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#

Ecosystem Services in Working Lands Practice and Policy of the U.S. Northeast:

Successes, Challenges, and Opportunities for Producers and Extension

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Northeastern Regional Association of State Agricultural Experiment Station Directors

ATTRIBUTION

Ecosystem Services in Working Lands Practice and Policy in the U.S. Northeast: Successes, Challenges, and Opportunities for Producers and Extension

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EXECUTIVE SUMMARY

Photo Credit: UMASS CAFÉ: The Center for Agriculture, Food, and the Environment

In the coming decades, the U.S. Northeast is expected to experience a number of the consequences of climate change, including rising temperatures, changes in precipitation and seasonality, and sea-level rise, among others (Horton et al. 2014). These consequences have varying implications for working lands and landscapes across the region as well as for the ecosystem services produced as part of working lands operations. Incentivizing the production of ecosystem services is critical to promote specific land management behaviors that improve ecological performance and ultimately sustain an environment for present and future generations. Broad regional adoption of ecosystem service production practices at scale, with the right support, can increase agricultural and forest profitability and sustainability, position working landscapes as a primary leader in the fight against environmental degradation (rather than a primary culprit), and drive a new generation of young people to consider a career across supply chains of working landscapes.

In this report, we document results from a regional assessment of over 1,300 ecosystem service provisioning programs and policies across the U.S. Northeast, in Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia as well as in the District of Columbia. Our assessment describes the programs' institutional arrangements, their incentive structures, and the ecosystem services they provide. This analysis was grounded in four overarching goals for the Northeast region named in the RFP by the Association of Northeast Extension Directors (NEED) and Northeastern Regional Association of State Agricultural Experiment Station Directors):

1. Increase farm profitability and sustainability.
2. Position agriculture as a primary leader in mitigating climate change.
3. Build the resiliency of rural and urban communities.
4. Increase the appeal of agricultural professions to a wide range of young people.

As of September 2021, a sample of approximately 1,300 programs were identified for their objectives to incentivize ecosystem service provisioning and practices on working lands in the Northeast. Overall, these programs target four primary working landscapes: 1) farming, food, and agriculture; 2) working forests and woodlands; 3) fisheries, aquaculture, and shellfish; and 4) non-industrial supporting landscapes and systems. These programs operate on national-, regional-, and state-levels and are organized through private and public sectors as well as public-private partnerships. They also contain a number of programs that allow ecosystem service producers to expand market presence and gain traction in their respective industry.

As seen in Table i, four main conclusions were drawn from this assessment and are intended to inform policy, programming, and research among Cooperative Extension and Agricultural Experiment Stations in the U.S. Northeast.

Table i. Conclusions and recommendations of this report

Conclusion 1: Producers and land managers operate according to the "safety-first" principle and are often risk-averse. In order to be successful, practices and programs must sufficiently and sustainably offset these risks in concrete ways.	
Recommendation 1.1	*Balance long-term ecological considerations with short-term economic returns by avoiding tradeoffs and diversifying direct and indirect incentives.*
Recommendation 1.2	*Promote ecosystem service provisioning on smaller scales (e.g. the household, farm, or community) to illustrate value, ensure long-term sustainability, and maintain local stakeholder participation.*
Conclusion 2: Programs are structured to incentivize either a single ecosystem service or multiple layered services. There are strengths and weaknesses to both approaches. Project design should account for those strengths and weaknesses as well as for the potential to scale practices from individual farms to multifunctional landscapes.	
Recommendation 2.1	*Conduct an expert panel of the strategic ecosystem services priorities for the region and compare to IPBES priorities for the Americas to assess gaps and opportunities for cross-scalar synergies.*
Recommendation 2.2	*Programs to provision ecosystem services are differentially accessible. Ecosystem services themselves impact communities differently. It is important to consider not only the effects of programs on ecosystem services but also their effects on equity.*
Conclusion 3: Very few programs reviewed in this assessment directly address resilience, and even fewer address resilience beyond the farm scale. Programs focused on resilience, especially as it functions across scale and between urban and rural areas, should be a priority..	
Recommendation 3.1	*Identify the indicators of resilience (e.g. for whom, by whom, for what, over what time period) at various scales and for various stakeholders across the U.S. Northeast.*
Recommendation 3.2	*Evaluate the effect of regional consortia and the role of existing governance and institutional structures, especially conservation districts and higher education.*
Conclusion 4: Ecosystem service provisioning programs for young and beginner farmers, while important, may not be enough to entice young people into working lands-related careers. Programs that couple ecosystem service provisioning with incentives that directly support livelihood provisioning, such as cash-in-hand (basic income), land access/acquisition, free education/professional development, childcare and health care, may help.	
Recommendation 4.1	*Evaluate the regionally specific factors inhibiting youth from working-lands careers in the U.S. Northeast, with a particular eye on issues of land tenure, childcare, health care, and higher education.*
Recommendation 4.2	*Evaluate the role of cash-transfer and basic income programs to supplement conventional, market-based systems.*

Part 1: Project Overview

1.1 RESEARCH OBJECTIVES

Supported by the Association of Northeast Extension Directors (NEED) and the Northeastern Regional Association of State Agricultural Experiment Station Directors (NERA), this ecosystem services landscape assessment disseminates primary source data related to ecosystem services practices, policies, and organizations of the U.S. Northeast. The assessment is intended to build capacity and expand the portfolio of the Cooperative Extension and Agricultural Research Station System's work in supporting producers to deliver ecosystem services on working lands, with a goal to: increase farm[1] profitability and sustainability; position agriculture as a primary leader in mitigating climate change; build resiliency of rural and urban communities; and increase the appeal of agricultural professions to a wide range of young people. In support of such goals, the research objectives of the project were described in the Request for Proposals and are the following:

- Inform the design and audience of a series of virtual listening sessions and a working symposium.
- Increase the knowledge that Northeast Land Grant University (LGU) Extension and Research partners and producers have about current Northeast agricultural ecosystem services activities, opportunities, and gaps.
- Integrate fragmented knowledge for future program, practice, and policy design.
- Encourage dialogue among producers, LGU Extension and Research programs, and policymakers.
- Along with the results from the virtual listening sessions and the working symposium, inform the potential development of funding streams and integrated Extension and research activities, policy proposals, and more.

1.2 SCOPE OF WORK

Our scope of work was driven by four research objectives as laid out in the original RFP:

- Identify the **organizational scope** of relevant policies and programs.
- Document ag-related **practices** that procure ecosystem functions/services.
- Report the breadth of **incentives** and **rewards** offered to ag-related producers for ecosystem function/service practices.
- Describe producers' strategies to **advertise** ecosystem functions/services and boost revenue.

This landscape assessment is grounded in a database of incentives programs and based on a review of select scholarly literature, internet research, and baseline documentation provided by the members of NEED and NERA. This database catalogs various types of incentive structures (e.g., financial mechanisms, programs, partnerships) that fund specific practices in agriculture, animal husbandry, and land management and, as result, procure ecosystem functions and services (e.g., water conservation, soil conservation, carbon sequestration). The geography of interest focuses exclusively on the U.S. Northeast and covers the following states, commonwealths, and districts: Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia. Through the duration of the project, the Fellows team met for at least one hour, once per week, between June and November 2021.

[1] Through this report, the term "farm" broadly includes a number of working lands and affiliated practices, including agriculture, animal husbandry, forestry, and fish or water-based cultivation.

Part 2: Introduction

2.1 BACKGROUND

In March 2021, the Extension Foundation released a Request for Proposals (RFP) for projects that would research and produce an assessment of ecosystem services practices, policies, and relevant organizations in the U.S. Northeast. Funded by the Association of Northeast Extension Directors (NEED) and the Northeastern Regional Association of State Agricultural Experiment Station Directors (NERA), the goals of this RFP were twofold. First, the research would help to "build capacity and expand the portfolio of the Cooperative Extension and Agricultural Research Station Systems to support and encourage producers to deliver ecosystem services on working lands." Second, the research would inform the design and audience of a Northeast Ecosystem Services Symposium, with the goal to encourage dialogue among producers, Land Grant University (LGU) Extension and Research programs, and policy makers across the Northeast.

This report describes a range of mechanisms, programs, and organizations presently available to incentivize the production of ecosystem services on farms, identifying the source of funding as well as the range of eligible recipients. This assessment also begins to delineate the contingencies of various incentive mechanisms and the ways in which advocacy for civic concern and/or land management practices affect the pursuit of improved ecosystem services for sustainable production systems, ecological health, and the livelihood security[2] of producers, managers, and surrounding community members. The framework of *landscape multifunctionality* is used to account for inherent multidimensionality of ecosystem services and how these services manifest across geographic and political scales. By doing so, this report relies on newly expanded definitions and constructs of ecosystem services, or nature's contributions to people (IPBES 2017), to map the webs of socio-ecological systems in the U.S. Northeast and better connect livelihoods and landscapes with practice and policy.

2.2 THE U.S. NORTHEAST IN AN AGE OF UNCERTAINTY

Incentivizing the production of ecosystem services is critical to promote specific land management behaviors that improve ecological performance and ultimately sustain an environment for present and future generations. Broad regional adoption of ecosystem service production practices at scale, with the right support, can increase agricultural and forest profitability and sustainability, position working landscapes as a primary leader in the fight against environmental degradation (rather than a primary culprit), and drive a new generation of young people to consider a career across supply chains of working landscapes. The U.S. Northeast is not unique in its need to sustain a healthy regional landscape and land-based economies, but there are several unique attributes in this region that propel the urgency to assess the production of ecosystem services on working lands: present and future land cover trajectories, expected and unknown regional shocks and threats, and opportunities to leverage natural capital as a direct and indirect source of income.

Within the United States, the Northeast is "the most heavily forested and most densely populated region in the country" (U.S. GCRP 2017), and the urban coastal corridor between Washington D.C. and Boston is one of the most developed environments in the world (Horton et al. 2014). Between 1996 and 2010, upland

[2] A livelihood "comprises the capabilities, assets (stores, resources, claims, and access) and activities required for a means of living; a livelihood is sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation" (Chambers & Conway 1992).

forests (51%), agriculture (13%), and open waters (13%) were the most common land covers of the region; however, more than two-thirds of all new development during this time was classified as low intensity or open space developed, converted from lands previously categorized as upland forest and agriculture (NOAA n.d.). At the same time, the region has struggled with a declining productive landbase (e.g., agriculture and other working lands), decreasing regional self-reliance (Griffin et al. 2015), and population migrating towards the coastline (Horton et al. 2014).

The need to sustain critical ecosystem services (e.g., food, fiber, clean water) across multiple spatial scales is an accepted tenant of modern resource management (Rickenback et al. 2011) and is highly relevant to the U.S. Northeast; however, the expansion of privately owned lands challenges cooperative, multi-scale sustainable land management strategies. Ten million private individuals and families own over 35% of all U.S. forestlands, with concentrations exceeding 85% in parts of the eastern United States (Butler 2008). Moreover, many ecologically important sites are on or connect to small private lands (Scott et al. 2006; Ruhl et al. 2007). Balancing land conversion—from forested or agricultural land covers—with land conservation remains a notable trend (U.S. GCRP 2017).

Shocks and threats to the U.S. Northeast also motivate the need to increase the pace and scale of ecosystem service provisioning. The COVID-19 pandemic beginning in 2020 laid bare a number of fault lines within production systems of the United States, including food and agriculture, forestry and wood products, and aquaculture and fisheries. However, the pandemic has also stoked public interest in food system resilience (Béné 2020; Hendrickson 2020) and access to outdoor public places (Pouso et al. 2021; Rollston & Galea 2020), and has subsequently driven political will to deliver on these interests. The U.S. Northeast is also expected to experience regionally specific impacts of a changing climate, including rising temperatures, changing precipitation patterns, and a warming ocean, especially in the Gulf of Maine (Horton et al 2014). An example of projected impacts is summarized in Table 1.

Table 1. Examples of projected climate change impacts to the U.S. Northeast

Projected Impact	Magnitude of Impact	Citation
Rising temperatures	• More than 3.6°F (2°C) warmer annual average temperatures than during the preindustrial era • Considered the largest temperature increase anywhere in the contiguous United States	US Global Change Research Group 2020
Increasing precipitation extremes	• Extreme precipitation greater than in any other region in the United States • Frequency of heavy downpours is projected to continue to increase over the remainder of the century.	
Rising sea levels	• The greatest increase in sea level rise rate globally has been documented on the stretch of coastline from the Delmarva Peninsula in Virginia to the elbow of Massachusetts (2 to 3.7 mm per year—more than three times the global average).	
Changing seasons	• Less distinct seasonal changes, including milder winters and earlier springs, threaten to alter ecosystems and environments in ways that adversely impact tourism, farming, and forestry.	

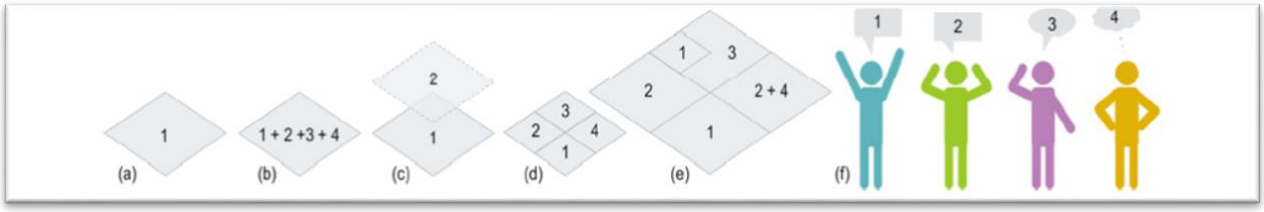
2.3 FROM ECOSYSTEM SERVICES TO MANAGING MULTIFUNCTIONAL & MULTISCALAR LANDSCAPES

Ecosystem services are generally understood as "the benefits people obtain from ecosystems," (MEA 2005). The concept was developed to rationalize and economically value the functions of ecosystems (Danly and Widmark 2016). Indicators of ecosystem services—and the value they provide—include clean water, healthy wildlife habitat, soil formation, and nutrient cycling. By definition, ecosystem services of working landscapes include the produced materials or goods with market value, for example, food for humans or livestock, field wood, timber, or carbon sequestration. However, a stringent focus on only the products or outcomes of discrete ecological processes avoids the complexity of socio-ecological systems (Selmen 2009) involved in the production of ecosystem services and de-emphasizes the operations and production processes of working landscapes. Therefore, the framework of *landscape multifunctionality* (the joint supply of multiple, stacked ecosystem services at the landscape scale, Mastrangelo et al. 2014) is used to situate this report's assessment of incentive programs that support and encourage producers to deliver ecosystem services on working lands.

Incorporating theoretical and applied principles from the fields of landscape ecology, agroecology, and ecological design, *landscape multifunctionality* is an approach to planning environmental, social, and economic functions of contiguous or regional landscapes while emphasizing land owners, managers, and users as primary stakeholders (Lovell and Johnston 2009). This means that the rural-urban divide can be unified as a continuous, interdependent matrix (Selman 2009) with functions beyond shared locations and single places or processes (Lovell and Taylor 2013). While intentionally designed working landscapes could serve independent functions (e.g. separating forests for timber from places for recreation), the institutional environment in the United States has not traditionally encouraged multiscalar thinking and cross-boundary collective action among landowners, resource managers, and policy makers (Rickenbach et al. 2011). As a result, few resources exist to evaluate the design of multifunctional landscapes independently (e.g. at the scale of the whole farm) and in aggregate (e.g. across multi-state regions) (Lovell et al. 2010). Both of these evaluation methods are important in designing and evaluating programs and policies that support a producer's capacity and ability to deliver ecosystem services on working lands, to sustain economic viability, and to build resilience across working landscapes.

Figure 1 illustrates example configurations of landscape multifunctionality and can be described through the lens of working landscapes. Unlike a mono-functional landscape (a), multifunctional landscapes support multiple functions in the same place and at the same time (b). For example, an acre of land used to exclusively produce corn can provide fewer ecological functions than an acre of land used to produce a mix of annual vegetables, perennial berries, and a cover crop. In addition, different landscape functions can be supported in the same place during different times (c); for example, inland floodplains function as stormwater retention after heavy rainfall and can serve as seasonal breeding habitat for amphibians. Last, different landscape functions can be supported by different places that interact (d), and these spatial combinations can differ in scale (e). e.g. upland forests support cleaner downstream waters that can be used as supplemental irrigation by farmers and healthy fishing ecosystems for anglers. Ultimately, the value of landscape multifunctionality depends on the ways in which stakeholders interpret different functions (f). e.g. the same field hedgerow could be seen by a farmer as a windbreak and by a hunter as deer habitat.

Figure 1. Depictions of landscape multifunctionality, created by Rolf et al. 2019
(based and extended as reported by the authors in the text below. From Brandt & Vejre 2004 and Selman 2009)



The framework of landscape multifunctionality is used in two ways for this assessment of incentive programs that support and encourage producers to deliver ecosystem services on working lands.

First, landscape multifunctionality values the provisioning of ecosystem services that occur within the **spatial boundaries** of private or public property as well as the regional matrices of land cover types and land management arrangements that exist in the U.S. Northeast. Thus, this outlook considers private landowners (from households to private-sector institutions) and public land owners (from federal, state, or local governments) as interdependent shareholders that manage ecosystem health at and above the scale of an individual property parcel. Table 2 itemizes several differences between land management practices exclusively tailored to an individual parcel and those practicing cross-boundary, multiscalar management (Rickenback et al. 2011).

Second, across a landscape, the spatial combination of functions inherently cross **institutional boundaries** and require "cross-boundary, multiscalar management". This interwoven complexity offers an opportunity to monitor and prioritize the variety of relationships among ecological processes, ecosystem service scope (i.e. what constitutes a service?) and scale (i.e. how to bridge local practices with global challenges, such as climate change mitigation?), and socio-economic functions embedded in the landscape (i.e. food and commodity production, livelihood provisioning, cultural heritage).

Table 2. Comparison of "owner-centric" versus cross-boundary land management models, by Rickenback et al. (2011)

Key differences between status-quo and cross-boundary land management.

	Status-quo or "ownership-centric" management	Cross-boundary, multiscalar management
Expected outcome	Parcel-scale impacts; aggregated impacts are considered primarily in geopolitical contexts	Landscape-scale impacts; allows for synergies from cooperation
What	Outreach, technical assistance, and/or subsidies to individual landowners, usually involving limited targeting	Outreach, technical assistance, and/or subsidies target specific geographic areas
Who	Individual landowners potentially in consultation with professionally trained public sector employees (e.g., USDA Natural Resource Conservation Service, state department of natural resources, county conservation)	A multiactor approach that more fully includes landowners, private nongovernmental organizations (e.g., watershed association, land trust, wildlife or recreation club), public agencies, motivated volunteers, and other professionals
Methods	Professionally trained public sector employees work on a landowner-by-landowner, visit-by-visit, property-by-property basis	Boundary spanners facilitate information sharing and transfer between peer landowners
Funding	Public and private philanthropic funds subsidize individual landowner behaviors or actions (e.g., federal farm bill programs) to pay for the purchase of scattered conservation easements or the development of individual management plans or access roads	Public and private philanthropic funds underwrite local organizations or individuals to provide spanning functionality; funds from the provision of ecosystem services (e.g., carbon credits, clean water credits, rare species credits) underwrite this spanner/network/counseling functionality
Philosophy	Technical assistance is a primary driver; experts deliver advice and money down to individual landowners with success equated to more practices implemented on individual properties	Varying levels of cross-boundary cooperation implemented by landowners in a landscape; technical assistance is brought in on an as-needed basis, and success is measured by overall landscape impact, such as improved landscape functionality
Scale	Individual ownerships	Habitat, watersheds, drainages, ecoregions, or other logical socioecological units

Part 3: Methods

3.1 OVERVIEW

From the outset, three primary types of information were of interest for this landscape assessment, including program administration, incentive structure, and ecosystem functions/services (Table 3). An initial list of inclusion/exclusion criteria was established *a-priori*, and a selection of public and private agencies/organizations was systematically used as an initial point to "snowball" and expand the search to additional agencies/organizations. This assessment considered programs available from the federal government or national organizations, regional collaborations, and state agencies or state-level entities; highly localized programs available only at the county or municipal level were not considered in this report.

Table 3. Inclusion and exclusion criteria that helped identify relevant programs

Category	Inclusion criteria	Exclusion criteria
Program Administration	U.S. public agencies, regional commissions/ coalitions: • Federal government • State government • Multi-state actors • Agricultural experiment stations/ Cooperative Extension	Municipal policy/ordinances, specific county- or municipal-level programs
	U.S. private organizations, for example: • Audubon Society chapters • The Nature Conservancy • Watershed organizations • Land trusts • Foundations	Corporations with missions outside the scope of this project
Incentive Structure	Programs that fund: • Compliance/regulatory standards • Income lost or costs accrued as a result of conservation practice(s)	Sponsorship, advertisement, fundraising programs, fee for service
	Timeline Ongoing: presently active during FY 20/ 21 In development: legally backed/funded program that is not yet implemented	Repealed, de-funded, or suspended programs
	Any USD amounts/eligible land units	
	All practices related to agriculture, animal husbandry, and land use/management	Practices related to the capture/release of wildlife for leisure
	All types of producers (small farm/second income to large industrial operations)	
Ecosystem Functions/Services	All types of ecosystem functions and services	Not tied to ag-related practices

Early in the data collection process, it became clear that the U.S. Northeast, in varying capacities, is not in deficit of public-facing programs or organizations working towards the provisioning of ecosystem services on working lands. Due to constraints of time and insider knowledge of emerging (but unadvertised) programs, our data collection does not represent a census of all programs in existence but, rather, can be considered a quasi-representative sample of programs available to land managers and producers.

Analysis of incentive programs began by separating the data between the specific types of working landscapes eligible for an incentive program. From these data, four broad categories emerged: 1) farming, food, and agriculture; 2) working forests and woodlands; 3) fisheries, aquaculture, and shellfish; and 4) non-industrial supporting landscapes and systems.

Within each of these categories, the data was further coded for several program attributes, including:

- The named funder or purveyor of the incentive program as well as its agency and department, affiliation with the public or private sector or a public-private-partnerships (PPPs), and the geographic reach (or scale) of the program in its entirety (listed by state in Section 4.5.2)
- The specific entity stated to be eligible for the incentive program (if not stated clearly, eligibility was determined from the program description)
- The type of indirect or direct incentives and mechanisms by which the incentives are offered to the eligible entities (in Section 3.2.3) (Some incentive mechanisms were not clearly in the program description and were assigned a category based on the inferred benefit of the incentive.);
- The primary, dominant category of ecosystem functions and services that the inventive is intended to assist (in Section 3.2.1) (While it was clear that many programs undoubtedly incentivize more than one ecosystem function and service, programs were conservatively assigned a category based on the predominant inferred intention and mission of the incentive.)

Next, programs were analyzed based on the relationships among eligible entities, purveying organizations, and target ecosystem services, especially as relevant among private, public, and PPPs. To visualize these connections, **alluvial plots** were used to link the relationships among these categories of interest (Figure 2).

Figure 2. What is an alluvial plot?

Alluvial plots are a type of flow diagram, showing the connections among different categories of data (Brunson 2020). The overall quantities, or frequency, of data per category are connected by ribbons, where narrower ribbons represent fewer quantities (and smaller connections) and thicker ribbons represent larger quantities (and more robust connections).

The alluvial plots shown in this report connect:

- The institutional sector issuing or administering each incentive program

The IPBES ecosystem function and services that the incentive program is intended to enhance or produce.

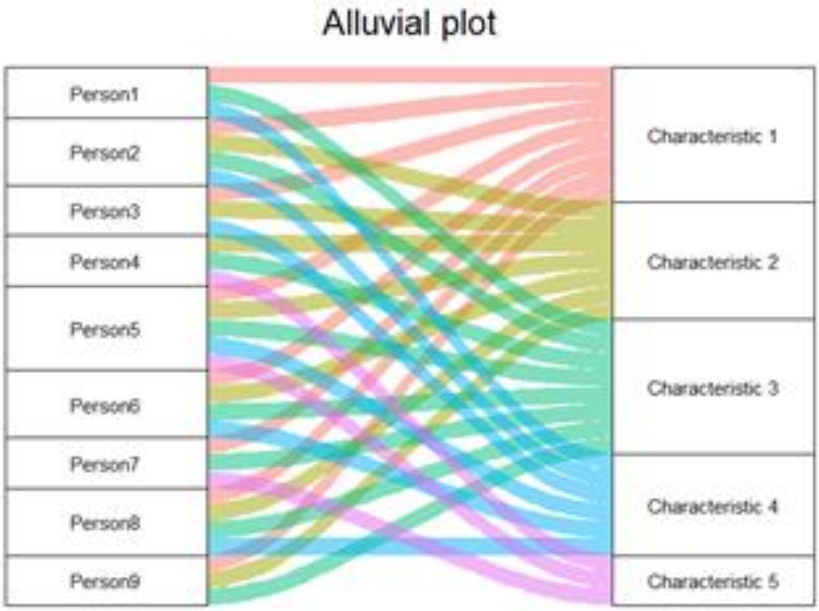


Photo Credit: R Studio Community (2019)

Last, programs were evaluated for the opportunities they provide for improved and/or expanded market presence generated by the provisioning of ecosystem functions/services for farmers, land managers, and working lands. This section was created from descriptive observations and emergent themes in the database.

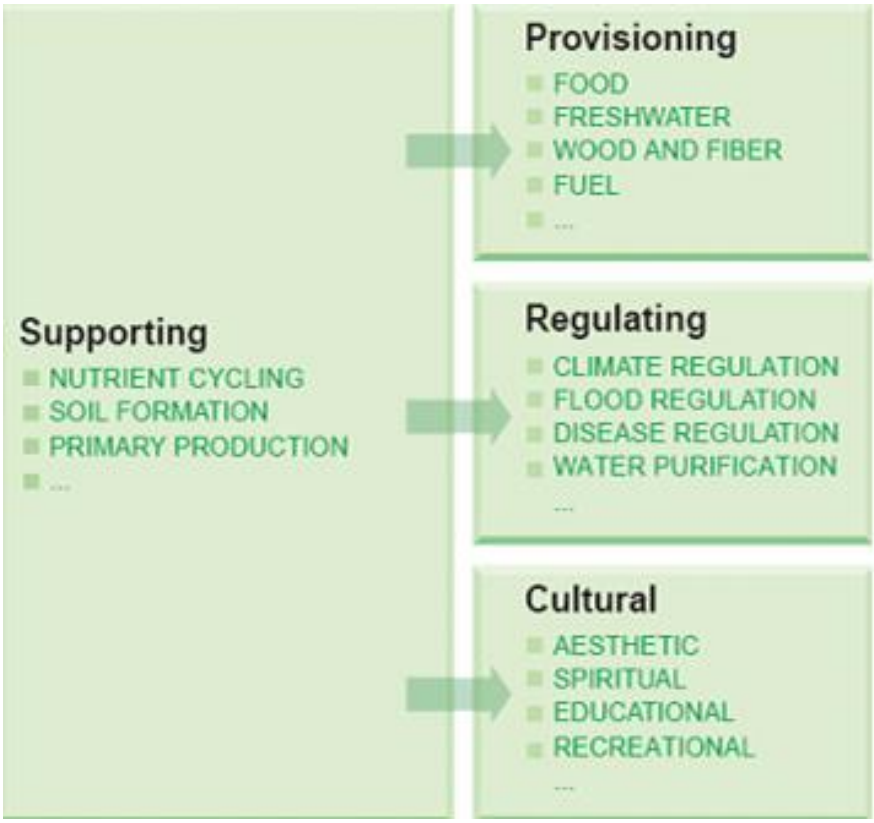
3.2 GUIDING CONCEPTS AND DEFINITIONS

As relevant to the U.S. Northeast, the ecosystem functions and services of four primary working landscapes we focused on were 1) farming, food, and agriculture; 2) working forests and woodlands; 3) fisheries, aquaculture, and shellfish operations; and 4) supporting landscapes and systems. Our scope of work and subsequent analysis were guided by the following definitions and assumptions.

3.2.1 Ecosystem functions and services

While definitions vary, ecosystem functions and services are popularly known as "the benefits people obtain from ecosystems" (MEA 2005). As part of this initial conceptualization, ecosystem services were described in four categories: provisioning services, regulating services, supporting services, and cultural services (Figure 3). To assign value to the diversity of benefits people receive from their environment, these benefits include not only economic functions such as production and profitability but also ecological and social functions (Bolund and Hunhammar 1999; MEA 2005). As such, ecosystem services have been framed to support the production of food and material goods and to maintain the continued function of the ecosystems that underlie these broader economic functions.

Figure 3. Traditional conceptualization of ecosystem services, developed by the Millenium Ecosystem Assessment (2005)



However, a stringent focus on only the products or outcomes of discrete ecological processes curtails the complexity of socio-ecological systems (Selmen 2009), especially those inherent to working lands and landscapes. Therefore, this assessment relies on the framework of *landscape multifunctionality* (the joint supply of multiple, stacked ecosystem services; see Section 2.3 for further discussion) and a broader, contemporary framework of ecosystem services created by the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) (2017). The expanded IPBES framework codes a variety of nature's contributions to people—or ecosystem services—into 18 categories. These four categories are grouped by their specific function to people and include regulating contributions, material contributions, and non-material contributions (Table 4).

Table 4. Conceptualization of nature's contributions to people (NCP) or ecosystem services by the Intergovernmental Panel on Biodiversity and Ecosystem Services (2017)

Regulating Contributions	
• Habitat creation and maintenance – maintaining the ecosystem structures and processes that allow the other NCP to be provided • Pollination and dispersal of seeds and other propagules – the ways that nature contributes to productivity of plants through fertilizing seeds and dispersing seeds and other vegetative propagules (IPBES, 2016a). • Regulation of air quality – regulation of CO_2/O_2 balance, Ozone for ultraviolet-B absorption, polluting gases • Regulation of climate – including regulating albedo, some aspects of greenhouse gas emissions, and carbon sequestration • Regulation of ocean acidification – maintaining the pH of the ocean through buffering the increases and decreases of carbonic acid (caused mainly by uptake of atmospheric carbon dioxide in the oceans)	• Regulation of freshwater quantity, location and timing – for both direct uses by people and indirectly for use by biodiversity and natural habitats • Regulation of freshwater and coastal water quality – capacity of healthy terrestrial and aquatic ecosystems to regulate water supply delivery and/or filter, retain nutrients, sediments and pathogens affecting water quality • Formation, protection and decontamination of soils and sediments – sediment retention and erosion control, soil formation and maintenance of soil structure, decomposition and nutrient cycling • Regulation of natural hazards and extreme events – preserved ecosystems' role in moderating the impact of floods, storms, landslides, droughts, heat waves, and fire • Regulation of organisms detrimental to humans – pests, pathogens, predators, competitors
Material contributions	
• Energy – biomass-based fuels • Food and feed – wild and domesticated sources, feed for livestock and cultured fish • Materials and assistance – production of materials derived from organisms in crops or wild ecosystems, for construction, clothing, printing, ornamental purposes and decoration	• Medicinal, biochemical and genetic resources – plants, animals and microorganisms that can be used to maintain or protect human health directly or through process of the organisms or their parts
Non-material contributions	
• Learning and inspiration – opportunities from nature for the development of the capabilities that allow humans to prosper through education, acquisition of knowledge and development of skills • Physical and psychological experiences – opportunities for physically and psychologically beneficial activities, healing, relaxation, recreation, leisure, tourism and aesthetic enjoyment	• Supporting identities - basis for religious, spiritual, and social-cohesion experiences, for narrative and story-telling and for sense of place, purpose, belonging, rootedness or connectedness • Maintenance of options – continued existence of a wide variety of species, populations and genotypes, to allow yet unknown discoveries and unanticipated uses of nature, and on-going evolution

As laid out in the IPBES framework, **regulating contributions** consist of ecosystem services that regulate and maintain the natural processes of an environment (see Díaz et al. 2015). These include everything from habitat creation and maintenance to soil formation and the regulation of detrimental organisms and natural hazards. **Material contributions** consist of material flows from the environment to people and include

everything from energy provisioning and food production to medicine and other harvestable materials. **Non-material contributions** consist of non-material flows from the environment to people and include things such as educational and volunteer opportunities, recreation, and cultural values.

The benefits of using the IPBES framework for this assessment were twofold. First, the spectrum of sub-categories outlined a generalized, standardized rubric by which to understand the complex interactions between practices and policies and the natural environment of the U.S. Northeast. Because the framework is standardized and supported by an international group of subject-area experts, it can be compared to other studies in the future. Second, the IPBES framework's three broad categories—regulating, material, and non-material contributions—includes important resources, services, and commodities as well as the interdependencies of social, cultural, spiritual, and experiential contributions (Díaz et al. 2018). These services are conceptualized as "nature's contributions to people," which serves to frame economic and natural science measures of ecosystem services to scale beyond individual parcels and landowners.

3.2.2 Working lands and producers/managers

Using concepts and definitions from the U.S. Department of Agriculture (USDA) and scholars in landscape ecology, Table 5 itemizes the definitions of working landscapes and its producers/managers used in this assessment.

Table 5. Definitions of working landscapes and producers/managers used in this report

Working Lands & Premises	Producer, Manager
Agricultural Land Agricultural land is used primarily for the production of farm commodities. The categories of "agricultural land" are cropland and pasture; orchards, groves, vineyards, bush fruits, and horticultural areas (such as nurseries); feeding operations; and others (USDA NAL 2021).) **Farmstead** Land used primarily for dwellings, barns, pens, corrals, gardens, and other uses in connection with operating farms or ranches (USDA NAL 2021)	**Crop and livestock farm owner/operator** A farmer, otherwise known as the "farm operator" (USDA 2020), is the person who runs a farm and makes day-to-day management decisions. Given the complex ownership and land access arrangements in U.S. farming, federal program incentive benefits are available to an owner-operator, a landlord, a tenant, or a sharecropper who shares in the risk of producing a crop and is entitled to a share of the crop produced on the farm (P.L. 101–171, Sec. 1001).
Woodland and forestland "Woodlands" are land used primarily for the production of adapted wood crops and to provide tree cover for watershed protection, beautification, etc; this does not include farmstead and field windbreak plantings (USDA NAL 2021). "Forestland" is any land at least 10% occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use (USDA NAL 2021).	**Woodland and forestry owner/operator** The corporate, family, or other private owner and tribal owners of forest or woodlands are known as "private forest and woodland owners" (Butler et al. 2016).
Fishery A "fishery" is any premise on which breeding, hatching, or fish-rearing facilities are situated when the premise is required to have a license by the state fish and game code, including ponds for commercial use (USDA NAL 2021).	**Fish, shellfish, and aquatic plants farm owner/operator** The production of aquatic organisms under controlled conditions throughout part or all their life cycle is known as "aquaculture" (USDA 2021).
Supporting regional landscape These landscapes are areas of land that encapsulate working lands, with ecological structures, processes, and dynamics that affect and are affected by (interact with) working lands (Forman 2014)	**Other land owner, manager, or operator** This is the person or entity that retains ownership or legal operation of the land and enacts its access and use rights (to be on the land and use its resources).

3.2.3 Incentive or finance mechanisms

Compensation for the provisioning of ecosystem functions and services comes in several ways (Figure 4), and incentives generally fall into one of two categories: direct and indirect. **Direct incentives** provide monetary support to protect, restore, enhance, or improve natural resources and land management practices; create an immediate impact on individuals and/or the community, either because they are given directly in cash (sum of money) or in-kind (provide transferable benefit that clearly improves everyday life) (de Camino Velozo, R. 1987). Direct incentives can be delivered **in-cash—**as in the case of payment for ecosystem services (PES)— cooperative/cost-share agreements, implementation grants, loans, loss adjustment, or land acquisitions/easements. In-cash compensation also includes marketable permits, which provide tradable credit for maintaining environmental impacts beyond a certain predefined baseline. These are often seen in the case of various mitigation banks for carbon or pollution. Direct incentives can also be delivered **in-kind**, as in the case of facility and/or infrastructure redevelopment or by providing access to tools and equipment.

On the other hand, **indirect incentives** are intended to protect, restore, enhance, or improve natural resources and land management practices without the transfer of direct monetary value. This includes **fiscal** support through certain tax abatements/credits, in-lieu fees, or certification based on the implementation of certain conservation activities or sustainable practices. Indirect incentives also include **services**, such as technical assistance and technical education, which provide access to medium- to upper-level technical staff or access to instruction free of charge. In addition, **social** benefits, whether through partnership programs aimed at harnessing the advantages of organized operations or preferred vendor programs, are also considered forms of indirect incentives.

Figure 4. Water Funds are an example of a collaborative ecosystem service incentive program. "Upstream" water providers are allocated funding to enhance or restore water quality best management practices, paid by "downstream" water users that directly receive benefit from upstream practices.

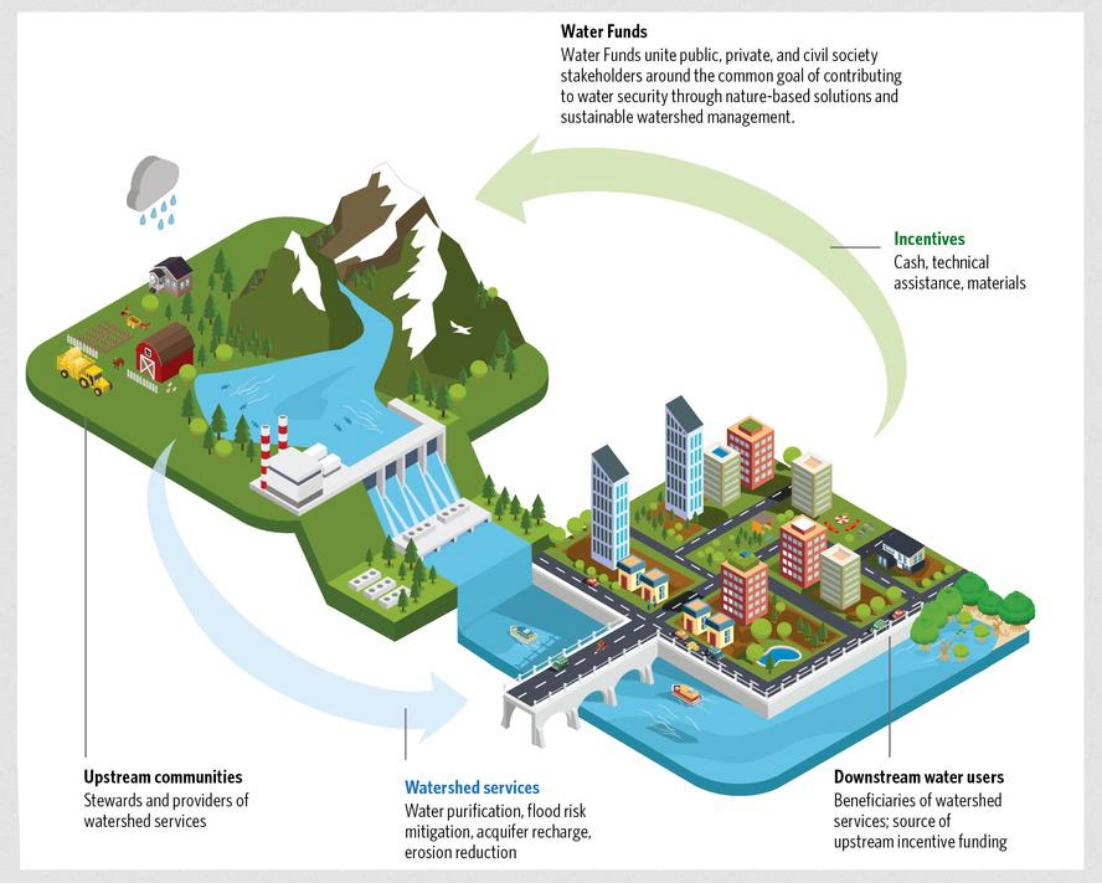


Photo Credit: The Nature Conservancy, Water Funds Toolbox

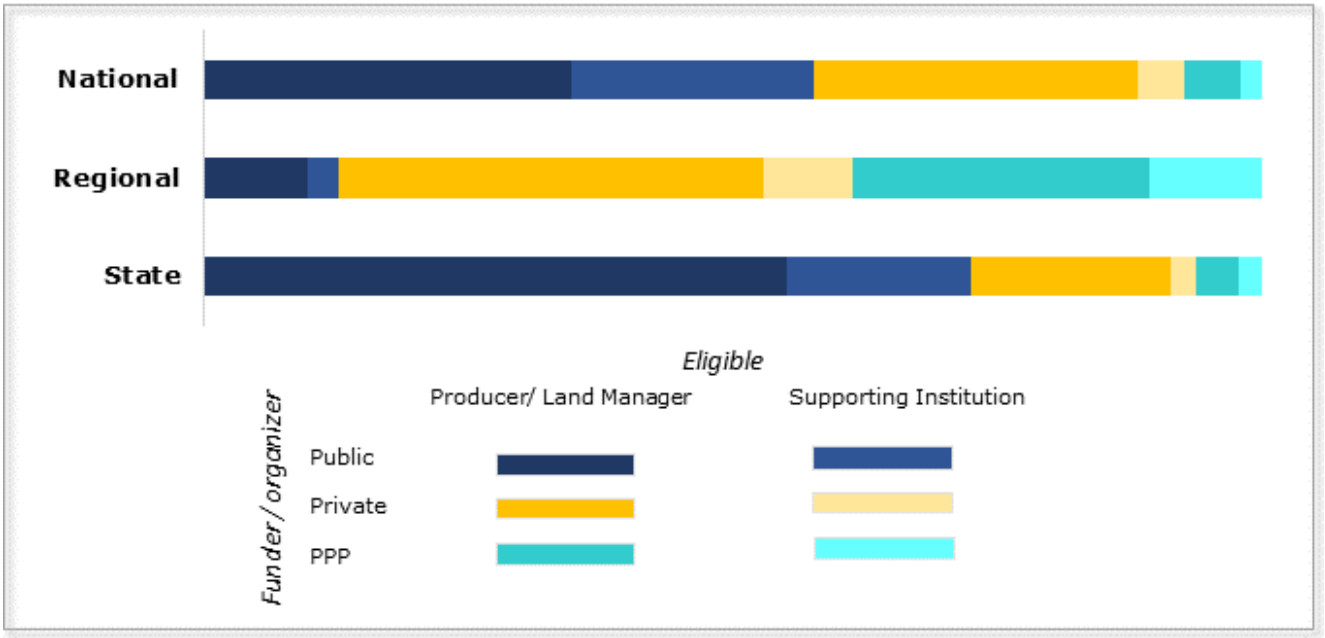
Part 4: Results

4.1 OVERVIEW

In total, this assessment identified just over 1,300 relevant incentive programs for the U.S. Northeast. These programs functioned at a variety of geographic scales, from the national to the regional to the state and also came from a variety of institutional actors, both private and public as well as various PPPs. The topical categories covered in this assessment include:

- Food, farming, and agriculture (Section 4.2)
- Working forests and woodlands (Section 4.3)
- Fisheries, aquaculture, and shellfish operations (Section 4.4)
- Supporting landscapes and systems (Section 4.5).

Figure 5. Distribution of incentive programs from this sample, separated by the eligible entity and funding sector



At the highest level, the results are shown by relative frequencies across the range of eligible groups for each incentive program as well as by the issuing institutional sector of each program and geographic reach (Figure 5). As applicable for the U.S. Northeast, national-scale incentive programs constitute about one-quarter of this sample (n=316, 24.2%). From this sample, it is clear that more federal programs (national scale, public sector) are directly available to individual producers/managers (which includes privately owned businesses, co-ops, and management institutions) (n=110) than they are to other institutions/organizations, like municipal or state governments and research institutions (n=72). Overall, incentive programs from federal agencies and departments included those available to the nation as a whole as well as to the U.S. Northeast region specifically. Of all federal agencies, most programs from this database were available through the U.S. Department of Agriculture (total n=139), followed by the U.S. Department of the Interior (n=22) (Table 6).

Private-sector incentive programs, provided by national organizations (available across the country), are also most available to individual producers/managers (n=97). These private organizations represent a range

of conservation organizations (e.g. Audubon International, Ducks Unlimited), non-governmental collaborations (e.g. National Black Food and Justice Alliance, Global Animal Partnership), and other cause-driven organizations (e.g. the Non-GMO project, Women Food & Ag Network). Of the smaller number of private-sector programs available to institutional entities, these organizations focus on supporting federal (e.g. Forest Stewardship Council's Federal Lands Certification) or municipal governments (e.g. Trust for Public Land's Climate-Smart Cities), non-governmental organizations (e.g. Land Trust Alliance's Land and Climate Catalyst Planning Grants), or other forms of professional services (e.g. Green Leadership Trust's Technical Services).

Table 6. Federal agencies with the largest number of programs in this sample

U.S. Department of Agriculture, total number of programs	
Agricultural Marketing Service (AMS)	37
Natural Resources Conservation Services (NRCS)	25
Farm Service Agency (FSA)	23
National Institute of Food and Agriculture (NIFA)	21
Forest Service (FS)	12
US Department of the Interior (DOI), total number of programs	
U.S. Fish and Wildlife Service (USFWS)	17
National Park Service (NPS)	4

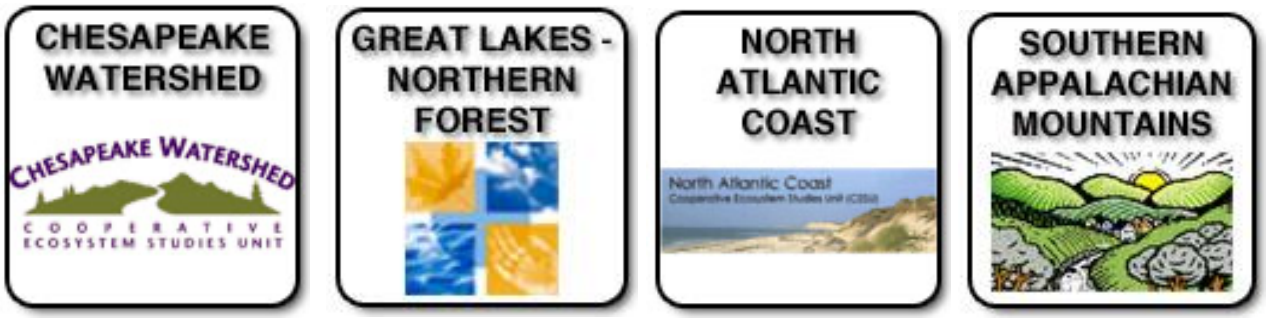
State-level programs hold the largest representation in our sample (n=847, 65.0%). It is important to note that some federal agencies are included in this list if the programs they offer are specific to that state only and not the nation as a whole. The most common form of state-funded incentive programs were technical assistance (total n= 133) and implementation grants (total n=115). While these trends were true across the states, there was also notable variability of the number of programs available in each state. For example, Maryland and Connecticut had the greatest number of state-supported programs available, while Washington D.C. and New Hampshire had the least.

Programs led by the **private sector** included those available nationally as well as programs available at smaller scales, both regionally and by state. The most frequently occurring private-sector programs came from organizations such as the Audubon Society and its state chapters, the state-level NOFAs (U.S. Northeast Organic Farming Associations), the Conservation Fund, the Chesapeake Bay Program, and various Aquaculture Associations and finance organizations.

This assessment also took stock of a number of programs available through PPP.s These PPP programs were most often available at the regional scale (n=21 total), like the Cooperative Ecosystem Studies Units (CESUs) (Figure 6), but there were fewer PPP programs overall.

After the initial data collection was completed, several funding streams were found to be either suspended or repealed and were removed from the final analysis. A summary of these programs is included in Appendix 1.

Figure 6. CESUs of the U.S. Northeast



Cooperative Ecosystem Studies Units (CESUs) are an example of regional public-private partnerships that work across agencies, sectors, and scales to address natural and cultural resource management issues. Nationally, CESUs efficiently facilitate collaboration between research institutions and federal agencies on research that informs the agencies' environmental and cultural management decisions. Four CESUs cover the extent of the U.S. Northeast: Chesapeake Watershed, Great Lakes Northern Forest, North Atlantic Coast, and Southern Appalachian Mountains. Photo Credit: CESU National Network

4.2 FARMING, FOOD, AND AGRICULTURE

The farming, food, and agriculture category focuses on programs that specifically target agricultural producers and food systems. While targeting agriculture, this category contained a wide range of programs that addressed diverse aspects of food systems in a number of different ways.

4.2.1 Programs for Producers/Businesses

Within the farming, food, and agriculture category, approximately half of the programs available specifically targeted producers and/or managers. Of these, a vast majority was directed towards the production of food and feed (n=346), with the regulation of detrimental organisms and biological processes (n=42) coming in at a distant second. Figure 7 shows only programs found for farmers and agricultural producers and illustrates the intended ecosystem function or service outcome of each program to its administrating sector and funding source.

Overall, the programs in this category offer indirect incentives (food production n=264, regulation of detrimental organisms n=34) more so than direct incentives (n=82, regulation of detrimental organisms n=8), although variation among incentive mechanisms exists.

4.2.1.1 Access to cash, land, and tools/machinery

Direct incentives for farmers and agricultural producers varied but most often consisted of cost-share/cooperative agreement programs and implementation grants.

- **Organic certification cost-share programs:** available to help subsidize the overall cost of obtaining an organic certification

- **Material expenses for infrastructure or management practices:**
    - to restore farmland (e.g. the Connecticut Farmland Restoration Program)
    - to protect soils (e.g. the Maryland Cover Crop Program)
    - to manage irrigation water (e.g. New York Implementation of High-efficiency Agricultural Irrigation Water Management Systems program)
    - to build the capacity of new and existing urban farms through infrastructure improvements (e.g. Washington D.C. Urban Agriculture Infrastructure grant)

State-level farmland preservation programs are prevalent in every state across the region and enacted through different strategies.

- **Limits of time in which farmland protection is enforceable.** The Massachusetts Agricultural Preservation Restriction (APR) program preserves farmland in-perpetuity, whereas a similar program in Pennsylvania (Agricultural Security Areas) protects farmland from conversion for 7 years.

- **The use of state bonds to fund farmland preservation.** The Connecticut Farm Reinvestment Grant provides matching funds to Connecticut farms to expand, diversify, and improve existing working farms through various projects with a lifespan of 10 years or more.

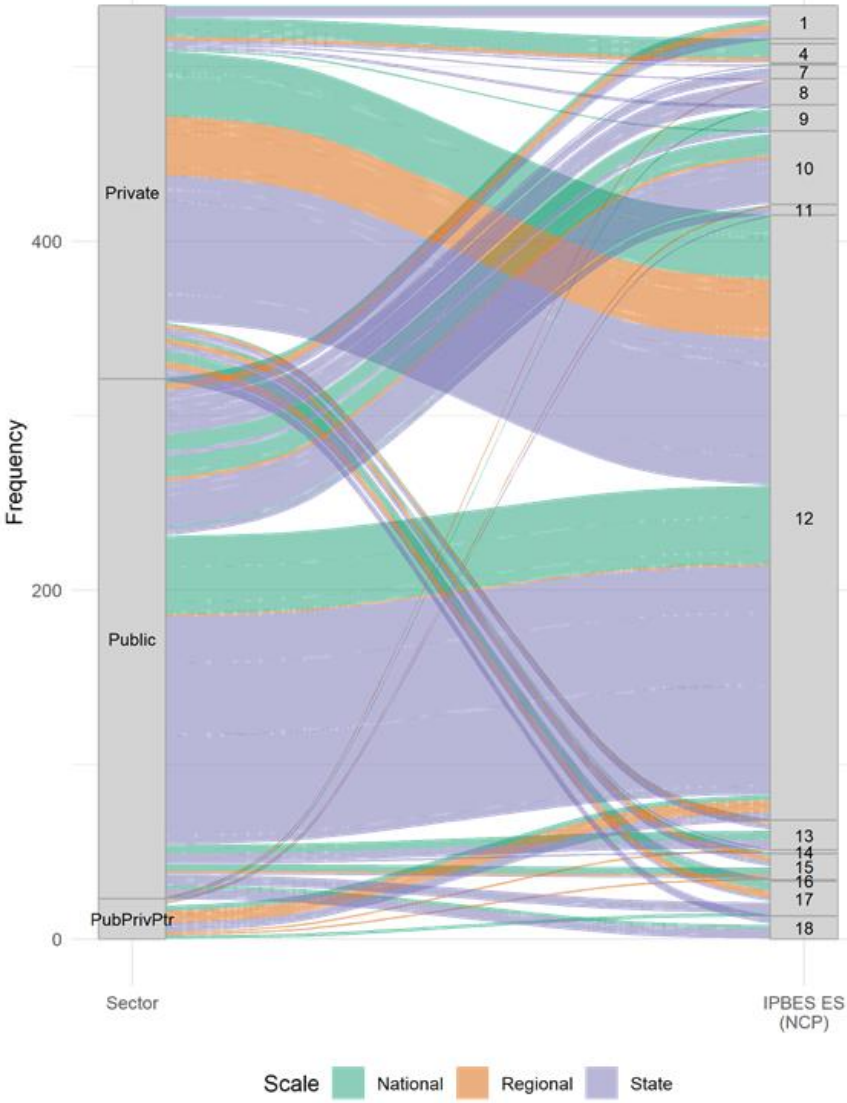


Figure 7. Distribution of programs for farmers and agricultural producers, connecting program funding or administration sources (left) to the predominant ecosystem function or service (right) being incentivized; the descending NCP numbers correspond to the legend below.

Regulating NCP
1. Habitat creation and maintenance
2. Pollination and dispersal of seeds and other propagules
3. ~~Regulation of air quality~~
4. Regulation of climate
5. ~~Regulation of ocean acidification~~
6. Regulation of freshwater quality, location, and timing
7. Regulation of freshwater quantity, location, and timing
8. Formation, protection, and decontamination of soils and sediments
9. Regulation of hazards and extreme events
10. Regulation of detrimental organisms and biological processes

Material NCP
11. Energy
12. Food and feed
13. Materials, companionship and labor
14. Medicinal, biochemical and genetic resources

Non-material NCP
15. Learning and inspiration
16. Physical and psychological experiences
17. Supporting identities
18. Maintenance of options

Regulating NCP
- Programs for the regulation of detrimental organisms are largely provided by state and federal governments.
- The private sector leads in providing nationwide programs that regulate climate (e.g. carbon sequestration).
- The production of wildlife habitat is supported across sectors and geographic scales.
- Programs that help regulate hazards and extreme events on farmland are largely sourced from the federal government.

Material NCP
- Public-sector programs (especially from state departments or agencies) are the greatest contributors to the production of food and feed in this sample. Regional programs from the private sector, and public-private partnerships to a lesser degree, also provide a number of these incentive programs.

Non-material NCP
- The experiential and less tangible ecosystem services constituted the smallest proportion of programs in this sample. Again, public programs—especially at the state-level—were the largest contributor to this category, followed by federal funding sources and programs.

Other direct incentive programs can work in tandem to assist with issues of financial viability, resource conservation, family succession, modernization of infrastructure, and other issues that may enhance the long-term continued use of the agricultural resource.

- **Voluntary financial and technical assistance**. Run by the USDA Natural Resources Conservation Services (NRCS) Environmental Quality Incentives Program (EQIP) is voluntary and provides financial and technical assistance to agricultural producers for up to 10 years. These contracts provide assistance to help plan and implement conservation practices that address natural resource concerns to improve and conserve soil, water, plant, animal, air, and related resources on agricultural land and non-industrial private forestland. EQIP also helps producers meet federal, state, tribal, and local environmental regulations.

- **Combined assistance programs.** In combination with EQIP, the Vermont EQIP Assist program, for example, is an opportunity for farmers with contracts through the NRCS's EQIP program to receive additional cost-sharing on the practices implemented as part of these contracts. In addition, the Massachusetts APR Improvement Program (AIP) program provides business planning and technical assistance to commercial farms with land that has already been protected through the Massachusetts Department of Agricultural Resources Agricultural Preservation Restriction (APR) program.

Land tenure is a central issue for the food and agricultural system in the U.S. Northeast, which has seen a decreasing agricultural land base and an increasing deed to improve land access to emerging or existing producers.

- **Selling publicly owned lands.** USFWS/USDA FSA Inventory Property Disposal Program, which provides direct and guaranteed farm ownership and farm operating loans to farmers who are temporarily unable to obtain private, commercial credit. The FSA is sometimes able to obtain the title to real property when a borrower defaults on a loan secured by the property. Once it has a title, the FSA holds such properties in inventory until sale or other disposal. In Rhode Island, the state Farmland Access Program, which is currently in development, will allow the Department of Environmental Management (Division of Agriculture) to partner with the state's Agricultural Land Preservation Commission to purchase farmland, protect it, and affordably sell it to farmers looking for land.

- **Leasing publicly owned lands.** In Washington D.C., the Urban Farming Land Lease Program, run by the Department of Energy and the Environment (DOEE), offers select District-owned parcels across all 8 wards for lease to private entities to facilitate agriculture production.

In addition to these in-cash direct incentive programs, there are a number of in-kind programs available in a number of states that provide direct links between producers and necessary resources, such as tools and equipment. Digital directories are available for farmers to

- share or rent tools (e.g. Tool and Equipment Sharing & Rental Platform organized by Future Harvest-Chesapeake Alliance for Sustainable Agriculture in WV, DC, MD, DE);
- find feed for livestock (e.g. organized by Maryland-Delaware Forage Council in MD and DE);
- find employment (e.g. New Entry Sustainable Farming Project organizes a Farm Employment Directory in MA); and
- find land (e.g. FarmLink in CT, ME).

4.2.1.2 Farmer training across career stages

A number of programs provide professional development across the career span, from young and beginning farmers to long-term farmers.

- **New farmer training programs.** Particularly important for incentivizing young people into agriculture, these programs are run by state-level U.S. Northeast Organic Farmer Associations (NOFAs) as well as by the Cooperative Extension programs in each state. Various NOFAs also offer a

Journey Person program, which provides services to help fill the educational gaps between being a farming apprentice and an independent producer. Other such programs include the New Entry Sustainable Farming project, which offers an Explore Farming Workshop, as well as the Armed to Farm program, which offers a Getting Started in Farming course for veterans interested in entering agriculture. Farm Credit East, a regional partner of the nationwide Farm Credit System, provides a Young, Beginning, Small and Veteran Farmer Incentive program (YBSV). This program is designed to help this growing customer segment get started in agriculture through special incentives available to program participants.

- **Advanced training programs.** Some NOFAs, such as in Rhode Island, offer an Advanced Grower Series, which offers technical education courses to long-term farmers. NOFAs in Vermont, New Hampshire, and Massachusetts, also provide cost of production fact sheets, which contain "crop profitability comparisons, whole farm financial metrics, and tips for success when undertaking cost of production analysis." Maine's Farms for the Future Program is a competitive grant program that provides selected farms with business planning assistance and investment support. While the availability of grants might make this program appear like a direct incentive program, the goal of these grants is not to directly subsidize farming practices or production, but rather to fund research and strategic business planning by farm business owners. This research is then distilled into various "Ideas for Change" aimed at increasing farm vitality, which is defined as "an increase in long-term, maintainable, farm profitability and net worth."

- **Mentorship programs and partnership groups.** Across the career span, there are examples of farmer-to-farmer mentorship or assistance programs. For example, the Carrot Project provides one-on-one coaching to farmers at various points in their careers.

4.2.1.3 Certified practices regulate detrimental organisms

All of the above programs, including those with direct and indirect incentives, deal primarily with food production, which is the predominant ecosystem service addressed by programs in the farming, food, and agricultural category. As mentioned, a distant second in this category is the regulation of detrimental organisms, which includes pest and disease management as well as the management of invasive and non-native species.

- **Certificates of compliance.** The USDA AMS Equipment Review (Dairy & Meat & Poultry), for example, is a voluntary, fee-based program that provides an AMS certification to businesses in the food processing industry as a means of regulating contamination and disease issues. In another example, FAMACHA certification, offered by the University of Rhode Island, is a program based on the Faffa Malan Chart, a method for estimating the level of anemia in sheep and goats affected by barber pole worm (*Haemonchus contortus*) infection. This method is a crucial tool for selective deworming of sheep and goats for producers and is an important incentive for producers to take an active role in regulating these detrimental organisms among livestock populations in the U.S. Northeast.

- **Technical assistance and education.** Beyond efforts to regulate specific organisms or disease vectors, other programs address the regulation of detrimental organisms through more comprehensive methods, such as Integrated Pest Management (IPM). The Northeastern IPM Center, for example, offers the Pest Management Strategy Plan (PMSP) and Production/Management Profiles Grant Program. This program requires participants to develop proposals for a PMSP or a Production/Management Profile (PMP) that addresses a specific pest management need/application that is significant to the U.S. Northeast. Other programs in this group are the various Pesticide Safety Education Programs, which are available through most of the Cooperative Extension programs in the U.S. Northeast.

Apart from food production and the regulation of detrimental organisms, other ecosystem services were addressed by programs in this category and can be explored in the database. For example, the regulation of hazardous events, which includes programs for hazard mitigation and disaster assistance funding programs, represents another prominent ecosystem service addressed, which stands out among these results. Most of

these programs were available primarily through the federal government, with significantly fewer being offered at the state level.

4.2.1.4 New frontiers: carbon sequestration

Last, among the programs for producers in the farming, food, and ecosystem category, there are a number of programs that represent an emerging industry centered on the ecosystem services of regulating the climate. These include carbon credit and sequestration programs; although it should be noted that the amount of money available often depends on the total amount of acreage a producer can enroll, which can favor large-scale producers over small-scale producers. Still, there are a number of relevant programs, including the TRU Carbon Carbon Credit Program, the Yara Agoro Carbon Alliance, the Farmer Business Network Gradable Carbon and the Grassroots Carbon Carbon Credit Program.

4.2.2 Programs for Supporting Institutions

In addition to the programs available for producers and businesses, the farming, agriculture, and food category also contained a number of incentive programs for supporting institutions (n=55, Figure 8). Among these were a variety of programs available to government agencies and organizations at various scales, from the state, county, and municipal levels. This group also contained programs for schools and Conservation Districts (CD), which will be reviewed in further detail below.

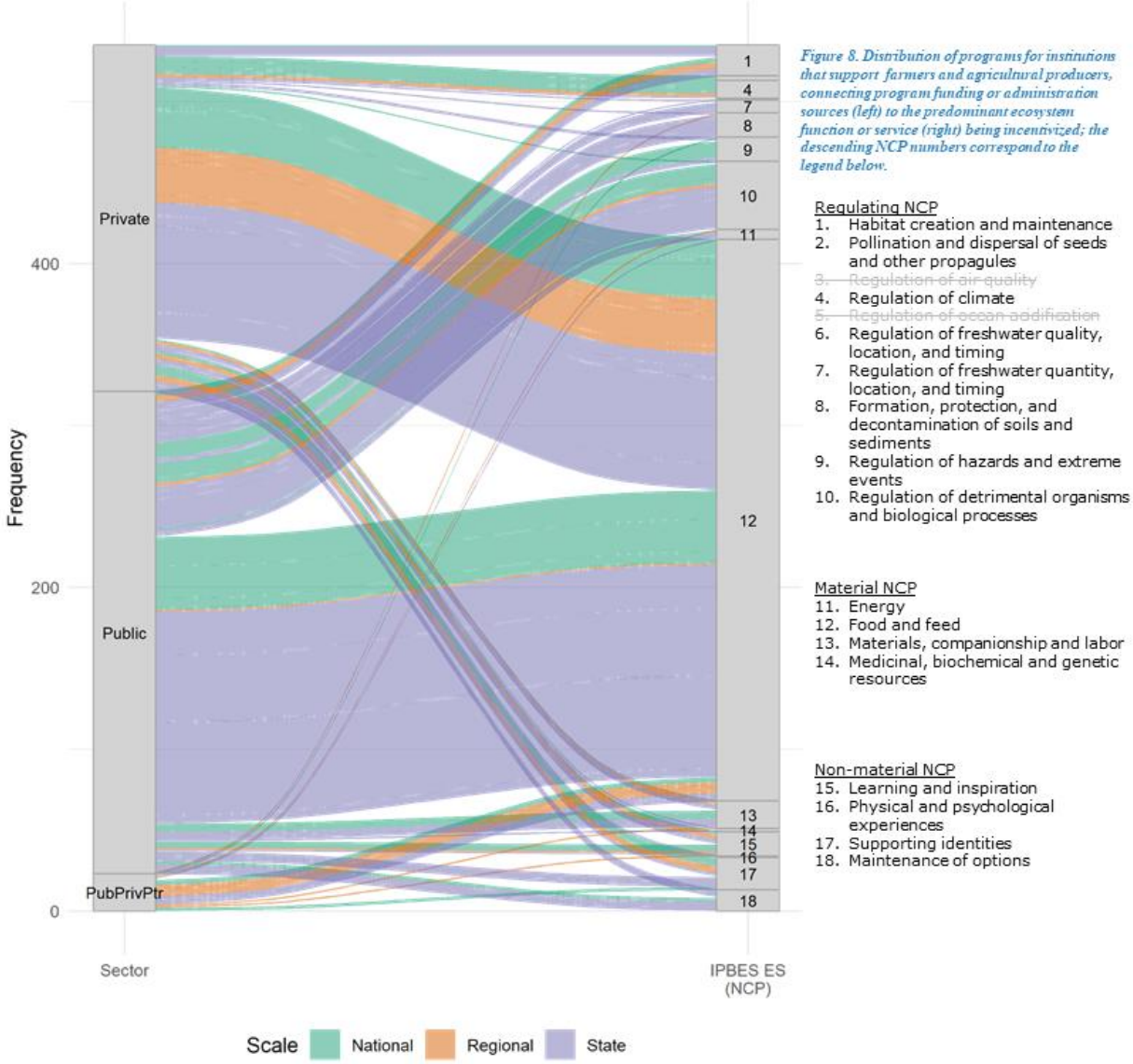


Figure 8. Distribution of programs for institutions that support farmers and agricultural producers, connecting program funding or administration sources (left) to the predominant ecosystem function or service (right) being incentivized; the descending NCP numbers correspond to the legend below.

Regulating NCP
- Supporting institutions facilitate the production of wildlife habitat through state agencies and government.
- Federal funding provides supporting institutions with a means to help producers regulate detrimental organisms.

Material NCP
- Food and feed production is facilitated by supporting institutions through state and federal governments, and programs led by private regional organizations to a lesser degree.

Non-material NCP
- Several state and federal programs are available for supporting institutions to build peer connections, strengthen leadership skills, and support project development.

4.2.2.1 Production of specialty crops and "foodsheds"

- **Multi-state and statewide programs.** The U.S. Department of Agriculture's Specialty Crop Block Grant Program and Specialty Crop Multi-State Program offer grants to supporting institutions in order to enhance the competitiveness of specialty crops. This is done by funding collaborative, multi-state projects that address regional or national level specialty crop issues such as food safety, plant pests and disease, as well as research, marketing, and promotion. Other state programs include efforts to influence state food purchasing, as is seen with the New York State Finance Law ("SFL") §165(4), which empowers state agencies purchasing food products to require that some or all of the food products be grown, harvested, produced, or processed in New York state. Similar programs, like the Maryland Certified Local Farm Enterprise Program, encourage state agencies, including public four-year universities, to increase the amount of food they purchase from certified local farm enterprises. These are just two examples of a number of similar programs available in states across the U.S. Northeast.

- **Programs for municipal and county administrators.** These include programs like the County Planning Incentive Grant from New Jersey, which is a new program that encourages a comprehensive planning process for farmland preservation at the county-level. Programs like this offer several advantages over the traditional easement purchase program, including enabling counties to accept and process farmland preservation applications year-round, rather than once a year. They also reduce the timeframe from landowner application to closing and reward counties that complete transactions in a timely manner with the potential for additional funding.

  In Maine, any town may develop and codify a Voluntary Municipal Farm Support Program to enter into "farm support arrangements" with eligible farmland owners. Those farmland owners, who are formally accepted by a town's legislative body, may then grant a 20-year agricultural conservation easement to the town in exchange for full or partial reimbursement of property taxes on their farmland and farm buildings during that 20-year period. In West Virginia, the Appalachian Regional Commission (ARC) Foodshed Development Program operates across a number of scales, between the municipality and businesses as well as between the municipality and the county, to create a network of partners capable of developing a hyper-local food system.

  In Maryland, the Sustainable Maryland Certification is a prestigious designation for municipal governments in the state. Municipalities that achieve this certification are considered by their peers, by state government, and by the experts and civic organizations in Maryland, to be among the leading municipalities in sustainability. All actions taken by municipalities to score points toward certification must be accompanied by documentary evidence and are reviewed. Such a municipal certification program, while rigorous and meaningful, is nevertheless free and voluntary.

4.2.2.2 Food production in schools and cities

Beyond those from governmental institutions, there are a number of programs in this category that are available for supporting institutions, such as schools, to fund either school gardens or farm-to-school programs. Of note are the New Jersey School Garden grant and the Pennsylvania Farm-to-School grant; however, there are a variety of other programs available across the U.S. Northeast.

Conservation Districts are important supporting institutions that make such programs available. The National Association for Conservation Districts (NACD), for example, maintains an Urban Agriculture Conservation (UAC) Grant Initiative, which is designed to enhance districts' urban agriculture conservation technical assistance activities in developed and developing areas of urban and rural communities. Through these grants, conservation districts increased their capacity related to urban technical assistance and small-scale conservation, while addressing community needs in rural and urban contexts.

4.2.3 Review of Funding/Program Organizations

The organizational trends in the farming, food, and agriculture category follow some similar trends in the supporting landscapes and systems category. In general, for both private and public organizations, there are more programs available at the state level rather than at the regional or the federal level. At the same time, public programs outnumber private programs overall regardless of scale. Only at the regional level do private and partnership programs seem more numerous relative to themselves, but even so, they still lag public programs generally. At the same time, private regional programs tend to be more available to producers than to supporting institutions.

Organizationally, most programs for producers are given through foundations and charitable organizations that provide technical assistance for short-term business planning and long-term estate planning, including the following:

- **Conservation Law Foundation** Legal Food Hub
- **Land for Good** Farm Legacy Program

There are also a number of regional partnerships that convene for specific groups of farmers.

- **Northeast Farmers of Color Land Trust Community Conservation Program** is one such example, convening in the interest of minority farmers in the U.S. Northeast.
- **Chesapeake Bay Foundation** and their Million Acres Challenge aims to build common ground among farming, profitability, resilience, and the environment for farmers in the Chesapeake Watershed. It's interesting that while this program encourages connection and innovation among farmers, it also provides up-to-date scientific information and research, as well as educational opportunities and financial analysis in the interest of promoting soil and ecosystem health.
- The **Delmarva Land and Litter Collaborative** is a regional partnership program that convenes in the interest of poultry farmers in the Delmarva peninsula. DLLC brings together representatives from chicken companies, farmers, regulatory agencies, academia, and environmental groups to identify solutions to support healthy and productive ecosystems and poultry farms.
- The **NOFA** TriState Order Program is another regional program available through a unique partnership. The NOFA Bulk Order was one of the first programs from NOFA, which was the parent organization from which all of the NOFA State Chapters would originate. Today, most state chapters run their own bulk orders; however, NOFA/Mass organizes the Tri-State Order on behalf of the NOFA organizations in Rhode Island, Connecticut, and Massachusetts.

Outside of these partnership programs, there are also state-level programs that are the key to empowering farmers to engage with ecosystem services beyond food production.

- **Managing Waste** is a Pennsylvania-based food recovery infrastructure grant. The purpose of this program is to reduce the amount of fresh and processed foodstuffs entering Pennsylvania's waste stream. Grants under this program can assist not-for-profit agencies with the costs of equipment necessary to prepare, transport, and store foodstuffs acquired from retailers/wholesalers.

- **New York's Land Trust Grants Program.** Like other permanent land protection programs, the Land Trust Grants Program awards state assistance to land trusts for activities that will assist counties and municipalities with their agricultural and farmland protection efforts, including providing technical assistance to county and municipal governments, owners of agricultural lands, and other agricultural interests. Generally, these grants have been offered to help cover transaction costs associated with donating an agricultural conservation easement; however, they can also be used to provide greater land access to current and future farmers or to educate landowners about how to protect their properties from conversion to non-farm uses.

Beyond these programs for producers, there are also a number of regional private and partnership programs available for supporting institutions to better serve their farmers in their community. Programs like the American Farmland Trust's Farms for the Future program, for example, offers a skill-building workshop series to provide education to municipalities, land trusts, and nonprofits so that these institutions might better support farms and farmers in the northern New England region.

4.2.4 Opportunities to Expand Market Presence

The most numerous opportunities to advertise and expand market presence come from programs that certify places, products, or practices (n=63). In other words, certification programs allow producers to charge premium prices for their products based on a particular aspect of either the product itself or the process through which it was produced.

Place-based certifications. Certification programs that target places, or place-based certifications, recognize particular areas or farms that have ecological, historical, or cultural value. In Pennsylvania, the Department of Agriculture recognizes Pennsylvania families through the Century and Bicentennial farm programs. To qualify for such certifications, the same family must have owned the farm for at least 100 (Century Farm) or 200 (Bicentennial Farm) consecutive years. In addition, a family member must live on the farm on a permanent basis; and the farm must consist of at least 10 acres of the original holding or gross more than $1,000 annually from the sale of farm products.

Product certifications. Certification programs also target a diversity of products like livestock, apples, maple products, hemp, and others, as well as non-GMO and organic certifications. For dairy products, in particular, there are various food safety and quality assurance certifications available to producers, as well as programs that certify products by origin, especially seeds. In addition, certification programs designate local products—such as the Buy Fresh Buy Local initiatives in various states as well as programs like the following:

- The #heartCTgrown program in Connecticut
- True Blue Crab Meat program in Maryland
- Jersey Fresh program in New Jersey

Practice-based certifications. Certification programs also designate products produced using particular practices across industries. There are animal welfare certifications, food safety certifications, and environmental certifications. Animal welfare, or certified humane, certifications designate livestock or dairy operations that meet certain criteria for raising and treating animals. Other programs, such as the USDA's Good Agricultural Practices grower certification, encourage certain food safety practices as part of a voluntary program developed by the FDA and USDA for fruit and vegetable growers, with the goal of reducing foodborne illness.

Still, other practice-based programs, like the Vermont Environmental Stewardship Program (VESP), require that producers meet high environmental standards regarding nutrient management, sediment and erosion control, soil health, greenhouse-gas emissions and carbon sequestration, and pasture health. If producers meet the standards in each category, this program awards them with a 5-year certification, an on-farm sign designating the farm as meeting high levels of environmental stewardship, and other recognition-based incentives. At the national level, there is also the Pollinator Partnership, which offers a Bee Friendly Farming program that promotes farming practices that improve pollinator populations and habitat.

Another major way for producers to expand market presence is with implementation grants.

- **Coordinate and expand business presence.** This includes programs that provide financial support to coordinate and expand rural and urban food businesses, such as the USDA Farmers Market Promotion Program, which funds projects that develop, coordinate, and expand direct producer-to-consumer markets. Other programs, such as the Urban Agriculture and Innovation Production Competitive Grants—which aim to improve local food access and collaborate with partner organizations—provide funds that support infrastructure needs by purchasing emerging technologies, underwriting educational endeavors, and facilitating urban farming policy implementation.

- **Produce specialty products or diversify product selection.** Programs to encourage specialty or diverse product lines include the Vermont Local Food in Your Community program, the Connecticut Farm Transition grant and the Food Export Market Entry program, which is available throughout the U.S. Northeast.

Finally, another growing area of opportunity for expanding market presence comes in the form of agro-tourism. This industry often includes various organizational partnerships or alliances and provides additional value to producers by marketing the places and experiences associated with food and agriculture along with the products it produces. In this sense, it taps a similar vein as place-, product-, and practice-based certifications do by drawing increased value and market presence from not only the thing being produced, but also the context in which it was produced. Agro-tourism programs in the U.S. Northeast are numerous, including the following:

- The **Maryland Wine Explorer** program promotes wine tours among the state's vineyards.
- The **Apple Orchards Membership** program through the New England Apple Association (NEAA) promotes the apple industry in the region through educational and promotional events and projects. For orchards that become members, the New England Apple Association (NEAA) provides a number of ways for farmers to increase their exposure and provide year-round visibility for their business.

In other states, there are also loan and grant opportunities available to producers to promote agritourism.

- The **Vermont Community Loan Fund's Agrotourism Loan Program** provides financing and business development services that help Vermont's farmers and food producers make agritourism a part of their business model. Through this program, typical agritourism activities include the operation of a farm stand, horseback riding, food and wine tasting, harvest festivals, overnight stays, and guided tours.
- In West Virginia, the **Partner Community Capital Local Food Value Chains Initiative** leverages the potential of agro-tourism as one part of a larger strategy to build scalable food and farm businesses that create real jobs by growing, buying, moving, and consuming local foods. They do so by nurturing strong business networks across the food system, including production, processing, retail, restaurants, agri-tourism, and more.

4.3 WORKING FORESTS AND WOODLANDS

The working forests and woodlands category specifically targets forests and woodland areas and/or land owners who manage such areas. Along with agricultural lands, forest areas constitute one of the major terrestrial working land covers, more broadly. Especially in the U.S. Northeast, where a substantial amount of forest lands are held by private landowners, the working forests and woodlands category is important for highlighting programs tailored specifically to these areas (Figure 9).

4.3.1 Programs for Producers/ Businesses

4.3.1.1 Sustaining habitat for family forests and working woodlands

For producers and businesses, the ecosystem service most frequently targeted by programs in this category was habitat production (n=54), specifically of forests, woodlands, and associated wildlife. In order to incentivize landowners to use these practices, there are a number of methods that these programs employ.

Tax incentives—whether through abatements, exemptions, or modifications— are one common way that a number of states promote conservation of forests and woodlands for private landowners.

- New Hampshire has a program that allows for modifications to personal income taxes among landowners who initiate forest management practices such as timber stand improvement and reforestation. As is the case with many of these tax-based programs, applicants must own a particular amount of forest land to qualify, in this case between 10 and 500 acres. For those that do qualify, however, certain practices may allow landowners to deduct double the amount from their state tax liability.

- Delaware has codified certain property tax exemptions through the Commercial Forest Plantation Act (chapter 26, "Commercial Forest Plantations", title 3), which gives landowners a property tax exemption for forests that are managed for timber production. As with the program in New Hampshire, in order to qualify for this 30-year exemption, landowners must have at least 10 contiguous forested acres and must follow a forest management plan approved by the Delaware Forest Service.

- In Massachusetts, there is also the Current Use Tax Program, which gives property tax breaks to landowners willing to commit to keeping some or all of their land undeveloped for a specified period of time.

Certificates of compliance also ensure that sustainable harvesting practices are undertaken on private land.

- The Forest Stewardship Council has a number of programs, including the Group Certification, Family Forest Program, Forest Management Standards, and the Controlled Wood Standard, which certify sustainable forest stewardship and harvest practices in the U.S. Northeast. The Forest Management Certification for Small Lands is a similar program offered by the American Forest Foundation that functions nationally.

  The American Tree Farm System (ATFS) provides third-party certification of small family-owned forestland through an internationally recognized process that is endorsed by the Programme for the Endorsement of Forest Certification (PEFC). To be certified, family forest owners must meet the ATFS Standards of Sustainability, which ensure that landowners are protecting and improving clean water, wildlife habitat, and more. In Massachusetts, the Department of Conservation Resources's (DCR's) Forest Stewardship Green Certification program, also referred to as Forest Certification, is a similar process whereby a third-party independent forest experts conduct audits of forestry sites and review management plans and procedures to assess if the forestry is of a high quality that meets certification standards.

Technical assistance and grant funding programs were also prominent in the working forest and woodlands category.

- In the Forest Stewardship Program (FSP) from the U.S. Forest Service, the USFS works in partnership with state forestry agencies, Cooperative Extension, and conservation districts to connect private landowners with the information and tools they need to manage their forests and woodlands.

- Watershed Agricultural Council's (WAC's) Harvests for Habitat program operates in New York to improve bird habitat and forest management.

- New Hampshire Fish and Game Department's Small Grants program helps landowners who own a minimum of 25 contiguous acres to restore or enhance habitat for wildlife with funding available for the creation and/or maintenance of wildlife habitat on the property. Under this program, a variety of projects may qualify for funding, including brush clearing or mowing to maintain grasslands and shrublands, the release of old apple trees, and maintenance of woodland openings.

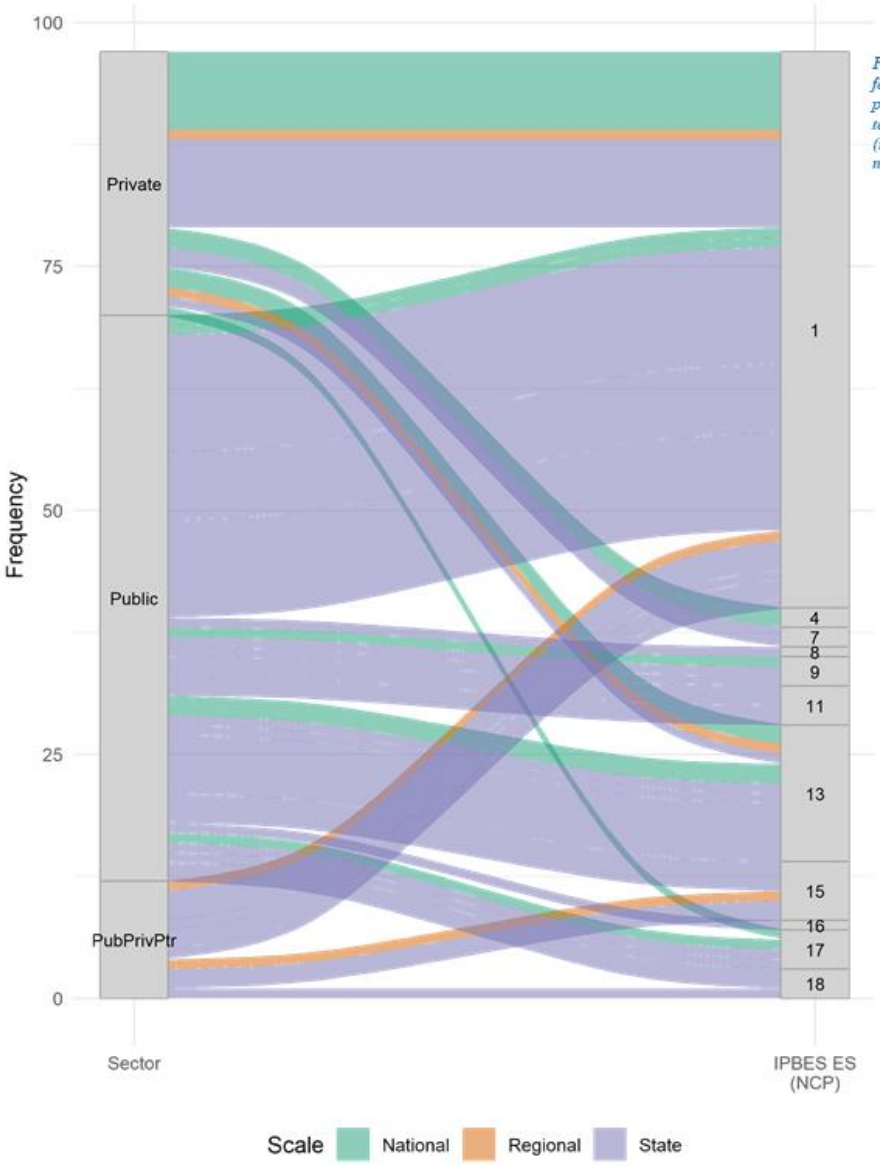


Figure 9. Distribution of programs for working forest and woodland producers, connecting program funding or administration sources (left) to the predominant ecosystem function or service (right) being incentivized; the descending NCP numbers correspond to the legend below.

Regulating NCP
1. Habitat creation and maintenance
2. ~~Pollination and dispersal of seeds and other propagules~~
3. ~~Regulation of air quality~~
4. Regulation of climate
5. ~~Regulation of ocean acidification~~
6. ~~Regulation of freshwater quality, location, and timing~~
7. Regulation of freshwater quantity, location, and timing
8. Formation, protection, and decontamination of soils and sediments
9. Regulation of hazards and extreme events
10. ~~Regulation of detrimental organisms and biological processes~~

Material NCP
11. Energy
12. ~~Food and feed~~
13. Materials, companionship and labor
14. ~~Medicinal, biochemical and genetic resources~~

Non-material NCP
15. Learning and inspiration
16. Physical and psychological experiences
17. Supporting identities
18. Maintenance of options

Regulating NCP
- Programs for forestry producers to sustain wildlife habitat are well-incentivized across sectors and scales.
- Programs that support the regulation of air quality were not found in this sample.

Material NCP
- Forestry products are most heavily incentivized through the public sector, especially by state governments and agencies.

Non-material NCP
- Public-private partnerships play an important role to support state and regional partnership programs, stewardship planning, and job training.

4.3.1.2 Assistance for reforestation programs

Large-scale tree planting and reforestation

- The USDA CRP Emergency Forest Restoration Program (EFRP) helps owners of non-industrial private forests in the U.S. Northeast and nationally restore forest health damaged by natural disasters.

- In Delaware, the Seed Tree Law program was passed due to the long-term decrease in pine and yellow-poplar forests. Run by the Delaware Forest Service, this program requires landowners to reforest all harvested sites of 10 acres or more that contain at least 25% pine and/or yellow-poplar, unless the site will be developed or cleared for agriculture. For this program, the Delaware Forest Service not only enforces the law but also provides landowners technical assistance to meet these requirements by supervising reforestation activities.

- Other programs, such as the Pennsylvania Riparian Forest Buffer project, do not restore forest specifically but include reforestation efforts as a broader part of habitat creation and maintenance, as is the case with the restoration of riparian buffers.

Citizens and/or volunteer-led tree planting

- The Maryland Tree-mendous program helps residents in the state gain access to affordable trees to plant on their public lands. With permission from landowners, volunteers can plant trees at schools, in state and community parks, in local open space, along streets, and more.

- The Maryland Department of Natural Resources' Forest Service has a Lawn to Woodland program that helps Maryland residents who own 1-4 acres of land convert unused lawn to forest cover at no cost.

- In West Virginia, Project CommuniTree (CTree) provides technical assistance, trees, and planting supplies to volunteers for planting trees on public land. CTree helps groups identify a proper planting location, develop a planting plan, and organize volunteers for planting day and follow-up maintenance. CTreealso provides CTree Kits that can be used to plant trees at schools, in parks, along road right-of-ways, near churches, and on other public lands.

4.3.1.3 Producing material goods

Beyond these programs aimed at habitat creation and maintenance, there are also a number of programs in this category that target the development of material goods in working forests and woodlands. These are often geared towards improving the delivery of wood products for energy, as in the U.S. Forest Service's Community Wood Grant program, which provides money to install thermally led community wood energy systems or to build innovative wood product manufacturing facilities.

Other programs provide various in-kind benefits to owners of working forests, such as the Delaware Wood Directory, which is a list of primary (sawmills, loggers, etc.) and secondary (furniture makers, pallet manufacturers, etc.) wood processors that is distributed to landowners and other interested parties to improve the production of wood and lumber products.

4.3.2 Programs for Supporting Institutions

4.3.2.1 Improving forest health

The working forests and woodlands category also contained a number of programs that provide funding and incentives for supporting organizations in order to help manage various aspects of forest and forest health (Figure 10). These include programs aimed at improving different aspects of forest health as well as program delivery at the municipal level. Programs like the USFS Biological Control of Invasive Forest Pests (BCIFP) and Forest Service Pesticide Impact Assessment Program (FS-PIAP) address forest pests and

pesticide use in forests, respectively. Maine's Project Canopy provides assistance grants to state, county, and municipal governments as well as educational institutions and non-profit organizations for developing and implementing community forestry projects and programs.

A number of programs also tackle forest health and tree cover in urban areas and communities. New York's Urban & Community Forestry Program Cost Share Grants, for example, aim to improve the health of urban and community forests and to increase the sustainability of forestry programs. This program, in particular, is a reimbursement grant program that focuses on partnerships, volunteers, community groups, professionals, and outreach and education because these are components of strong and sustainable community forestry programs. Examples of projects that are eligible for this funding include tree inventories, management plans, tree planting, maintenance, and education programming for those who care for community trees.

4.3.2.3 Supporting forest plans

Another aspect of working forests that some of these programs tackle directly is the development of forest management plans.

- **Urban and community forest health.** The USFS Forest Health Protection Grants, Special Technology Development Program (STDP) is one example of a program in this area that differs from the rest. While forest management plans are generally straightforward, this program applies research results and cutting-edge technologies to develop field operation methods that improve the ability of field specialists to restore and protect America's forests.

- **Community and neighborhood "livability".** In addition, while many of the programs in this category target woodlands, another aspect of forest cover and working lands is the need to create pleasant, livable places for residents to live. The Chesapeake Bay Trust, for example, provides the Green Streets, Green Jobs, Green Towns program, which supports design projects, financing strategies, and/or implementation of green street projects. This program also supports white papers on innovative ideas for green infrastructure and charrettes to plan and vision a green street project with developers, citizens, planners, and other stakeholders. The Massachusetts Gateway City Parks Program is another program that funds the creation and restoration of parks and recreational facilities in underserved urban neighborhoods.

4.3.3 Review of Funding/Program Organizations

As in other categories, in the working forests and woodlands category, state programs dominate in numbers for producers/businesses (n=72) and supporting institutions (n=14), just as public programs (n=77) dominate over private programs (n=32). Public-private partnerships are still dominant for regional activities.

Of these regional partnership programs, several are specifically geared towards tree farms. The **American Forest Foundation's American Tree Farm System (ATFS) Certification** is a certification system that works through a number of public and private subsidiary organizations to encourage landowners to improve the sustainability and management of forests on private lands.

- The New York Audubon Society works as one such subsidiary of the American Forest Foundation and offers a tree farm program of their own. The aim of this program is to promote the growth of renewable forest resources on private lands in New York State while protecting environmental benefits and increasing public understanding of all benefits of productive forestry.

- The New Hampshire Division of Forested Lands is another subsidiary implementing the American Tree Farm System (ATFS) standards. In New Hampshire, this Tree Farm Program is operated by volunteers through the New Hampshire Tree Farm Executive Committee and has since 1950.

In the private sector, programs are focused on professional development for foresters.

- The **Connecticut Forest and Park Association's Master Woodland Manager program** is a year-long program that provides woodland owners and managers with the knowledge and skills that they need to make decisions for their woodland that can enhance their lives and help wildlife and the environment.
- The **Watershed Agricultural Council (WAC) Trained Logger Certification** is one aspect of the council's broader Forestry Program that supports training for loggers in order to promote professional timber harvesting on watershed lands for a variety of reasons. Not only do trends in the U.S. Northeast and across the United States indicate that training loggers is the key to developing certifications on private woodlots, but trained loggers are also safer in their harvesting practices, resulting in fewer injuries and a better understanding of sustainability and water quality as it relates to their harvesting decisions.

State programs in this category generally provide information and outreach materials about industrial and non-industrial forest lands and are administered by state agencies and/or Cooperative Extension. Cooperative Extension also provides programs for private landowners that provide technical assistance and education to private businesses and landowners who are interested in improving forest management or harvesting practices on lands that are not managed for profit.

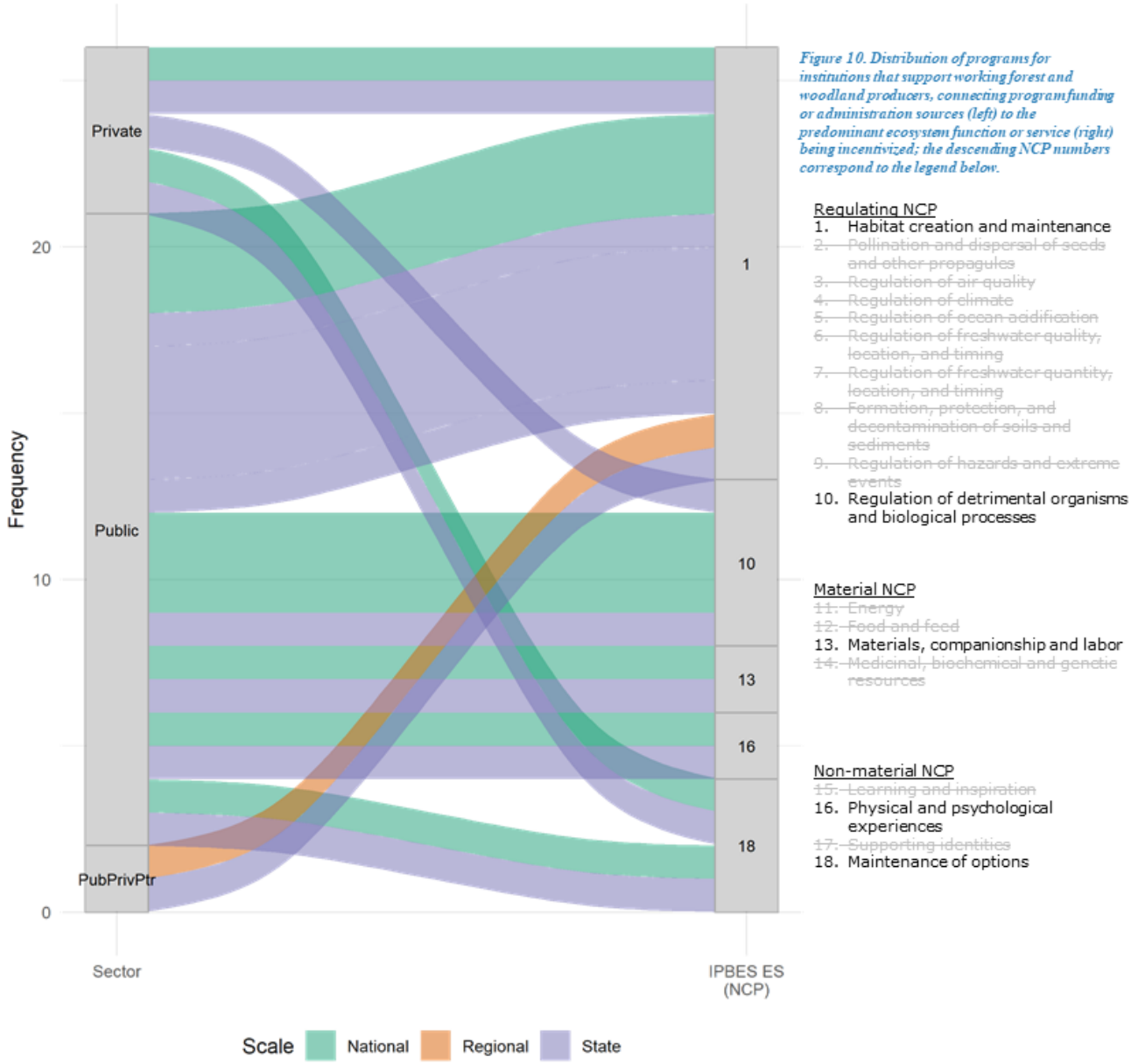


Figure 10. Distribution of programs for institutions that support working forest and woodland producers, connecting program funding or administration sources (left) to the predominant ecosystem function or service (right) being incentivized; the descending NCP numbers correspond to the legend below.

Regulating NCP
- Supporting institutions help producers sustain wildlife habitat across sectors and scales.

Material NCP
- State and federal governments or agencies help institutions support forestry producers' material goods and services.

Non-material NCP
- Training and resources are available to supporting institutions from public and private sources at the state and federal levels.

There are also a number of notable regional collaborations in the working forests and woodlands category.

- The **Woods, Wildlife, and Warblers (WWW)** program is a collaborative project among Audubon Vermont, New York Forest Owners Association, New York Tree Farm Program, and Vermont Woodlands Association that seeks to create and improve forest bird habitat. This is accomplished by providing forest owners with the education, tools, and resources they need to enhance and protect the health of forests.

- The **Central Appalachia Habitat Stewardship Program** is another such example. It restores and sustains healthy forests, rivers, and streams that provide habitat for diverse native birds and aquatic populations. The program supports projects in various portions of the Appalachian region including Maryland, New York, Ohio, Pennsylvania, Virginia, and West Virginia.

4.3.4 Opportunities to Expand Market Presence

In the working forests and woodlands category, there are also a number of programs that allow for expanded market presence for landowners. As with the other categories, these include various place-, product-, and practice-based certifications that give landowners commercial or marketing benefits.

- **Place-based certifications** include the Forest Stewardship Council Federal Lands Certification and TreeCity USA certifications, which certify forest management practices and help communities manage and expand their public trees, respectively.

- **Product- and practice-based certifications** include programs that couple biodiversity conservation practices with specialty products, as in the VT Bird Friendly Maple Syrup program and the Connecticut Grown Forest Products program. The maple syrup program certifies that maple syrup producers in Vermont use particular management strategies that promote bird habitat in the state. The forest products program is the result of an agreement between the Connecticut Department of Energy and Environmental Protection (DEEP) and the Department of Agriculture (DOA) to include products from Connecticut's forests in the widely known Connecticut Grown program. Requirements for this program Connecticut Grown Forest Products Program ensure that Connecticut-grown forests are managed in a sustainable and responsible manner.

There are also initiatives that support the implementation of forest health-management practices on public woodlands in the interest of increasing revenue from these lands.

- The **New Hampshire State Land Timber Sale Program**, for example, is run by the Forest Management Bureau and sells timber on state reservations while demonstrating sound forestry principles. As codified by New Hampshire state law (RSA 227-G:1), forest benefits include not only forest products but also a viable forest-based economy, recreational opportunities, scenic values, healthful surroundings, climate mitigation, clean water, and biologically diverse populations of plants and animals.

Beyond these certification efforts, there are additional ways for landowners to expand their market presence to support the use of wood energy on private and public lands.

Run by the USDA and the USFS, the **Community Wood Energy and Wood Innovation Grant Program** provides funding and grants to install community wood energy systems or to build innovative wood product manufacturing facilities.

4.4 FISHERIES, AQUACULTURE, AND SHELLFISH OPERATIONS

The fisheries, aquaculture, and shellfish operations category includes programs that support producers, businesses, and land-owners engaged in or associated with some aspect of marine or aquatic food production. It's not surprising that a majority of these programs are focused on the ecosystem service of food production; however, some programs are also engaged with ecosystem services as diverse as wildlife habitat protection (n=13) and off-shore wind energy production. Many of these programs are limited to the states in the U.S. Northeast with significant stretches of coastline. Overall, of the four working lands covered in this assessment, the fisheries, aquaculture, and shellfish operations category is by far the least number of programs (n=83). Nevertheless, with working waterfronts representing part of the economic engine driving coastal redevelopment (USGCRP, 2017), aquatic ecosystem services are essential to various redevelopment efforts.

4.4.1 Programs for Producers/Businesses

4.4.1.1 Food production and operations

As mentioned, a majority of the programs in the fisheries, aquaculture, and shellfish category, especially those targeting producers and businesses, are also involved in the ecosystem service of food production (Figure 11). Programs in this area generally consisted of partnership programs offering in-kind resources, technical assistance and education programs, and programs incentivizing opportunities for land leases.

In-kind resources. One such program is the Maryland Seafood Oyster Aquaculture List program. This program collates a list of oyster aquaculture facilities that operate in the state of Maryland annually. The information is then published to better connect foodservice with the Maryland seafood industry, whether or not the companies listed sell directly to Maryland food services.

Technical assistance and education. Examples in this category include both federal-level resources, and regional- and state-level resources through organizations like the Greater Atlantic Regional Fisheries Office of NOAA. At the federal level, the U.S. Food and Drug Administration offers the Seafood Hazardous Analysis Critical Control Point (HACCP) program, which provides guidance and certification for the aquaculture industry to ensure food safety on the part of producers. State-level resources include programs such as the Rhode Island Shellfish Harvester Education program, an effort of the Rhode Island Department of Health with support from the National Shellfish Sanitation program. This program provides training and certification to shellfish harvesters in the state with the goal of improving the delivery of safe products to consumers in Rhode Island.

In addition to these partnership and technical assistance programs, there are also a number of programs that support land lease efforts in areas surrounding the aquaculture industry.

- The Connecticut Department of Agriculture, for example, offers the Shellfish Ground Leasing Procedure and Lease Opportunities program. This program permits shellfish farmers to obtain underwater lands in Long Island Sound for planting, cultivating, and harvesting shellfish crops. The Long Island Sound area includes some 70,000 acres that is currently farmed—about12,000 acres of this area is leased by the local shellfish commission. They offer additional leases to shellfish operations based on a competitive bid process.

- The Rhode Island Division of Fish and Wildlife also leases acreage to shellfish producers in the Inland Bay area. These leases are available for lands within defined Shellfish Aquaculture Development Areas (SADA), which offer expedited state- and federal-permitting processes, as well as for lands outside of those areas.

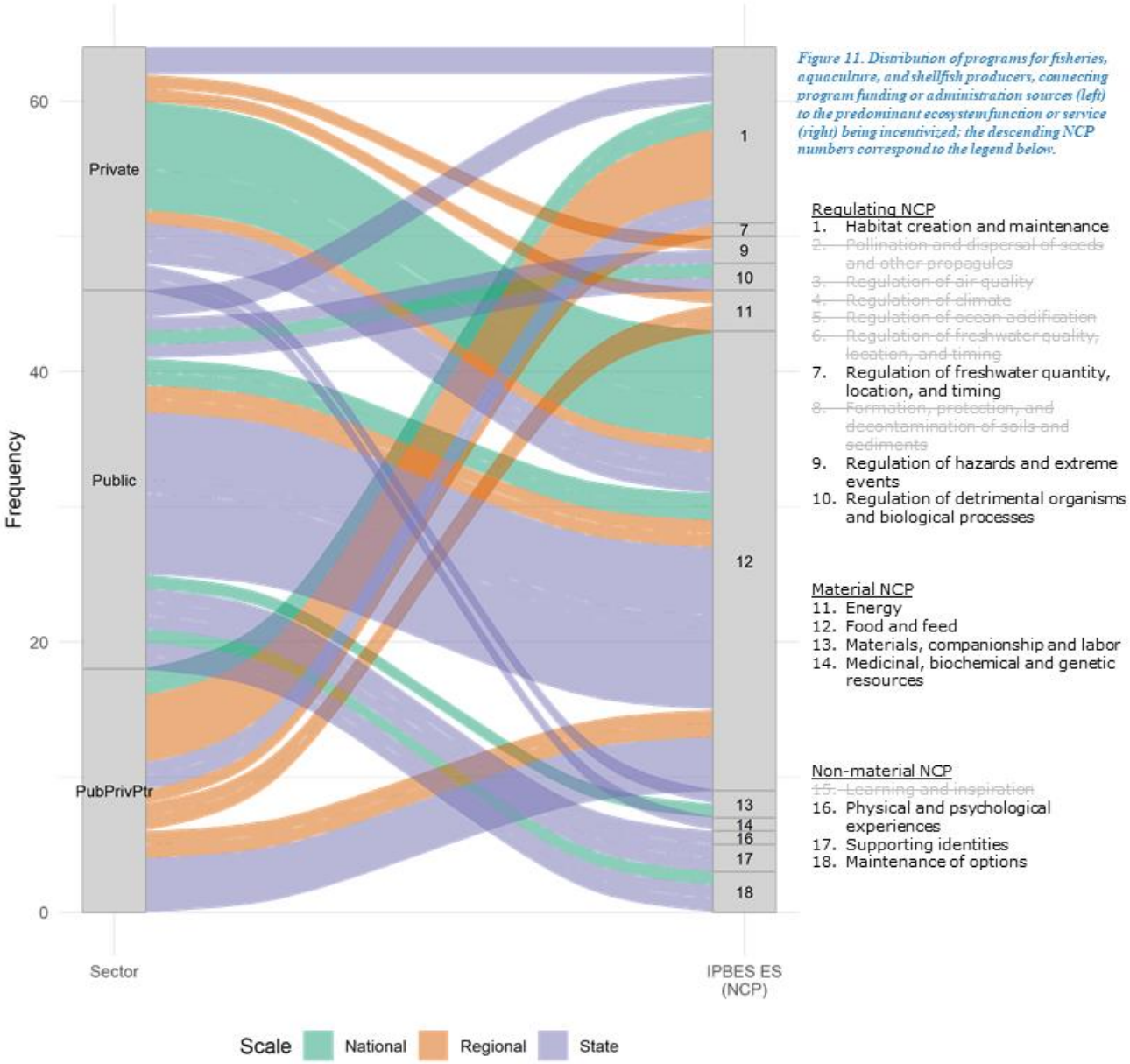


Figure 11. Distribution of programs for fisheries, aquaculture, and shellfish producers, connecting program funding or administration sources (left) to the predominant ecosystem function or service (right) being incentivized; the descending NCP numbers correspond to the legend below.

Regulating NCP

- Regional public-private partnership programs support water quality and wildlife habitat, as well as the treatment of raw sewage.

Material NCP

- Private organizations at the national level and state-level public sector programs support the cultivation of food and materials.

Non-material NCP

- State-led partnership programs provide professional training and industry support for producers.

4.4.2 Programs for Supporting Institutions

4.4.2.1 Healthy aquatic habitats

Unlike the other programs available to producers in this category, the incentive programs for supporting institutions are directed largely toward wildlife habitat (n=12) (Figure 12).

State government programs. These programs include the USFWS/ Northeast Sustainable Agriculture Working Group's Sport Fish Restoration (SFR) program, which provides grants to the states, the District of Columbia, and insular-area fish and wildlife agencies for fishery projects, boating access, and aquatic education. The SFR program was modeled after the Wildlife Restoration program and aims to restore and better manage America's declining fishery resources.

Municipal government programs. The Delaware Coastal Training program offers training and assistance to local governments through the Delaware National Estuarine Research Reserve. The Coastal Training program also offers resources to help communities make informed decisions. For non-governmental organizations (NGOs) and municipalities, programs like the Casco Bay Estuary Partnership's Habitat Protection Fund Award provides cost-sharing grants to support the permanent protection of aquatic habitats in the Casco Bay Watershed of Maine.

Municipal government and NGO programs. The Casco Bay Estuary Partnership resembles other partnership efforts that connect with local communities in the interest of aquatic habitat preservation. For example, the Association of National Estuary Programs and the National Fish and Wildlife Foundation support the Long Island Sound Futures Fund, which funds projects in local communities that aim to protect and restore Long Island Sound. In these efforts, the program brings together federal and state agencies as well as various foundations and corporations with the goal of achieving high-priority conservation objectives in Long Island Sound.

In addition to these partnership programs, there are a number of other public regional programs with similar conservation interests. The Northeastern Regional Aquaculture Center (NRAC) at the University of Maryland, for example, is one of five Regional Aquaculture Centers established by Congress. With funding from the USDA, the NRAC functions like a Cooperative Extension program for the aquaculture industry in the U.S. Northeast, developing and conducting research and Extension activities in the interest of supporting producers and businesses.

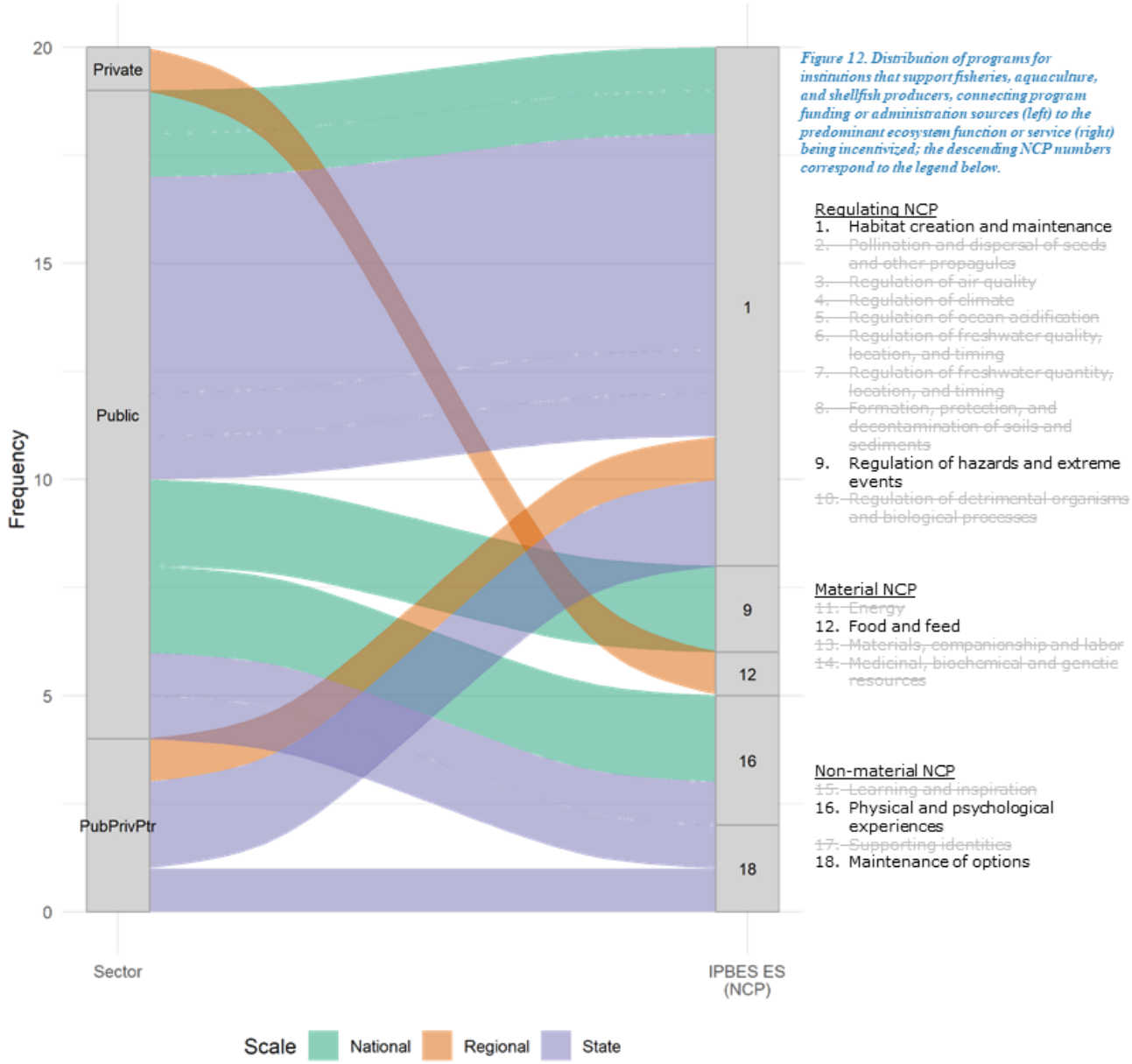


Figure 12. Distribution of programs for institutions that support fisheries, aquaculture, and shellfish producers, connecting program funding or administration sources (left) to the predominant ecosystem function or service (right) being incentivized; the descending NCP numbers correspond to the legend below.

Regulating NCP
- Public and public private partnerships outnumber private programs for supporting institutions across scales.

Material NCP
- Institutions supporting food production are exclusively incentivized by the private sector.

Non-material NCP
- State and federal partnership programs and technical education are available to institutions that support fisheries, aquaculture, and shellfish.

4.4.3 Review of Funding/Program Organizations

In the fisheries, aquaculture, and shellfish operations category, public programs for producers and supporting institutions were dominant over both partnership and private programs at the state level. At the national level, however, private programs dominate, while at the regional level, partnerships dominate. Similar trends were evident in the other categories, as well.

Partnerships at the regional scale included a number of programs geared towards producers. Among these, a few programs seem to stand out.

- The Division of Agriculture at the Rhode Island Department of Environmental Management, for example, administers the **Local Agriculture and Seafood Act Grants** program with the goal to support the growth, development, and marketing of local food and seafood in Rhode Island. Funding for this program comes from the State of Rhode Island and is matched by funds from the Henry P. Kendall Foundation, the van Beuren Charitable Foundation, and the Rhode Island Foundation. This type of public-private partnership is unique, providing grants to directly benefit and strengthen the food system in Rhode Island.

- Other partnership programs, like the **Mid-Atlantic Coast Fish Habitat Partnership (ACFHP)**, **New England Fishery Management Council**, **Mid-Atlantic Fishery Management Council**, and Atlantic **States Marine Fisheries Commission**, represent similar efforts to address aquatic habitat and sustainability issues across larger, regional areas that often include several states on the Eastern seaboard.

At the national level, there are a number of noteworthy public and federal programs.

- The **Mussels for Clean Water Initiative (MuCWI)** is part of the multifaceted Freshwater Mussel Recovery Program (FMRP) that aims to restore native species of freshwater mussels to streams, rivers, and lakes. This program is particularly focused on the Delaware River Basin but includes areas across the upper mid-Atlantic region. Like many other programs across the United States, the FMRP strives to restore mussels because they are one of the most imperiled animal groups. The MuCWI, however, is different because it aims to directly restore or enhance the ecosystem services that are provided by healthy beds of mussels. The larger goal of MuCWI, therefore, is not just to promote mussel populations but to promote cleaner water and healthier aquatic ecosystems.

Aquaculture programs, including public and private and partnership programs, also offer a number of opportunities to residents, with a number of initiatives aimed at homeowners and landowners.

- The Partnership for the Delaware Estuary, for example, offers an **Oyster Shell Recycling** program.

- Peconic Estuary Partnership offers a **Homeowner Rewards** program as part of their work with the Association of National Estuary Programs (ANEP).

- In Delaware, the **Youth Fishing** program from The Division of Fish and Wildlife offers free fishing lessons for children and young teens.

- The Chesapeake Bay Foundation offers an **Oyster Gardening** program for homeowners and landowners, providing education about and technical guidance for revitalizing oyster populations along private docks and waterfronts.

4.4.4 Opportunities to Expand Market Presence

Other than various land lease opportunities available for the aquaculture industry (see Section 4.4.1), there are limited programs that offer expanded market presence for aquaculture businesses and producers.

- The **Surfrider Foundation's Ocean Friendly Restaurant** program, for example, is a compliance and certification program that recognizes restaurants that are committed to making sustainable choices in terms of the seafood products that they source. This certification program, like other certification programs, incentivizes sustainable practices and encourages restaurants to be transparent about their seafood sourcing so that consumers can make informed decisions about where and what they eat.

Other certification programs also serve the aquaculture industry in a similar way, but rather than certify food service establishments, they certify food products. Organizations like the **Aquaculture Stewardship Council (ASC)** and **Marine Stewardship Council (MSC)** offer various programs, like the Seaweed Standard, Chain of Custody Standard and the Fisheries Standard, which provide compliance and regulatory guidelines as well as certification for various aquatic resources. Still other programs such as the **Eco-Certified Seafood**, the **Salmon Welfare Certified**, and the **Seafood HACCP** are certification-based programs that target aquatic products to improve sustainability and animal welfare in the industry.

4.5 SUPPORTING LANDSCAPES AND SYSTEMS

The supporting landscapes and systems category includes programs that sit at the nexus of social, economic, and environmental systems. While there is great variability in this data, as will be discussed in the following sections, the programs it contains all aim to address social and economic considerations alongside returns to or investments in the environment. This slice of overall data contains just under 500 programs total.

Of particular note in this category are the number of programs related to infrastructure and personal livelihoods. A critical issue for the U.S. Northeast is its aging infrastructure: roads, bridges, railroad lines, water and wastewater pipelines, culverts, and electrical power networks (U.S. GCRP 2017). The region has the oldest industry and building inventory in the United States, much of which was built along the coast and in estuaries—both of which are highly vulnerable to flooding.

4.5.1 Programs for Producers/Businesses

Within this category, a significant portion of programs were directed towards producers and businesses (n=288). Most of these programs are about improving wildlife habitat and water quantity/quality and protecting sensitive ecological resources from commercial development.

4.5.1.1 PES and land protection restore wildlife habitat

Payments for Ecosystem Services (PES). At the federal level, one such program is the USDA FSA's Conservation Reserve Program (CRP). Under the 2018 Farm Bill, CRP aims to protect environmentally sensitive agricultural lands by increasing habitat for endangered and threatened species for a 10- to 15-year enrollment period. CRP is one of the most sizable private-lands conservation programs in the United States, paying producers a rental fee in exchange for withholding agricultural production on ecologically sensitive lands and encouraging the establishment of plant species that improve environmental health and quality (USDA 2021).

Land acquisition and protection. There are many other land acquisition options for producers and businesses, which often function to directly limit development pressures. Many states have some if not several land acquisition programs that expand existing state and wildlife management areas through land acquisitions. These programs can be narrowly focused on particular areas and habitats or can be more broadly focused, taking into consideration different parts of a landscape.

- Programs like the USDA NRCS Wetland Reserve Easement program uses either 30-year or permanent easements to restrict development in critical wetland areas. Another example is the USFWS Migratory Bird Conservation Commission (MBCC), whose funds allow for the purchase, lease, or easement of valuable habitat for migratory birds.

- Delaware's Open Space Program, on the other hand, is not focused on particular habitat types but instead coordinates the acquisitions of various parts of the landscape by expanding state parks and preserves, fish and wildlife areas, state forests, and cultural resource sites. These management areas include some of the finest examples of Delaware's diverse natural and cultural heritage.

4.5.1.2 Nutrient trading and household rebates serve water quality/quantity concerns

Beyond programs aimed at regulating development and improving conservation, there are a large number of programs for producers that address issues related to water quality and quantity. Various programs use different strategies and incentives to creatively mitigate nonpoint-source pollution through things like mitigation banks and payment for ecosystem service schemes.

Nutrient trading, for example, is a promising strategy for introducing cost-effectiveness and market-driven efficiency into the realization of reducing nutrient run-off from a number of industries, including agriculture. Under this approach, various industries are given the flexibility to meet their nutrient limits by purchasing credits or offsets by reducing nutrient run-off elsewhere. The success of such programs depends on a number of factors including the price of credit purchases versus alternative practices.

- The Maryland Departments of Agriculture (MDA) and Department of the Environment (MDE) have been working collaboratively to establish one such voluntary, market-based program to promote the use of trading as a viable option for achieving the state's nutrient reduction goals. Maryland Nutrient Trading Program is a program that envisions trading not only between sectors (cross-sector trading) within Maryland, but ultimately between Maryland and the other Bay states (interstate trading).

- The Vermont Pay-for-Phosphorus Program, through funding from the USDA NRCS RCPP AFA program, will build a novel pay-for-performance program in Vermont that will pay for phosphorus reductions beyond the requirements of the Lake Champlain Basin Phosphorus Total Maximum Daily Load (TMDL).

Other programs address water quality issues through efforts to control point-source pollution and reduce impervious surface covers. This is of particular importance in urban areas, where runoff and stormwater can cause significant economic and ecological damage.

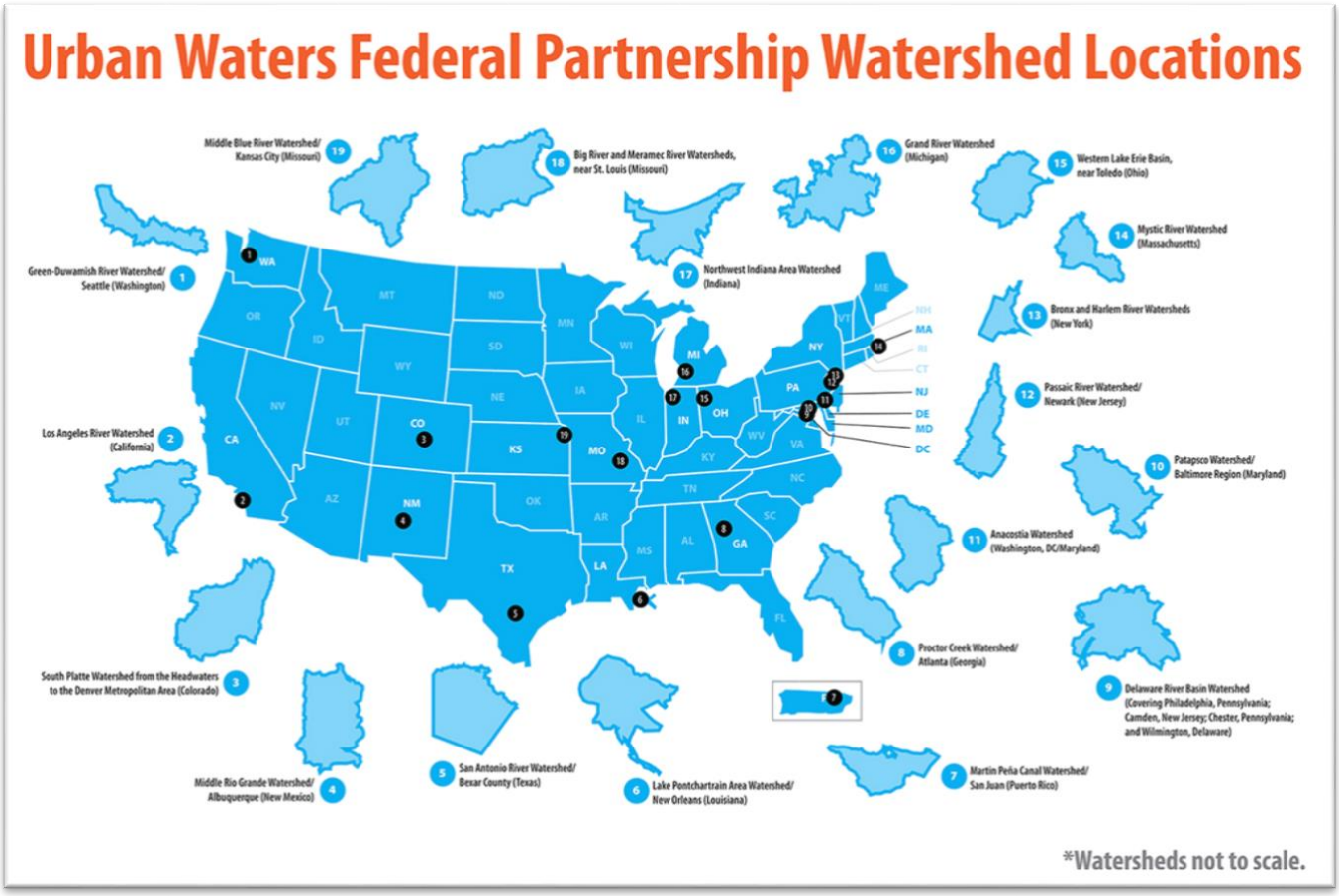
- The USDA FSA Source Water Protection Program (SWPP) encourages producers in participating states to use conservation practices and become a member of the local team responsible for developing the SWPP. Through this program, areas where pollution prevention is most needed are identified, after which technicians work with state rural water associations to create teams made up of local citizens and individuals from federal, state, local, and private organizations, who collaborate to create a Rural Source Water Protection plan to promote clean source water.

- EPA's Urban Waters Partnership, which has six locations in the U.S. Northeast, directs the Urban Waters Federal Partnership (Figure 13). The partnership reconnects urban communities, particularly those that are overburdened or economically distressed, with their waterways by improving coordination among federal agencies and collaborating with community-led revitalization efforts to improve water systems and promote economic, environmental, and social benefits.

- Washington D.C. RiverSmart programs—in particular the Clean Rivers and Impervious Area Charge (CRIAC) incentive—are examples of other efforts to reduce impervious areas in urban centers. The RiverSmart program offers discounts to residents on their water bill and discounts of up to 55% off the District Department of Energy and Environment's (DOEE's) Stormwater Fee when they reduce stormwater runoff by installing green infrastructure (GI). For the purposes of this program, green infrastructure includes things like green roofs, bioretention, permeable pavement, and rainwater harvesting systems. The use of GI helps protect the Anacostia and Potomac rivers and Rock Creek, which are the main waterways in the city.

- The Washington D.C. Clean Rivers and Impervious Area Charge (CRIAC) program is an extension to the RiverSmart Rewards program and incentivizes customers to manage stormwater on their property through the use of approved best management practices, including rain gardens, rain barrels, pervious paving, green roofs, bioretention practices, and stormwater reuse methods. In addition to this, the RiverSmart Homes program offers rebates when homeowners install their own trees, rain barrels, or rain gardens or remove impervious surfaces from their property and replace them with permeable pavers and/or vegetation. Any single-family homeowner in D.C. is eligible to apply for these rebates.

Figure 13. The geographic reach of the U.S. EPA's Urban Waters Partnership, with six offices in the U.S. Northeast



4.5.1.3 Multilevel incentive structures and access to capital

Compounded incentives from conservation easements also are important tools for encouraging producers and businesses to improve landscapes and ecosystems. These generally consist of tax credits that landowners can claim once they enter into a conservation easement agreement.

Reduction in general property tax or income tax. New Hampshire, for example, offers a property tax reduction for conservation easement, while West Virginia offers an income tax deduction for the same. These easement programs sometimes establish agreements for certain lengths of time, as in the Maryland Conservation Easement Program. Through the Conservation Property Tax Credit, this program encourages the donation of conservation easements and gives participating landowners a 15-year property tax credit on unimproved land under easement to the Maryland Environmental Trust. In this case, tax credits are seen as more powerful incentives than simple deductions because they represent a direct offset against tax due rather than a reduction of the income against which tax is assessed.

Historic preservation. Historic preservation is a narrower land protection program, focused on the preservation of historical sites, not just areas of interest to conservation. These programs take a number of forms, whether through loans, as in the Maryland Historical Trust Historic Preservation Loan Program, or through tax credits, as in the National Park Service's 20% Historic Rehabilitation Tax Credit. As the latter program indicates, these historical preservation programs operate at the national and state levels, as the Rhode Island Historic Tax Credit does. Such programs might not seem relevant to landowners or producers; however, it is important to note that these funds can be used to help restore old barns and wood frame houses, not only increasing the overall value for landowners but also potentially supporting other income-generating activities such as agro-tourism.

Capital investment funds. For producers and businesses, there are also ground-up economic development programs that improve returns to landscapes and ecosystems. A number of capital investment funds, called natural capital investment funds, have been developed for these purposes. The Partner Community Capital fund supports the work of The Conservation Fund, a national nonprofit organization with a mission of advancing conservation that makes economic sense. The goal of Partner Community Capital is to address the lack of access to capital for small businesses and farms in rural communities adjacent to areas rich in natural resources. The need for such programs was identified by the Appalachian Regional Commission and West Virginia's Small Business Development Center in the early 2000s and Partner Community Capital has been working in the state ever since.

4.5.2 Programs for Supporting Institutions

In general, the programs that were directed towards supporting institutions within this category focused on enhancing water quality and quantity, improving public access to and acquiring lands across landscapes, mitigating hazards, and professional development.

4.5.2.1 Land acquisition to sustain water quality and quantity

There are a number of grants to fund programs to improve water quality and quantity through the purchase of critical lands that need to be protected. For example, in conjunction with the EPA, the Open Space Institute manages the Delaware River Watershed Protection Fund, which provides capital grants to NGOs and municipalities to purchase land and easements in order to permanently protect important watershed lands. In Maine, the Maine Community Foundation offers the Maine Land Protection grant to NGOs and municipalities for land acquisition or land conservation easement projects.

4.5.2.2 State grants support public access to parks and trails

Programs focused on improving public access often involve efforts to acquire lands across landscapes.

- The USDA NRCS Voluntary Public Access and Habitat Incentive program, for instance, provides funding to help state and tribal governments encourage landowners to allow public access to their land for hunting, fishing, and other wildlife-dependent recreation.

- In Massachusetts, the Local Acquisitions for Natural Diversity (LAND) grant program and the Parkland Acquisitions and Renovations for Communities (PARC) grant program have similar goals. While both grants assist cities and towns in acquiring and developing land for recreational purposes, the LAND grant program does so in order to establish a conservation restriction, while the PARC program does so to establish new parkland or to renovate an existing park.

- The goal of the Pennsylvania Trail grant program, under the Department of Conservation of Natural Resources, is to have a trail within 15 minutes of every Pennsylvania citizen. The DCNR's Bureau of Recreation and Conservation provides grants to support the enhancement and expansion of non-motorized and motorized trails. Trail grants are awarded through the Community Conservation Partnerships program for such projects as land acquisition, planning, construction, rehabilitation and maintenance, and the development and operation of trail educational programs.

4.5.2.3 Loans and grants to regulate present, recurring, and future hazards

Programs for mitigating hazards represent a significant portion of the programs available to supporting institutions in this category (n=43).

Mitigate existing hazards. Examples of programs that target existing hazards are the Delaware Hazardous Substance Site Cleanup Loan Program (HSSCLP), which provides loans to nonprofit organizations and businesses that are potentially responsible for site rehabilitation or brownfield developers with an executed agreement for investigating and remediating a hazardous substance release at a site. New York provides Technical Assistance Grants through the New York State Department of Environmental Conservation (DEC) that give eligible not-for-profit community groups independent technical assistance with investigation and cleanup of state Superfund and Brownfield Cleanup Program (BCP) sites that pose a significant threat to public health or the environment.

Address recurring hazards. Many programs that address recurring hazards are focused on flood and stormwater issues. The Washington D.C. Community Stormwater Solutions grant program funds activities such as educational events/workshops, the installation and maintenance of runoff-reducing green infrastructure, art installations, the restoration of habitat, litter or pollution reduction, and other projects that address stormwater issues. On a national scale, the Buzzards Bay National Estuary program provides municipal mini-grants for projects that target stormwater remediation, especially in areas whose discharge affects marine waters. It also funds wetland/open space/habitat restoration, preservation, acquisition and/or protection as well as the updating or digitizing of wetland boundaries or land elevations from wetland permits.

Hazard preparedness and maintenance. In contrast to the above programs that are mostly state focused, many programs that address hazards preparedness/maintenance often do so at the national and state levels. The FEMA Building Resilient Infrastructure and Communities (BRIC) grant program, for example, supports projects in states, local communities, tribes, and territories to reduce risks from disasters and natural hazards. The BRIC program does this through capability- and capacity-building in communities and by encouraging innovation and partnerships that enable large projects, maintain flexibility, and provide consistency. What is unique about the BRIC program is that it categorically shifts federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. In Maryland, the Community Resilience grant has similar aims. It supports and funds local communities and nonprofits in their efforts to prepare for coastal flooding, storms, and other climate change-related consequences, while enhancing community resilience and sustainability through natural, nature-based, and green infrastructure projects.

4.5.2.4 Experiential professional development builds local capacity

Programs that support ecosystem services at the landscape and systems scales may also do so by providing professional development to various supporting institutions, especially those focused on returns to landscapes and ecosystem services.

Programs for municipal officials. For example, the Rain Barrel Train the Trainer program from Rutgers Cooperative Extension provides environmental commission members, recycling coordinators, educators, Extension Master Gardeners, garden clubs, and environmental organizations with the tools to teach their communities about the environmental benefits of rain barrels. From the University of Connecticut's Cooperative Extension there is the Nonpoint Education for Municipal Officials program. Through this program, UCONN's Cooperative Extension has been working with communities to protect water quality through better land use since 1991.

Programs for public volunteers. These include programs like the University of Rhode Island's Geospatial Training Program, which offers introductory hands-on instruction in geospatial technology with potential application for environmental monitoring purposes. There are also a number of volunteer water quality programs, such as Washington D.C.'s Volunteer Water Quality Monitoring in District Waters program. Through this program the Department of Energy and Environment provides funding for a water quality citizen science program that uses volunteers to monitor water quality in the District's waterways. Through this program, funds may be used to recruit, coordinate and train volunteers, produce volunteer training materials, cover costs of monitoring supplies, analyze water samples collected by the volunteers, and generate publicly accessible online data.

4.5.3 Review of Funding/Program Opportunities

Public programs (n=344) vastly outnumber both private (n=82) and partnership programs (n=66). Among these public programs, state-level programs are most prominent (n=282).

Within these public programs, federal programs are consistently, though less robustly, represented in the sample data. Many nationwide efforts improve habitat creation/maintenance, especially as they support both coastal and inland systems. These programs fall under the auspices of the U.S. Fish & Wildlife Service, NOAA Office of Coastal Management, and the USDA's various conservation reserve and easement programs through the FSA and NRCS.

Overall, public-private partnerships are less frequent within the sample data; however, this depends largely on the scale of analysis. While public programs are more numerous at the federal and state levels, partnership programs operate most prominently across the regional scale.

- Regional consortiums, such as the Cooperative Ecosystem Studies Units (CESU) network and National Estuary programs, often overlap with watersheds and other ecological features, which by their nature function across state lines in the U.S. Northeast.

- Finance Centers also emerged as an important partner to expand the capacities of public and private stakeholders and strategically use conservation finance mechanisms.

- The small- and standard-grants programs that function as part of the North American Wetlands Conservation Act are examples of programs aimed at promoting these regional-scale partnerships. The Small Grants Program and the Standard Grants program are competitive, matching grant programs that support public-private partnerships carrying out projects that further the goals of the North American Wetlands Conservation Act. These projects must involve long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats for the benefit of all wetlands-associated migratory birds.

Private programs are slightly more represented in the data than partnership programs; however, there are still substantially fewer of them than there are public programs, regardless of scale.

- These private programs are the work of various foundations or funding networks, including most notably the Conservation Fund, Audubon International and its state chapters, and Ducks Unlimited, among others.

- Watershed organizations like Maine Lakes and NH Lakes are also important in organizing rebate programs for landowners, through their LakeSmart programs. LakeSmart is an education, evaluation, and recognition program that is free, voluntary, and non-regulatory and helps lakefront homeowners manage landscapes in ways that protect water quality. Through this program, trained volunteers perform property assessments for participating homeowners, who then receive individualized suggestions for keeping pollutants in stormwater out of lake waters. Sites that score well earn the coveted LakeSmart Award, a type of certification for houses engaging in sustainable, water quality-friendly practices.

Although less representative in this sample, privately organized regional programs offer a number of unique approaches for incentivizing ecosystem service provisioning.

- The Regional Greenhouse Gas Initiative supports the development of a CO_2 Budget Trading Program.

- The Highstead Foundation's Regional Conservation Partnership activates networks of partners concerned with conservation issues.

- The Chesapeake Bay Funders network gathers grant makers that want to develop collaborative strategies to support communities and the natural environment in the Chesapeake region.

- The Lake Champlain Basin Program offers the support and services of the U.S. Army Corps of Engineers (in-lieu of grant funding) to work on behalf of issues related to the Lake Champlain watershed.

4.5.4 Opportunities to expand market presence

Beyond the organizational breakdown of these programs, there were noticeable trends in programs that provide opportunities to expand market presence. Such opportunities centered around certification programs and conservation finance programs. These programs usually certify goods and services based on whether they are produced or delivered according to specific business practices. These certifications usually mean that the producer or provider can charge a higher price and/or attach a "certified" label to their product or service.

- The Green Business Certification from Green America and the Green Business Certification program from the Maryland Department of Environmental Protection encourage lodging facilities, restaurants, grocers and other businesses to implement specific green initiatives.

- Other notable programs in this category include the Best for DMV program, which aims to rapidly expand the number of businesses in the Washington D.C., Maryland, and Virginia area that incorporate social and ecological impacts into their business models.

Apart from these certification programs, there are also a number of conservation finance programs, including green banks, revolving loans, and investment funds, among others. Unlike certification programs, which incentivize certain practices, these programs provide mission- or value-driven financing to entities that want to generate profit and provide returns to natural resources and ecosystems.

- The New York Green Bank and the D.C. Green Bank use public funding to attract private investment for green energy systems across their respective regions.

- The Rural Maryland Prosperity Investment Fund (RMPIF) provides funding to raise the overall standard of living in rural areas and support sustainable rural development objectives.

4.6 SUMMARY BY REGION AND STATE

4.6.1 Areas of regional significance

This section summarizes programs that cross multiple state boundaries, with focus on food production, watershed improvements, and technical assistance/job training. Each value and color gradient in the maps signifies the number of times a state was identified as part of a multi-state program and does not represent frequencies of programs between neighboring states.

4.6.1.1 Programs for food production

Across programs evaluated for this database, the greatest number of multistate, regional programs support the production of food and feed (n=24 total, Figure 14 and Table 7). Most of these programs are based in New England, with slightly more programs in southern New England (Connecticut, Massachusetts, and Rhode Island) than northern New England states (Maine, New Hampshire, Vermont).

Figure 14. Multistate programs that support the production of food and feed, with the greatest concentration in southern and central New England.

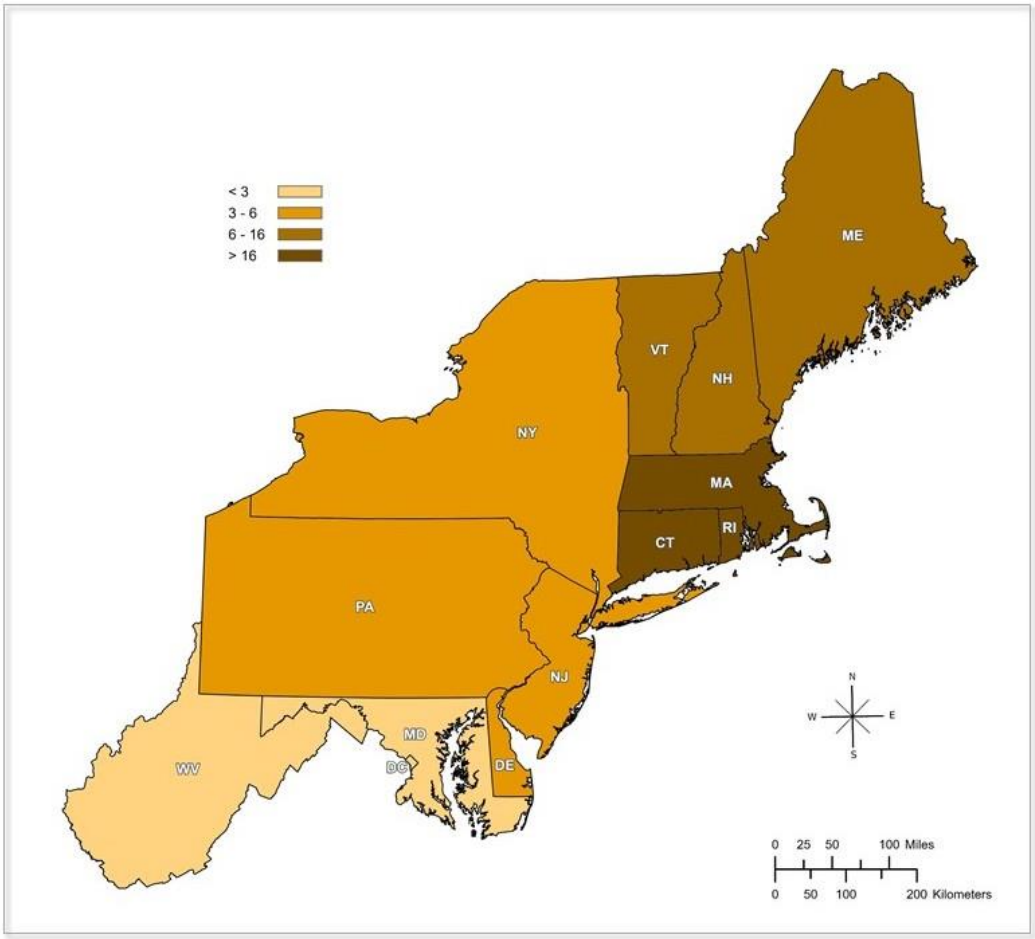


Table 7 Regional Programs for Food Production

Organization	Program	States
American Farmland Trust	Farms for the Future	ME, NH, VT
Conservation Law Foundation	Legal Food Hub	CT, ME, MA, NH, RI, VT
East Coast Shellfish Growers Association	Industry Resources	CT, DE, ME, MA, NH, NJ, NY, PA, RI, VT
Equity Trust	Farm preservation resources	CT, ME, MA, NH, RI, VT
Equity Trust	Urban Ag technical assistance	CT, ME, MA, NH, RI, VT
Equity Trust	Technical Assistance	CT, ME, MA, NH, RI, VT
Farm Credit East	Young, Beginning, Small and Veteran Farmer Incentive program (YBSV)	CT, ME, MA, NH, MJ, NY, RI
Farm to Institution New England	New England Healthy Food in Health Care	CT, ME, MA, NH, RI, VT
Food Export	Seafood Program	CT, DE, ME, MA, NH, NJ, NY, PA, RI, VT
Food Export	Market Entry Program	CT, DE, ME, MA, NH, NJ, NY, PA, RI, VT
Future Harvest - Chesapeake Alliance for Sustainable Agriculture	Beginner Farmer Training Program	DE, DC, MD, PA, WV
Land for Good	Farm Legacy Program	CT, ME, MA, NH, RI, VT
Land for Good	Farm Seekers Program	CT, ME, MA, NH, RI, VT
National Association of Resource Conservation & Development Councils	USDA StrikeForce Rural Growth and Opportunity Initiative	CT, MA, MD, NJ, PA, WV
New England Farm Link Collaborative	New England Farmland Finder	CT, ME, MA, NH, RI, VT
New England Small Farm Institute	On Farm Mentors	CT, ME, MA, NH, RI, VT
New England Small Farm Institute	New England Landlink	ME, NH, VT, MA, CT, RI
Northeast Organic Farming Association	Organic No-till on Northeast Farms: A Practical Exploration of Successful Methods	CT, MA, NJ
Northeast Organic Farming Association	NOFA Cost of Production Project	MA, NH, VT
The Carrot Project	One-on-One Coaching	CT, MA, RI
The Carrot Project	Business Consulting	CT, MA, RI
U.S. Department of Agriculture (USDA)	Tri-State SARE Project	CT, MA, RI
Vermont Law School	Farm to Institution Policy Project	CT, ME, MA, NH, RI, VT

4.6.1.2 Interstate watershed improvement programs

Across programs evaluated for this database, additional multistate, regional programs support a variety of water quality, quantity, and watershed-related issues (n=19 total, Figure 15 and Table 8). Most of these programs are based in Pennsylvania and New York, followed by states of the southern Mid Atlantic.

Figure 15. Multistate programs that support watershed improvement programs, predominantly in New York and Pennsylvania

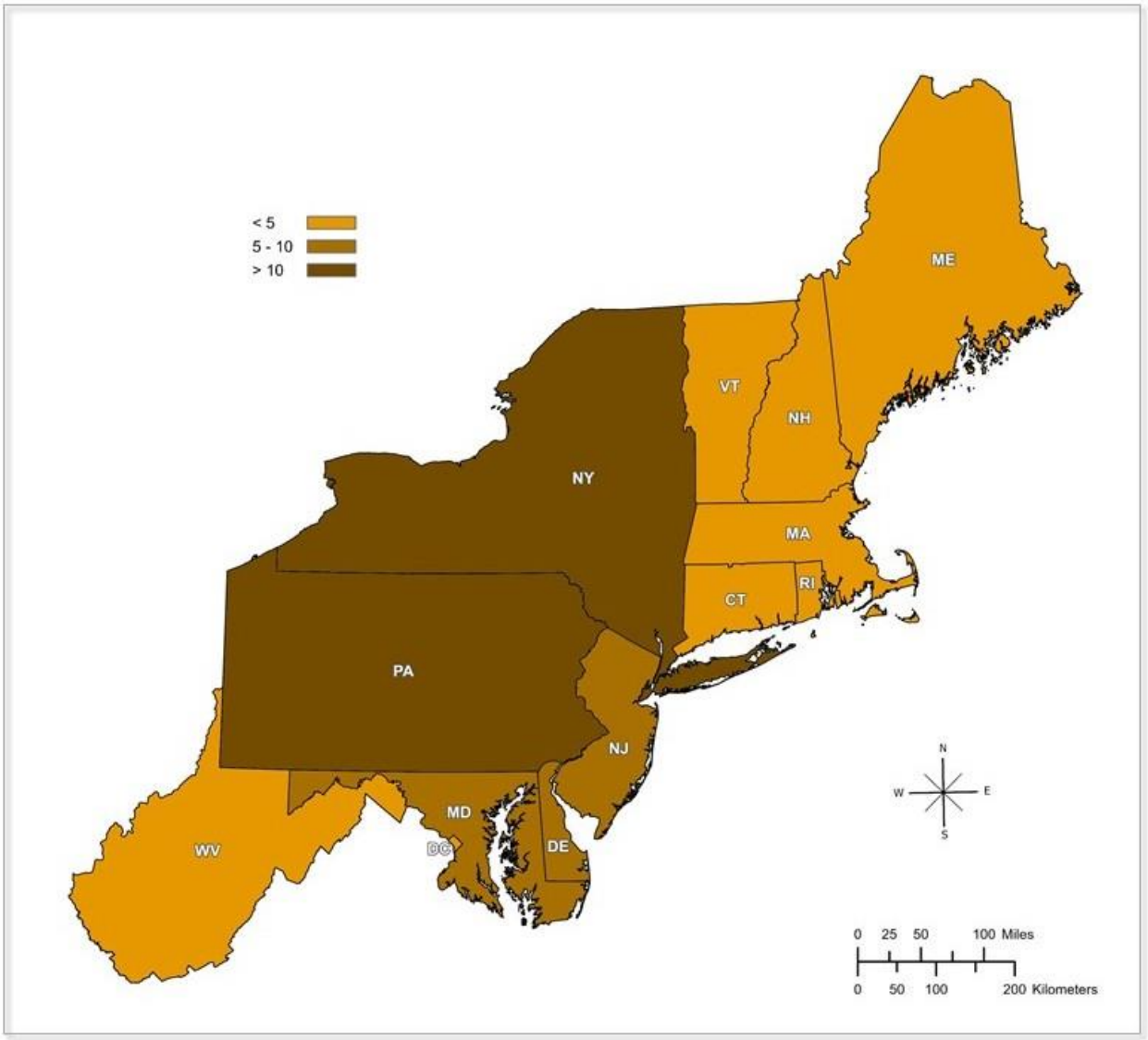


Table 8. Regional Programs for Watershed Improvement

Organization	Program	States
Chesapeake Bay Funders Network	Urban Waters Work Group	DE, DC, MD, NY, PA, WV
Chesapeake Bay Program	Chesapeake Bay Small Watershed Grants Program	DE, DC, MD, NY, PA, WV
Chesapeake Bay Trust	Goal Implementation Team Project Initiative	DE, DC, MD, NY, PA, WV
Coalition for the Delaware River Watershed	Partnership Program	DE, NJ, NY, PA,
CoBank	Rural Water and Wastewater Lending	CT, DE, ME, MD, MA, MD, NH, NJ, NY, PA, RI, VT
Environmental Protection Agency (EPA)	Great Lakes Grant Programs	NY, PA
Environmental Protection Agency (EPA)	Pilot Watershed Initiative	MA, RI
Environmental Protection Agency (EPA)	Urban Waters Partnership Program	DC, MD, NJ, NY, PA
Fish and Wildlife Service (USFWS)	Delaware River Restoration Fund	DE, MD, NJ, NY, PA
Fish and Wildlife Service (USFWS)	Delaware Watershed Conservation Fund	DE, MD, NJ, NY, PA
Interstate Commission on the Potomac River Basin	Partnership program	DC, MD, PA, WV
Lake Champlain Basin Program	Watershed Environmental Assistance Program	NY, VT
Multiple federal agencies and research institutions	CESU Chesapeake Watershed	DE, MD, NY, PA
multiple federal agencies	Great Lakes Restoration Initiative and Task Force	NY, PA
Open Space Institute	Delaware River Watershed Protection Fund	NJ, NY, PA
Partnership for the Delaware Estuary	Delaware Estuary Program	DE, NJ, PA
The Association of National Estuary Programs	Narragansett Bay Estuary Program	MA, RI
University of Delaware	Brandywine-Christina Revolving Water Fund (the "Water Fund")	DE, PA
URI Cooperative Extension	New England Onsite Wastewater Training	CT, ME, MA, NH, RI, VT

4.6.1.3 Technical assistance and job training programs

Across programs evaluated for this database, a fewer number of multistate, regional programs directly support technical assistance and job training (n=10 total, Figure 16 and Table 9). The geographic spread of these programs concentrates in southern New England states and Maryland, followed by its neighboring states.

Figure 16. Multistate programs that support technical assistance and job training, centering in and around Maryland, Massachusetts, and Rhode Island

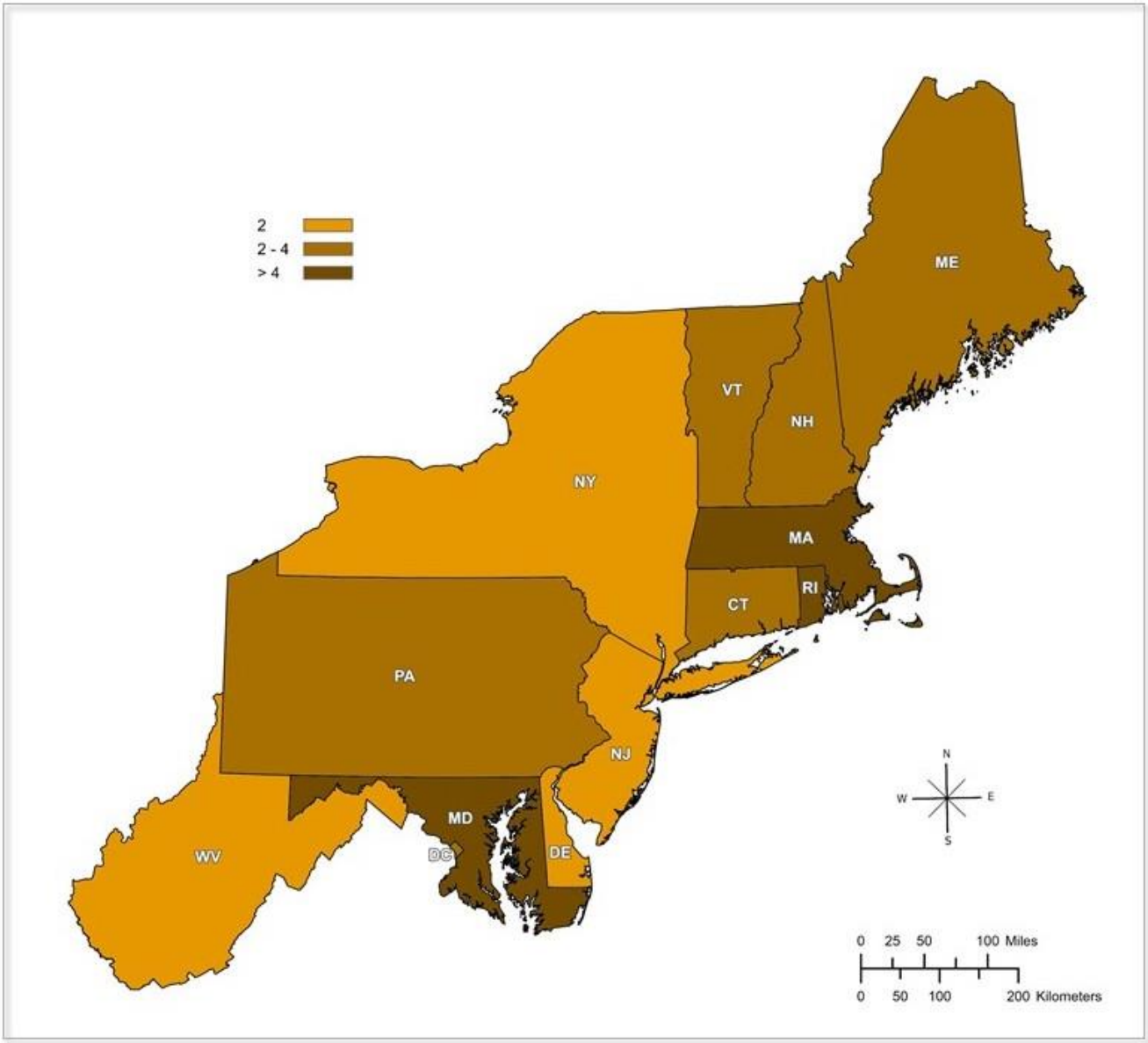


Table 9. Regional Programs for Technical Assistance and Job Training

Organization	Program	States
Alliance for the Chesapeake Bay	Woodland Stewardship Networks	MD, PA
Bethesda Green	Best for DMV	DC, MD
Cornell Cooperative Extension	Network for Environment and Weather Applications	CT, DE, DC, ME, MD, MA, NH, NJ, NY, RI, VT
Environmental Finance Center at the University of Maryland	Assorted Programs and Projects	DE, DC, MD, PA, WV
Farm to Institution New England	Farm Corrections Program	CT, ME, MA, NH, RI, VT
National Association of Resource Conservation & Development Councils	Train Tomorrow's Leaders	CT, MD, MA, NJ, PA, WV
New England Environmental Finance Center at the University of Southern Maine	Assorted Programs and Projects	CT, ME, MA, NH, RI, VT
Southern New England Program Network	Southeast New England Program Network Technical Assistance Program	MA, RI
Southern New England Program Network	Southeast New England Program Network Liaison Assistance	MA, RI
U.S. Department of Labor	Workforce Opportunity for Rural Communities (WORC)	MD, NY, PA

4.6.2 State Summaries

The programs evaluated in this report can be viewed as a digital database, hosted by the Extension Foundation. The following states and district are included in the database.

Connecticut
Delaware
District of Columbia
Maine
Maryland
Massachusetts
New Hampshire
New Jersey
New York
Pennsylvania
Rhode Island
Vermont
West Virginia

Part 5: Conclusions and Recommendations

In the coming decades, the production of material goods from working landscapes in the U.S. Northeast will be subject to increasing impacts of climate change, which will further undermine working lands production in a region already suffering from a declining working landbase and decreasing regional self-reliance (Griffin et al. 2015). In such a context, the role of Cooperative Extension and Agricultural Experiment Stations will become even more essential in helping landowners adopt practices on working lands in ways that not only help them to navigate rising uncertainty, but also to help mitigate these impacts and sustain their livelihoods. As research indicates "[a]gricultural extension services, both public and private, have been shown to have a positive impact on program adoption rates; Connecting these programmes with national extension systems can result in a significant change in agricultural sustainability" (Piñeiro et al. 2020).

The following discussion grounds this assessment to parallel conversations and industry trends that affect the provisioning of ecosystem services on working lands in the U.S. Northeast. The following section details these findings in light of the four goals of this research project, namely:

- Increase farm profitability and sustainability.
- Position agriculture as a primary leader in mitigating climate change.
- Build resiliency of rural and urban communities.
- Increase the appeal of agricultural professions to a wide range of young people.

Conclusion 1: Producers and land managers operate according to the "safety-first" principle and are often risk-averse. In order to be successful, practices and programs must sufficiently and sustainably offset these risks in concrete ways.	
Recommendation 1.1	*Balance long-term ecological considerations with short-term economic returns by avoiding tradeoffs and diversifying direct and indirect incentives.*
Recommendation 1.2	*Focus on programs that promote ecosystem service provisioning at smaller-scales (e.g. the household, farm, or community) to illustrate value, ensure long-term sustainability and maintain local stakeholder buy-in.*
Conclusion 2: Programs are structured to either incentivize a single ecosystem service or multiple layered services. There are strengths and weaknesses to either approach. Project design should account for those strengths and weaknesses as well as the potential to scale practices from individual farms to multifunctional landscapes.	
Recommendation 2.1	*Conduct an expert-panel of the strategic ecosystem services priorities for the region and compare to IPBES priorities for the Americas to assess gaps and opportunities for cross-scalar synergies.*
Recommendation 2.2	*Ecosystem service provisioning programs are unequally accessible and the benefits that derive from them unequally felt and experienced based on existing social and economic disparities. It is important to consider not only the impacts of programs on ecosystem services, but also their impacts on equity.*

Conclusion 3: Very few programs reviewed in this assessment directly address resilience and even fewer address resilience beyond the farm-scale. Programs focused on resilience, especially as it functions across scale and between urban and rural areas, should be a priority going forward.	
Recommendation 3.1	*Identify the indicators of resilience (e.g., for who, by who, for what, over what time) at various scales and for various stakeholders across the U.S. Northeast.*
Recommendation 3.2	*Evaluate the impact of regional consortia and the role of existing governance and institutional structures, especially conservation districts and higher education.*
Conclusion 4: Ecosystem service provisioning programs for young and beginner farmers, while important, may not be enough to entice young people into working-lands related careers. Programs that couple ecosystem service provisioning with incentives that directly support livelihood provisioning such as cash-in-hand (basic income), land access/acquisition, free education/professional development, and healthcare, may help.	
Recommendation 4.1	*Evaluate the regionally-specific factors inhibiting youth from working lands careers in the U.S. Northeast with a particular eye to issues of land tenure, healthcare, and higher education.*
Recommendation 4.2	*Evaluate the role of cash-transfer and basic income programs to supplement conventional, market-based systems.*

5.1 INCREASING FARM PROFITABILITY AND SUSTAINABILITY

Conclusion 1: Producers and land managers operate according to the "safety-first" principle and are often risk-averse. In order to be successful, practices and programs must sufficiently and sustainably offset these risks in concrete ways.

Across production scales, but especially, for small-scale producers and managers to whom margins are thin and market conditions often volatile, the provisioning of ecological services cannot come at the expense of economic profitability. Working lands producers are inherently risk-averse, meaning they operate according to what James Scott (1973) calls the "safety-first principle," whereby the livelihood subsistence must first be guaranteed—whether directly, through on-farm production/consumption or indirectly, through income-generating activities—before risk-taking activities, such as changing practices or implementing new technologies, can be justified. This logic can be seen at play in the contemporary research on ecosystem services provisioning programs, which incentivize innovative practices that, while potentially ecologically beneficial in the long term, are nevertheless not economically risk-neutral. According to Piñeiro et al. (2020), "Regardless of the incentive type, adoption rates are higher when programmes offer short-term economic benefits [rather] than those solely aimed at providing a positive ecological outcome."

In thinking about programs to incentivize ecosystem service provisioning, this fundamental risk-averse disposition must be taken into consideration, a reality that holds especially true in the context of rising climatic and economic uncertainty. Effective programs with innovative practices may fail to get producer buy-in if they do not offer incentives that sufficiently offset the economic risks inherent in changing working lands practices. At the same time, once practices have been implemented, these programs must also provide continuing incentives that are reliable and oversight that is reasonable in order to expect new practices to translate into returns to the environment. Programs that are not funded adequately or consistently or are subject to arduous oversight may still create initial buy-in but fall short of making sustainable differences in ecosystem service provisioning in the long term.

Recommendation 1.1 *Balance long-term ecological considerations with short-term economic returns by avoiding tradeoffs and diversifying direct and indirect incentives.*

- **For Cooperative Extension:** Connect working lands producers and managers with a variety of potential incentive programs and facilitate participation in these programs through education, technical assistance, and labor-/cost-sharing efforts.
- **For Agricultural Experiment Stations:** Investigate the ecological and economic trade-offs in a particular region to better understand how incentive structures may affect different producers differently in this context.

With many ecosystem services, the ecological benefits derived from changing working lands practices are often part of longer-term processes that are temporally at odds with the seasonal economic cycles experienced by producers. To bridge this gap, policies and programs should be developed that allow working lands producers to avoid trade-offs between short-term economic profitability and ecosystem service provisioning and long-term ecological benefits. Put another way, these programs incorporate risk aversion into the programmatic scope and aim to alleviate risk directly before incentivizing potentially risky changes in decision making and in practice.

To do this, it may be constructive to combine and offer compounded incentive programs in tandem. While direct and indirect incentives both are important in the context of improving ecosystem services, from the perspective of maintaining working lands profitability and the sustainability of management practices, direct incentives can be more effective. Programs that offer indirect incentives, such as technical education or assistance, are valuable in providing training, shifting values, and sharing knowledge but may have less to offer farmers concerned with economic profitability. By combining them in innovative ways, however, the benefits of both might be leveraged.

This might entail, for example, targeting a specific type of agricultural industry with a year-long campaign of federal-level easement purchase programs (direct incentive) along with state-level tax credits (indirect) and NOFA technical education (indirect). It might also entail the introduction of a federal-level PES program on private forestland coupled with state-level technical assistance to help monitor and document ecosystem services production. There are a number of ways to couple direct and indirect incentive structures to avoid the trade-offs that naturally arise through either incentive type alone. Researching and exploring these possibilities is an interesting avenue for future efforts.

Recommendation 1.2 *Promote ecosystem service provisioning at smaller scales (e.g., the household, farm or the community) to illustrate value, ensure long-term sustainability, and maintain local stakeholder participation.*

- **For Cooperative Extension:** Work closely with working lands managers and producers to develop comprehensive economic and ecological sustainability plans at 1-year, 10-year, and 25-year intervals.

- **For Agricultural Experiment Stations:** Research how to (i.e., what types of ecosystem services, producers, and incentives will) best scale up ecosystem service provisioning programs to achieve changes at the landscape scale and beyond.

Balancing long-term and short-term goals is one challenge of implementing ecosystem service provisioning programs in the U.S. Northeast. A related challenge is the need to ensure sustainable stakeholder buy-in and commitments to new practices after program windows close and active incentives cease. To do this, it is essential that working lands producers not only derive economic benefit from these programs, but also that they see the effects of these programs in a way that is local and tangible and worthy of the investment of time. According to Piñeiro et al. (2021), "it seems that one of the strongest motivations for farmers to adopt and maintain sustainable practices is the perceived positive outcomes of these practices for their farm or the environment."

Viewed from this perspective, certain programs like carbon credit markets or offset trading, for example, might sound good in the abstract, but on the ground, they mean very little to producers and landowners who do not see the effects on their lands or in their communities. Other programs, especially those that are more locally focused and that address not only ecological returns but also social and economic ones, hold greater potential for achieving long-term results through higher adoption rates. For small-scale producers and landowners, in particular, who as discussed are inherently risk-averse, direct incentives may help offset the risks of initial buy-in. Long-term sustainability, however, will be attained only through programs and practices that demonstrate value through improved ecosystem services delivery at a scale that is accessible and meaningful to these same producers and their livelihoods.

5.2 POSITIONING AGRICULTURE AND FORESTRY AS PRIMARY LEADERS IN MITIGATING CLIMATE CHANGE

Conclusion 2: Programs are structured to incentivize either a single ecosystem service or multiple layered services. There are strengths and weaknesses to both approaches. Project design should account for those strengths and weaknesses as well as for the potential to scale practices from individual arms to multifunctional landscapes.

Programs that are designed to promote a single ecosystem service can be quite effective at creating measurable environmental changes at the farm scale, especially when these programs are paired with the appropriate incentive structure. However, the utility of such programs is limited, as improvements in specific metrics for a single ecosystem service do not necessarily translate to improvements in other ecosystem services or their provisioning across a landscape. As Bennett, Peterson & Gordon (2009) explain, "[e]cosystem management that attempts to maximize the production of one ecosystem service often results in substantial declines in the provisioning of other ecosystem services." Put another way, there are trade-offs between services and scales that are inherent in the structure of provisioning programs, regardless of whether these programs focus on discrete practices and services or on more diversified sets of practices and services.

Through the lens of landscape multifunctionality, it is possible to envision different programs operating at different scales in order to improve ecosystem service provisioning across the landscape. Single owners of large tracts of working forests, for example, may be more enticed by the types of carbon sequestration programs that are available only to large acreages. At the same time, farmland-adjacent riparian areas with many landowners may be better suited for material-based incentive programs that improve pollution interception, wildlife habitat, and flood surge, among others. This is just one example. Determining the appropriate mix of services and scales for improving provisioning across particular working landscapes is a research challenge across the U.S. Northeast. In order to do this, new kinds of scientific thinking and institutional arrangements are required that encourage multiscalar thinking and cross-boundary collective action among landowners, resource managers, and policy makers (Rickenbach et al. 2011).

Recommendation 2.1 *Convene an expert panel about the strategic ecosystem services priorities for the region and compare to IPBES priorities for the Americas to assess gaps and opportunities for cross-scalar synergies.*

- **For Cooperative Extension:** Work closely with working lands managers and producers to conduct household- and farm-level needs assessments that incorporate economic, social, and ecological dimensions to better understand vulnerabilities as well as opportunities for future programmatic efforts.

- **For Agricultural Experiment Stations:** Integrate ecosystem services needs assessments conducted at various scales, from the household to the community to the state, to better understand needs and priorities in particular regions as well as the possible synergies among them and across scales.

One way to position working land production as a leader in climate change mitigation would be to conduct an ecosystem services needs assessment to allow for more strategic targeting of ecosystem services provisioning programs and policies at multiple scales. Further studies should build from the database created for this landscape assessment to further catalog which specific ecosystem services and practices are being invested in. Such a study should investigate trends in investment data—who has been awarded grants or has received direct/indirect incentives to accomplish what. Many organizations and levels of government have begun this type of work and have their own agendas and priorities in this regard. Cooperative Extension and Agricultural Experiment Stations, however, might be able to take a broader, multi-scalar perspective on this work with the effect of reconciling these disparate agendas while also contributing their own.

Research in this area might consist of impact assessments of recent programming to see current trends and where potential gaps may lie. This work could then be compared with expert perspectives such as those from the IPBES, as laid out in the table on the next page (Figure 17), which show such trends and their relative importance across the Americas. The graphic below reveals the trajectories of nature's contributions to people (NCPs), the IPBES analogue to ecosystem services, as well as the services' relative importance in the context of climate change. A new research agenda for Agricultural Experiment Stations and Cooperative Extension networks might begin to ask whether these larger trends hold true across the U.S. Northeast, or more specifically, within particular states or other geographically meaningful boundaries. This might help identify gaps in current programming as well as specific producers/landowners and geographic areas of highest concern.

Figure 17. IPBES Trends and Trajectories of Nature's Contributions to People (NCPs) and Units of Analysis Relevant to the U.S. Northeast

Trends and importance values are based on a modified Delphi process* to build consensus, as indicated by synthesis among experts from Chapters 2 and 3. Values were assigned based on the proportion of the unit of analysis that has not been converted by human activities. Squares without arrows indicate that there is no clear link [or trend] between nature's contributions to people for that category and the corresponding unit of analysis. (Note: the cryosphere is not considered in this analysis.)

	MATERIAL NCP				NON-MATERIAL NCP			REGULATING NCP										
UNIT OF ANALYSIS	Food and Feed	Materials and assistance	Energy	Medicinal, biochemical and genetic resources	Learning and inspiration	Supporting identities	Physical and psychological experiences	Maintenance of options	Climate regulation	Regulation of freshwater quantity, flow and timing	Regulation of freshwater and coastal water quality	Regulation of hazards and extreme events	Habitat creation and maintenance	Regulation of air quality	Regulation of organisms detrimental to humans	Pollination and dispersal of seeds and other propagules	Regulation of ocean acidification	Formation, protection and decontamination of soils and sediments
Tropical and subtropical moist forest	↘	→	↗	↗	→	→	→	↘	↓	↘	↘	↘	↓	→	↓	↘	↘	↓
Tropical and subtropical dry forest	↓	↘	→	↗	→	↘	→	↓	↓	↓	↘	↘	↓	↘	↘	↘	→	↘
Temperate and boreal forests and woodlands	↘	→	→	→	→	↘	→	↘	↘	↘	↘	→	↘	→	→	↘	↘	↘
Mediterranean forests, woodlands and scrub	↘	↘	↘	↘	→	→	→	↓	↓	↓	↘	↓	↘	→	↘	↓	→	↓
Tundra and high montane habitats	↘	→	↓	↘	→	↘	→	↓	↓	↘	↘	↓	↓	→	↘	→	↘	↘
Tropical and sub-tropical savannas and grasslands	↘	↘	↘	↗	→	→	→	↓	↘	↘	↘	↘	↘	↘	↘	↘	→	↘
Temperate grasslands	↘	↘	↘	→	→	→	→	↓	↘	↘	↘	→	↘	↘	↘	↘	→	↘
Drylands and deserts	↘	↘	↘	→	→	↘	↘	↘	→	↘	↘	→	↘	→	→	↘	→	↘
Wetlands – peatlands, mires bogs	↓	↘	↘	→	↗	→	→	↘	↓	↓	↓	↘	↓	↘	↘	↘	↘	↘
Inland surface waters and water bodies / freshwater	↘	→	↗	↘	→	↘	→	↓	↓	↓	↓	↓	↓	→	↓	↘	→	↓
Coastal habitats and nearshore marine	↓	→	→	↘	→	→	→	↘	↓		↓	↘	↓	→	↓	↘	↘	↘
Marine/ deepwater/ offshore systems	↘	→	→	↘	→	↘	→	↘	→		↓	↘	↘	→	→		↓	→
Urban areas	→	→	→	↘	↗	↗	↗	↘	↘	↓	↓	↓	↘	↓	↘	↓	↘	↓
Agricultural, silvicultural, aqua-cultural systems	↑	↑	↑	→	↘	↘	→	→	↓	↓	↓	↘	↓	→	↘	↓	↓	↓

* The Delphi method is a structured and iterative evaluation process that uses expert panels to establish consensus regarding the assessment of a specific topic.

Importance of unit of analysis for delivering each nature's contribution to people

Very High | High | Medium High | Medium | Medium Low | Low | Very Low

Direction of change in provision of each nature's contribution to people

↑ Strongly Increasing ↗ Increasing → Stable ↘ Decreasing ↓ Strongly Decreasing

Recommendation 2.2 *Programs to provision ecosystem services are differentially accessible. Ecosystem services themselves impact communities differently. It is important to consider not only the effects of programs on ecosystem services but also their effects on equity.*

- **For Cooperative Extension:** Develop outreach and educational programs and provide resources that are designed for traditionally marginalized and disenfranchised groups, particularly people in the BIPOC community, LGBTQI+ community, and the landless.

- **For Agricultural Experiment Stations:** Investigate disparities not only in the effects of ecosystem service provisioning but in who has access to programs that promote it to better understand these inequities and develop programs capable of addressing them.

In one sense, improving climate change mitigation on working lands is an ecological challenge, one that is centered on the need to improve ecological functions across working landscapes. In another sense, , improving climate change mitigation is also a socio-economic challenge, one that forces us to focus not just on the social and economic dimensions of ecological services, but also on the unequal vulnerabilities and discrepancies that exist within these same working landscapes. These inequalities manifest in not only who has access to the programs and policies being implemented, but also in how ecosystem service provisioning is felt and experienced and who benefits the most from this provisioning. This dynamic points to trade-offs and potential synergies that often arise in ecosystem service programs between the equity and efficiency of different schemes or incentive structures to improve provisioning on working lands (see Loft et al. 2019).

According to Pascual et al. (2014), while payments for ecosystem service schemes are often portrayed as being more efficient, this efficiency is sometimes at odds with a more comprehensive understanding of social and equity considerations. To some extent, resolving this tension is beyond the scope of any single program or policy. The design of individual programs still needs to consider how to best achieve the ecosystem service goals of that particular project as well as the structures or incentives that are needed to do so. But as an increasing number of scholars make clear, equity considerations are an essential component of designing ecosystem service provisioning programs that are capable of addressing the social, economic, and ecological dimensions of ecosystem services (McDermott et al. 2012).

In this assessment, a number of innovative and interesting programs addressed issues of equity in programs for ecosystem service provisioning. At the national level, the non-profit Agrarian Trust runs a number of programs to help farmers and land-based organizations by focusing on issues of land tenure, reparative justice, and regenerative agriculture. At the regional level, the organization Land For Good offers the Working Lands Program, which helps non-farming landowners bring land into agriculture to improve community food systems, increase access to farmland, and address land stewardship goals. At the state level, the Connecticut Department of Agriculture offers the Farm Viability Grant for supporting institutions that focus on issues of equity, urban agriculture, and farmland accessibility. In the broader scheme of ecosystem services policies and programs in the U.S. Northeast, greater focus and attention is needed on the importance of equity in addressing not only the ecological dimensions of ecosystem services provisioning but the social and economic dimensions, as well.

5.3 BUILDING RESILIENCY OF RURAL AND URBAN COMMUNITIES

Conclusion 3: Very few programs reviewed in this assessment directly address resilience, and even fewer address resilience beyond the farm scale. Programs focused on resilience, especially as it functions across scale and between urban and rural areas, should be a priority.

The concept of resilience is most generally defined as "the ability of a system to sustain itself through change via adaptation and occasional transformation" (Magis 2010). Recent work on community resilience in urban and rural areas has taken an integrated approach, pointing to important social, ecological, economic, and cultural dimensions that must be taken into consideration when thinking about climate change adaptation and transformation, especially at the local, community scale (Berkes & Ross 2013). From this perspective, community resilience can be defined as the "existence, development and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability and surprise" (Magis 2010).

As this definition highlights, resilience thinking is important not only in light of sudden disruptions, as in the case of a natural disaster, but also in the context of rising uncertainty and unpredictability as a result of lingering factors, including climate change, economic precarity, and others. Planning for and building resilience into institutions, programs, and policies is an essential part of confronting the multi-pronged challenges that working lands will face in the coming decades. While there were few programs in this assessment that explicitly dealt with questions of community resilience, those that do deserve to be mentioned, as they provide models for expanding upon or introducing new programs that prioritize ecological, community, and individual/business resilience.

<u>National level</u>

- *Urban and Community Forestry program* (US Forest Service):
    - This program supports forest health through an integrated approach that creates jobs, contributes to vibrant regional wood economies, enhances community resilience, and preserves the unique sense of place in cities and towns of all sizes.

<u>Regional level</u>

- *Community Resilience Building workshop* (The Nature Conservancy, The Hudson River Watershed Alliance):
    - This program is a one-day, community-driven, and participatory workshop focused on improving local adaptation to flooding and other climate change consequences.

<u>State level</u>

- *Community Resilience Grants* (Maryland Department of Natural Resources):
    - This program provides grants and financial support to prepare communities for climate change-related events in Maryland.
- *Farmer Resilience Grants* (Northeast Organic Farmers Association [NOFA]):
    - This program provides grants to farmers to support activities that enhance resilience with the understanding that a more resilient local food system contributes to overall community resilience.

From this brief review, it is clear that while there are important steps being taken to include resilience planning into policy and programming at various scales, there is still much work to be done. This is a crucial gap to be addressed in the U.S. Northeast, especially as broader questions of community resilience intersect with questions about the resilience of agricultural systems, forests, and working lands. Ultimately, as within all coupled socio-ecological systems, these different forms of resilience are interlinked. In that sense, not only does resilience thinking need to feature more prominently in policy and programming, but attention must be paid to how these various forms of resilience relate to each other and collectively produce more resilient, multifunctional landscapes, more broadly.

Recommendation 3.1 *Identify the indicators of resilience (e.g., for whom, by whom, for what, over what time period) at various scales and for various stakeholders across the U.S. Northeast.*

- For Cooperative Extension: Working closely with working lands managers and producers, develop resilience strategies at the household and farm scales that address the multiple, intersecting dimensions of resilience, especially economic, ecological, social, and climatic resilience. [Note: these efforts can be linked with the development of sustainability plans as discussed in recommendation 1.2]
- For Agricultural Experiment Stations: Research how different forms of resilience (e.g. social, economic, ecological, climatic) relate across scale (e.g. household, farm, community, region, watershed) to better understand what kinds of ecosystem service provisioning programs might be most effective and at what scale.

To really begin to grapple with resilience for a diversity of stakeholders at the community scale, critical questions need to be asked about exactly what and/or who is being made resilient and in what way are they being made resilient (Cutter 2016; Meerow & Newell 2019). Put another way, if the goal is to make working landscapes more resilient, one set of practices or programs might be necessary, but if the goal is to make communities resilient, that might entail an entirely different set of practices and policies. Also inherent in this question are important issues of scale: at what scale can a community be made resilient? How does the resilience of one community relate to the resilience of another or the resilience of urban areas relate to the resilience of rural areas? How does the resilience of a community relate to the resilience of states, regions, or even of the U.S. Northeast as a whole?

Addressing these questions from a scholarly perspective is a potentially important and ambitious research agenda for the coming decades. From a practical perspective, these ideas can begin to be put into practice by increasing the emphasis on and funding of resilience considerations in ecosystem service programs and policies. To accomplish this, it is necessary to identify and evaluate the indicators of resilience at various scales and for various stakeholders. Echoing some of the concerns from the previous sections, this would also oblige these programs and policies to engage with issues of equity among different stakeholders as well as issues of scalability, from individual landowners to communities to working landscapes.

Recommendation 3.2 *Evaluate the effect of regional consortia and the role of existing governance and institutional structures, especially conservation districts and higher education.*

- **For Cooperative Extension:** Increase programmatic engagement between working lands managers/producers and local organizations interested in ecosystem service provisioning, especially higher education (land grant universities), Cooperative Extension, and county conservation districts. Explore the potential for cross-collaboration within this more localized institutional space.

- **For Agricultural Experiment Stations:** Explore possibilities for increased engagement with local communities through citizen science, volunteering, and environmental monitoring to improve local knowledge production. Consider pairing this community work with direct incentives, such as in-cash payments, to offset time and labor investments of and appeal to participating individuals.

Building community resilience in urban and rural areas is not only a programmatic and policy challenge, but an institutional one, as well. Just as the programs reviewed tend to focus on a single ecosystem service, private and public institutions tend to focus on one specific scale of intervention. Improving ecosystem service provisioning across landscapes requires new kinds of thinking and institutional arrangements that encourage multiscalar thinking and cross-boundary collective action among landowners, resource managers, and policy makers (Rickenbach et al. 2011). We detail a number of institutional arrangements and potential institutional partners that are well suited to pursuing such multiscalar thinking and cross-boundary action below.

The first type of arrangement is public-private partnership, which typically entails a consortium of public and private stakeholders organized around shared interests. This assessment showed that these partnership

consortia were most prevalent at the regional scale. In addition, many of these efforts come in the form of watershed protection groups or programs (e.g., the Watershed Agricultural Council, the Delaware Watershed Conservation Fund, or the Chesapeake Watershed Cooperative Ecosystem Studies Unit), which target not only a variety of ecosystem services, but do so across a landscape matrix that spans the rural-urban divide. Such efforts are notable in that they are potentially more adept at achieving a landscape perspective on how to address a set of ecosystem services simultaneously. Researching the efficacy of regional public-private partnerships when compared to public or private programs alone might be one interesting avenue for future research and may be used as a model for future watershed and non-watershed related work.

Another institutional framework of interest in regards to multiscalar thinking and cross-boundary action is that of county conservation districts. County conservation districts, which cover nearly all states and municipalities, can implement programs and practice at a local level and bridge the gap between communities and larger scales of governance. Not only do conservation districts have a longstanding history of working with producers and landowners at the local scale, they also have a unique socio-political history, which dates from another era of socio-ecological crisis in U.S. history, namely the Dust Bowl. Exploring and leveraging the institutional framework and unique capabilities of county conservation districts in implementing ecosystem service programs and policies is important.

Last, the land grant university system, Agricultural Experiment Stations, and Cooperative Extension programs—as regional partners with pre-existing state, multi-state, and regional collaboration structures in place—are vital institutional partners for achieving improved multiscalar thinking and cross-boundary action. Extension services and the educational institutions in which they are embedded are often the source of not only new practices regarding the management and production on working lands, but they are also a source of new knowledge of and thinking about working lands. In this sense, the land grant university system and higher education in general have a crucial dual role to play in developing research and implementing programs to improve ecosystem service provisioning on working lands across the U.S. Northeast.

5.4 INCREASING THE APPEAL OF AGRICULTURAL PROFESSIONS TO A WIDE RANGE OF YOUNG PEOPLE

Conclusion 4: Ecosystem service provisioning programs for young and beginner farmers, while important, may not be enough to entice young people into working lands-related careers. Programs that couple ecosystem service provisioning with incentives that directly support livelihood provisioning such as cash-in-hand (basic income), land access/acquisition, free education/professional development, and health care, may help.

Another challenge for working lands comes from the need to increase the appeal of working lands careers as a profession to a wide range of young people. Such a challenge is not new for the sector, which for years has struggled with a declining number of farms, producers, and landowners, as well as with issues of farm succession and farmland preservation. In the context of a changing climate and precarious economic realities (see Kalleberg 2018), however, such a challenge becomes even more complex. Addressing this problem will require policy and programmatic solutions that allow farmers, young and old, to navigate the increasing uncertainty of agriculture as a profession. Put another way, the challenge is not just how to make the profession of agriculture more appealing, it's how to make agriculture a *good livelihood option* for young people entering the labor market at a time of unprecedented economic precarity and climatic disruption.

Of the programs reviewed in this assessment, there are 30 designed specifically to reach new, young farmers. These programs have a range of incentives—from loans and grants to technical assistance and education—but generally, they are present in each of the U.S. Northeast states and the District of Columbia. Such programs are important and need to be expanded if current leaders want to systematically increase the appeal of working lands careers to young people. Programs geared towards farmland preservation and succession planning are also important. Despite the moderate availability of these incentive and

preservation programs, an increasingly precarious economic, social, and environmental context makes agriculture a difficult industry for well-established small-scale farmers, let alone prospective small-scale farmers, foresters, and aquaculturists who are trying to develop their farms and businesses.

While changing the macro-economic context for farmers in the U.S. Northeast is not a reasonable goal for any individual policy or program, it is possible to think about policies and programs that protect farmers, especially young farmers, from climatic and economic uncertainties at the same time. This requires big-picture thinking about and research into critical issues beyond but not unrelated to ecosystem services. In the context of increasing labor precarity in the US, especially among young people, the activation energy and resources required to enter the field of agriculture alone is often a monumental hurdle, never mind the challenge of getting training, obtaining health care, and arranging child care, among other things. For young people interested in working on farms to gain experience, low wages, limited benefits and seasonality all introduce a significant amount of precarity into agriculture as a long-term livelihood prospect. For young people interested in owning and operating a farm, the cost of securing land is often prohibitive as are the perennial concerns of affordable healthcare for individuals and/or childcare for families.

There are a number of programs and policies that could overcome these obstacles, like offering free health care to all farm workers or subsidizing small-farm owner salaries. On-the-job certification, training, and professional development also could be huge incentives—so could a program that grants agricultural land to farm workers with 10+ years of consistent employment in the sector, as a way to incentivize them to establish their own farms and/or working lands-related business and encourage an expansion of local agriculture. Put together, such programs quickly make agriculture look like a promising career and livelihood path, especially for young people and especially in rural areas.

Recommendation 4.1 *Evaluate the regionally specific factors inhibiting youth from working lands careers in the U.S. Northeast, with a particular eye on issues of land tenure, health care, and higher education.*

- **For Cooperative Extension:** Develop outreach, education, and programming that specifically target new, young farmers/working lands producers and provide training on ecologically sound management practices alongside economic planning and financial and material support.

- **For Agricultural Experiment Stations:** Investigate the barriers to entry for prospective farmers and working lands producers to identify key obstacles and bottlenecks, especially as they relate to land tenure, health care, and education. Explore programmatic possibilities, incentive structures, and institutional mechanisms to help prospective producers overcome these hurdles.

While the opportunity to contribute meaningfully to the environment and to a community are strong incentives for young people interested in working-land professions, in the context of increasingly precarious economic, social, and ecological realities, such incentives will likely not be enough to outweigh the risks associated with pursuing such livelihoods. Working-lands careers, and agriculture more specifically, are inherently risky activities that involve high start-up costs and long-term commitments, each of which is a big hurdle for young people, many of whom are saddled with student debt and health care needs as well as concerns about the economy even before they enter the job market.

Based on the data collected in this assessment as well as personal experiences navigating these waters, the authors of this report conclude that the major problem in this regard is not lack of motivation on the part of young people, but rather an increasingly precarious macro-economic context, a generally poor social safety net, and the consequences of climate change in the U.S. Northeast.

In order to address this, research on ecosystem service provisioning in the U.S. Northeast should begin to investigate the factors inhibiting youth from working-lands careers. Likely, these factors are complex and multi-scalar, with both universal and regionally-specific dynamics at play. In this work, attention should be paid to the role of non-ecosystem service-related issues, in particular land tenure, health care and child care availability, and access to higher education. If the goal is to not only increase the appeal of working land professions to young people, but to also improve the provisioning of ecosystem services, it is necessary to think more holistically about the myriad factors shaping the economic and social realities of young people in the U.S. Northeast.

Recommendation 4.2 *Evaluate the role of cash-transfer and basic income programs to supplement conventional, market-based systems.*

- **For Cooperative Extension:** Working closely with working-lands managers and producers, develop an understanding of how to give farmers the financial support and other resources they need to make a good living in agriculture.

- **For Agricultural Experiment Stations:** Gauge the feasibility and scope of cash-transfer/basic income programs and investigate ways of combining these efforts with efforts to improve the provisioning of ecosystem services to increase synergies between economic and ecological needs and priorities.

In thinking critically about some of these issues, the authors of this report see a lot of benefit from talking about ecosystem services in the context of the changing labor market. This is especially true in the wake of the coronavirus pandemic, which has dramatically shifted attitudes about labor in the U.S. and elsewhere. Labor geographies are shifting across the traditional urban-rural divide, and options for hybrid and remote employment and education are also becoming more numerous and widespread, especially in the U.S. Northeast. Therefore, new opportunities are emerging to rethink how labor is distributed and how changing distributions of labor might be leveraged to improve livelihoods and ecosystem services.

This change comes as novel policy solutions such as direct cash transfers and universal basic income have gained traction, leading to unprecedented public support and political will. In different ways, cash transfer and basic income programs involve direct, unconditional payments to individuals or households with the aim of supplementing income derived from other livelihood activities (Lee 2021). Research has shown that not only do such schemes work remarkably well in low-, middle- and high-income countries (Forget et al. 2013), but they do so in such a way that is more efficient and cuts down on bureaucratic oversight and the additional costs that come with it (Van Parijs 2004). Put succinctly, while such programs are not a silver bullet, they are an important policy tool that can be used strategically to address the effects of macro-economic factors on households and individuals.

In the context of working-lands professions, and agriculture more specifically, one could imagine a direct cash transfer or basic income scheme that supplements farm-based income, especially during the vulnerable first years for new and beginning farmers. Such a basic income structure could also be scalable based on the production of various ecosystem services that new farmers produce on their land. One might also imagine a basic income program that covers young farmers or farm workers during the off-season as a way to bridge lean winter months and keep them plugged into the local food system. If combined with programs that actively provide education to prospective farmers—as well as with resources and financing opportunities to secure farm land—such a program might incentivize multiple material and non-material ecosystem services at the same time.

The confluence of changing labor geographies and attitudes provides an interesting and timely space for exploring potentially transformative policy solutions that address intersecting concerns around labor and ecosystem services on working lands. Such policies are, no doubt, of interest to producers and land managers generally; however, for young people attempting to enter into the profession, they may prove particularly valuable. Researching such programs and policies that specifically target this gap between labor and ecosystem services is one important avenue of future research, one with potentially much to offer in regards to increasing the appeal of agriculture and working-lands careers to young people.

References

Béné, C. (2020). Resilience of local food systems and links to food security–A review of some important concepts in the context of COVID-19 and other shocks. *Food Security*, 1-18.

Bennett, E. M., Peterson, G. D., & Gordon, L. J. (2009). Understanding relationships among multiple ecosystem services. *Ecology letters*, 12(12), 1394-1404.

Berkes, F., & Ross, H. (2013). Community resilience: toward an integrated approach. *Society & natural resources,* 26(1), 5-20.

Bolund, Per, and Sven Hunhammar. 1999. "Ecosystem Services in Urban Areas." *Ecological Economics* 29 (2): 293–301.

Brandt, J., & Vejre, H. (2004). Multifunctional landscapes-motives, concepts and perceptions. In *Multifunctional Landscapes: Volume 1 Theory, Values and History* (pp. 3-32). WIT press.

Brunson, J. C. (2020). Ggalluvial: layered grammar for alluvial plots. *Journal of Open Source Software,* 5(49), 2017.

Butler, B., Hewes, J. H., Dickinson, B. J., Andrejczyk, K., Butler, S. M., & Markowski-Lindsay, M. (2016). USDA Forest Service National Woodland Owner Survey: national, regional, and state statistics for family forest and woodland ownerships with 10+ acres, 2011-2013. *Res. Bull. NRS-99. Newtown Square, PA: US Department of Agriculture, Forest Service, Northern Research Station. 39 p.*, *99*, 1-39.

Chambers, R. and Conway, G. (1992). Sustainable Rural Livelihoods: Practical Concepts for the 21st Century, IDS Discussion Paper 296, Brighton: IDS

Cutter, S. L. (2016). Resilience to what? Resilience for whom? *The Geographical Journal*, 182(2), 110-113.

Danley, B., Widmark, C. (2016). "Evaluating conceptual definitions of ecosystem services and their implications." *Ecological Economics*, 126, pp. 132-138.

de Camino Velozo, R. (1987). Incentives for community involvement in conservation programmes. *FAO Conservation Guide (FAO)*.

Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., ... & Zlatanova, D. (2015). The IPBES Conceptual Framework—connecting nature and people. *Current opinion in environmental sustainability,* 14, 1-16.

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R. T., Molnár, Z., ... & Shirayama, Y. (2018). Assessing nature's contributions to people. *Science*, 359(6373), 270-272.

Forget, E. L., Peden, A., & Strobel, S. (2013). Cash transfers, basic income and community building. *Social Inclusion*, 1(2), 84-91.

Griffin, T., Conrad, Z., Peters, C., Ridberg, R., & Tyler, E. P. (2015). Regional self-reliance of the Northeast food system. *Renewable Agriculture and Food Systems*, 30(4), 349-363.

Hendrickson, M. K. (2020). Covid lays bare the brittleness of a concentrated and consolidated food system. *Agriculture and Human Values*, 1.

Horton, R., G. Yohe, W. Easterling, R. Kates, M. Ruth, E. Sussman, A. Whelchel, D. Wolfe, and F. Lipschultz (2014). Ch. 16: Northeast. Climate Change Impacts in the United States: The Third National Climate Assessment, J.M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 16-1-nn.

H.R.2646 - 107th Congress (2001-2002): Farm Security and Rural Investment Act of 2002. (2002, May 13). https://www.congress.gov/bill/107th-congress/house-bill/2646

IPBES (2017). *Update on the classification of nature's contributions to people by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* Bonn, Germany.

Kalleberg, A. L. (2018). Precarious work and young workers in the United States. *Youth, jobs, and the future: Problems and prospects*, 35-52.

Lee, S. (2021). Politics of Universal and Unconditional Cash Transfer: Examining Attitudes Toward Universal Basic Income. *Basic Income Studies*, 16(2), 191-208.

Loft, L., Gehrig, S., Le, D. N., & Rommel, J. (2019). Effectiveness and equity of payments for ecosystem services: Real-effort experiments with Vietnamese land users. *Land Use Policy*, 86, 218-228.

Lovell, S. T., & Johnston, D. M. (2009). Creating multifunctional landscapes: how can the field of ecology inform the design of the landscape?. *Frontiers in Ecology and the Environment*, 7(4), 212-220.

Lovell, S.T., Nathan, C.A., Olson, M.G., Mendez, V.E., Kominami, H.C., Erickson, D.L., and Morris, W.B. (2010). Integrating agroecology and landscape multifunctionality in Vermont: An evolving framework to evaluate the design of agroecosystems. *Agricultural Systems,* 103(5), 327-341.

Lovell, S. T., & Taylor, J. R. (2013). Supplying urban ecosystem services through multifunctional green infrastructure in the United States. *Landscape ecology*, 28(8), 1447-1463.

Mastrangelo, M. E., Weyland, F., Villarino, S. H., Barral, M. P., Nahuelhual, L., & Laterra, P. (2014). Concepts and methods for landscape multifunctionality and a unifying framework based on ecosystem services. *Landscape Ecology*, 29(2), 345-358.

Magis, K. (2010). Community resilience: An indicator of social sustainability. *Society and Natural Resources*, 23(5), 401-416.

McDermott, M., Mahanty, S., & Schreckenberg, K. (2013). Examining equity: a multidimensional framework for assessing equity in payments for ecosystem services. *Environmental Science & Policy*, 33, 416-427.

Millenium Ecosystem Assessment. (2005) A Report of the Millennium Ecosystem Assessment. Ecosystems and Human Well-Being. Island Press, Washington D.C.

Meerow, Sara, and Joshua P. Newell. 2019. "Urban Resilience for Whom, What, When, Where, and Why?" *Urban Geography* 40 (3): 309–29.

NOAA. n.d. Northeast Regional Land Cover Change Report 1996–2010.

Pascual, U., Phelps, J., Garmendia, E., Brown, K., Corbera, E., Martin, A., ... & Muradian, R. (2014). Social equity matters in payments for ecosystem services. *Bioscience*, 64(11), 1027-1036.

Piñeiro, V., Arias, J., Dürr, J., Elverdin, P., Ibáñez, A. M., Kinengyere, A., ... & Torero, M. (2020). A scoping review on incentives for adoption of sustainable agricultural practices and their outcomes. *Nature Sustainability*, 3(10), 809-820.

Pouso, S., Borja, Á., Fleming, L. E., Gómez-Baggethun, E., White, M. P., & Uyarra, M. C. (2021). Contact with blue-green spaces during the COVID-19 pandemic lockdown beneficial for mental health. *Science of The Total Environment*, 756, 143984.

Rickenbach, M., Schulte, L. A., Kittredge, D. B., Labich, W. G., & Shinneman, D. J. (2011). Cross-boundary cooperation: A mechanism for sustaining ecosystem services from private lands. *Journal of soil and water conservation*, 66(4), 91A-96A.

Rolf, Werner, Stephan Pauleit, and Hubert Wiggering (2019). "A Stakeholder Approach, Door Opener for Farmland and Multifunctionality in Urban Green Infrastructure." *Urban Forestry & Urban Greening*, 40 (April): 73–83.

Rollston, R., & Galea, S. (2020). COVID-19 and the Social Determinants of Health. *American Journal of Health Promotion: AJHP*, 34(6), 687-689.

Ruhl, JB, Steven E. Kraft, and Christopher L. Lant (2007). *The Law and Policy of Ecosystem Services.* Washington, DC: Island Press.

Scott, J. C. (1977). The moral economy of the peasant. Yale University Press.

Selman, P. (2009). Planning for landscape multifunctionality. *Sustainability: Science, practice and policy,* 5(2), 45-52.

USDA (2021). *About the Conservation Reserve Program*. Conservation Reserve Program. Retrieved January 7, 2022, from: https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program

USDA ERS (Economic Research Service) (2020). *Farm Household Well-being Glossary.* Retrieved January 7, 2022, from: https://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/glossary /

USDA ERS (Economic Research Service) (2021). *Animal Products, Aquaculture, Overview.* Retrieved January 7, 2022, from: https://www.ers.usda.gov/data-products/aquaculture-data/documentation/

USDA NAL (National Agricultural Library). (2021). *Agricultural Thesaurus and Glossary* .Retrieved January 7, 2022, from: https://agclass.nal.usda.gov

USGCRP (2017). Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington D.C., USA, 470 pp.

Van Parijs, P. (2004). Basic income: a simple and powerful idea for the twenty-first century. *Politics & Society*, 32(1), 7-39.

Appendix

Appendix 1. Inactive programs (e.g., de-funded, repealed) documented in the initial database but ultimately excluded from the analysis.

	Agency	Program	Incentive/ funding type	Description	Year inactive
federal	Environmental Protection Agency	Piscataqua Region Region Environmental Planning Assessment Grant Program	Implementation grant	The program provided a grant opportunity in the 42 New Hampshire and 10 Maine communities within the Piscataqua Region watershed based on regional priorities.	2016
	USDA Farm Service Agency (FSA)	Conservation Reserve Program - Grasslands	PES	Provided participants with rental payments and cost-share assistance so that environmentally sensitive agricultural land is not farmed or ranched, but instead used for conservation benefits.	2014
	USDA Forest Service (USFS)	Biological Control of Invasive, Native and Non-Native Plants (BCIP)	Research grant	A program to develop technologies that address the spread and impacts of invasive plants.	2017
	USDA Natural Resources Conservation Services (NRCS)	Wildlife Habitat Incentives Program (WHIP)	Implementation grant	Provided technical and financial assistance to landowners for the establishment and improvement of fish and wildlife habitat.	2014, 10-year contracts still open
	US Small Business Administration (SBA)	Paycheck Protection Program	Loan	Provided a direct incentive for small businesses to help fund payroll costs, including benefits, pay for mortgage interest, rent, utilities, worker protection costs related to COVID-19, uninsured property damage costs caused by looting or vandalism during 2020, and certain supplier costs and expenses for operations.	2021
state	CT Department of Agriculture	Connecticut Grown Joint Venture Grant	Certificate of compliance	Offered competitive, matching funds to promote Connecticut agricultural products through the use of the Connecticut Grown logo or slogan.	unknown

	CT Department of Agriculture	Environmental Assistance Program	Technical assistance	Offered to manage nutrient waste efforts.	unknown
	DE Cooperative Extension	Nutrient Management Certification	Certificate of compliance	Certificate program to manage nutrients from waste.	unknown
	NH Department of Agriculture	Agricultural Development Grant Programs	Implementation grant	Provided grants for promotional efforts designed to increase the demand for New Hampshire agricultural products in existing markets, as well as to identify new markets and build product demand.	2021
	NY Department of Agriculture	New Farmers Grant Fund	Implementation grant	Provided grants for beginning farmers to improve farm profitability.	unknown
	NY Department of Environmental Conservation	Hudson River Estuary Program Grants	Implementation grant	Provided funding to implement Hudson River Estuary Action Agenda priorities	unknown
	VT Cooperative Extension	Community Caring for Canopy Grants	Implementation grant	Provided seed funding to help communities care for their publicly managed trees and forests.	2021
private	National Fish and Wildlife Foundation / Wells Fargo	Resilient Communities Program	Implementation grant	Provided funding for communities to "bounce back more quickly" after a disaster; prioritized projects that enhance fish and wildlife resources and avoid or reduce risk to life, and costly and devastating impacts from events such as sea-level risk, floods, droughts, fires and more.	2020
	Health Care Without Harm / New England Innovation Hub	Nourished by New England	Partnership program	Connected health care facilities to purchasing within regional food systems and local producers	2020