). Carbon burial executed by seagrasses is estimated to occur at a rate of approximately 1.38 metric tons of carbon per hectare per year (McLeod et al. 2011).

Natural oyster reefs are another of New Jersey's important ecosystems. Shellfish remove excess nutrients and sediments from the water column, thus reducing turbidity and improving water quality; they can also act as a buffer for waves, thus reducing heavy wave action that could cause coastal erosion. Oyster reefs have varied results with carbon fluxes; they may have the potential to be carbon sources as well as sinks, depending on age or environmental context, so more research is needed to understand the carbon dynamics in these important systems (Fodrie et al. 2017).

Reports & Plans Consulted

- Regional Greenhouse Gas Initiative (RGGI) Strategic Funding Plan, Years 2020-2022
- New Jersey Climate Change Resilience Strategy

Existing Strategies & Recommendations

- Restore and protect seagrass habitat to increase carbon sequestration potential and other co-benefits of seagrasses.
- Extend Marine Conservation Zone to seagrass beds.
- Develop an ocean acidification action plan to address impacts to fisheries, aquaculture, and ocean resilience. This plan can be expanded to include research regarding seagrass beds and natural oyster reefs allowing better adaptation to future ocean conditions.

Example Initiatives

Coastal Habitats Carbon Modeling, Nicholas Institute for Environmental Policy Solutions – Duke University is currently developing mapping tools and modeling outputs to assess the role of tidal marshes and seagrasses in coastal protection and climate mitigation through the lens of blue carbon. This research will assess how these coastal habitats in the eastern United States may be impacted by sea level rise, both now and in the future; this effort will expand understanding of carbon dynamics in coastal systems and inform coastal planning and restoration efforts.

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APPENDIX 1: LITERATURE REVIEW

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