

STRATEGIC PLAN FOR AQUACULTURE ECONOMIC DEVELOPMENT

PREPARED BY THE
NATIONAL SCIENCE AND TECHNOLOGY COUNCIL
SUBCOMMITTEE ON AQUACULTURE

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About the National Science and Technology Council

The National Science and Technology Council (NSTC) is the principal body through which the Executive Branch coordinates science and technology policy across the diverse entities that make up the federal research and development enterprise. A primary objective of the NSTC is to ensure science and technology policy decisions and programs are consistent with the President's stated goals. The NSTC prepares research and development strategies that are coordinated across federal agencies aimed at accomplishing multiple national goals. The work of the NSTC is organized under committees that oversee subcommittees and working groups focused on different aspects of science and technology. More information is available at <http://www.whitehouse.gov/ostp/nstc>.

The National Science and Technology Policy, Organization, and Priorities Act of 1976 established the Office of Science and Technology Policy (OSTP) to provide the President, and others within the Executive Office of the President, advice on the scientific, engineering, and technological aspects of the economy, national security, homeland security, health, foreign relations, the environment, and the technological recovery and use of resources, among other topics. OSTP leads interagency science and technology policy coordination efforts, assists the Office of Management and Budget with an annual review and analysis of federal research and development in budgets, and serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the federal government. More information is available at <http://www.whitehouse.gov/ostp>.

About the NSTC Subcommittee on Aquaculture

The National Aquaculture Act of 1980 stated that “Congress declares that aquaculture has the potential for reducing the United States trade deficit in fisheries products, for augmenting existing commercial and recreational fisheries, and for producing other renewable resources, thereby assisting the United States in meeting its future food needs and contributing to the solution of world resource problems. It is, therefore, in the national interest, and it is the national policy, to encourage the development of aquaculture in the United States.” To this end, the NSTC Subcommittee on Aquaculture (SCA), and its predecessors, were established as the federal interagency coordinating group to increase the effectiveness and productivity of federal aquaculture research, regulation, technology transfer, and assistance programs. The SCA is a statutory subcommittee composed of federal agency representatives that operates under the Committee on Environment of the NSTC under the OSTP in the Executive Office of the President [National Aquaculture Act of 1980 (Public Law 96-362, 94 Stat. 1198, 16 U.S.C. 2801, et seq.) and National Aquaculture Improvement Act of 1985 (Public Law 99-198, 99 Stat. 1641)].

About This Document

The National Aquaculture Development Plan (NADP), originally developed in 1983 in response to the National Aquaculture Act of 1980, had not been updated since. Following the 2020 Executive Order calling for the NADP to be updated, the three SCA plans—Research Planning,

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Regulatory Efficiency, and Economic Development—were developed as the three primary legs of the revised NADP, designed to improve interagency coordination, promote regulatory efficiency, spur research and technology development, and support economic growth in collaboration with State, Tribal, academic, private sector, and other partners. Collectively, the three SCA strategic plans constitute an updated National Aquaculture Development Plan (NADP), pursuant to the National Aquaculture Act of 1980.

The SCA envisions a more robust, resilient, globally competitive, and environmentally sustainable domestic aquaculture sector. To this end, the SCA established three Task Forces to develop national-level goals and objectives to help prioritize and implement interagency efforts. In October 2018, the SCA established the Science Planning Task Force to document federal science and technology opportunities and priorities for aquaculture by revising and updating the National Strategic Plan for Aquaculture Research (2021–2025). In February 2019, the SCA established the Regulatory Efficiency Task Force to develop a new work plan for interagency coordination to improve regulatory efficiency. Each of these task forces published final strategic plans in February 2022.

In May 2020, the SCA established the Economic Development Task Force to develop a strategic plan for aquaculture economic development. The SCA charged the Economic Development Task Force to develop a national Strategic Plan for Aquaculture Economic Development that outlines actions federal agencies are taking or plan to take within their existing statutory authorities and budgetary resources. This document is a public draft of the *Strategic Plan for Aquaculture Economic Development*.

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Anil Rupasingha, USDA ERS, task force co-
chair

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Abbreviations and Acronyms		NIFA	U.S. Department of Agriculture, National Institute of Food and Agriculture
AMS	U.S. Department of Agriculture, Agricultural Marketing Service	NMFS	National Marine Fisheries Service, or NOAA Fisheries
APHIS	U.S. Department of Agriculture, Animal and Plant Health Inspection Service	NOAA	National Oceanic and Atmospheric Administration
ARS	U.S. Department of Agriculture, Agricultural Research Service	NRCS	U.S. Department of Agriculture, Natural Resource Conservation Service
CAHPS	Comprehensive Aquaculture Health Program Standards	NSF	National Science Foundation
DOC	U.S. Department of Commerce	NSTC	National Science and Technology Council
DOD	U.S. Department of Defense	OSTP	Office of Science and Technology, in the Executive Office of the President
EDA	U.S. Department of Commerce, Economic Development Administration	RD	U.S. Department of Agriculture, Rural Development
EPA	U.S. Environmental Protection Agency	RMA	U.S. Department of Agriculture, Risk Management Agency
ERS	U.S. Department of Agriculture, Economic Research Service	SBA	U.S. Small Business Administration
FAS	U.S. Department of Agriculture, Foreign Agricultural Service	SBIR	Small Business Innovation Research program

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FDA	U.S. Food and Drug Administration	SCA	NSTC Subcommittee on Aquaculture
FNS	U.S. Department of Agriculture, Food and Nutrition Service	SIP	NOAA Seafood Inspection Program
FSA	U.S. Department of Agriculture, Farm Service Agency	NSGP	National Sea Grant Program
HBCU	Historically Black Colleges and Universities	STEM	Science, Technology, Engineering, and Math
ITA	International Trade Administration	U.S.	United States
LG	USDA Land Grant Cooperative Extension System	USDA	U.S. Department of Agriculture
MBDA	U.S. Department of Commerce, Minority Business Development Agency	USFWS	U.S. Fish and Wildlife Service
NAHP&S	National Aquaculture Health Plan and Standards	USTR	U.S. Trade Representative
NASS	U.S. Department of Agriculture, National Agricultural Statistics Service	USTDA	U.S. Trade and Development Agency

Executive Summary

The Strategic Plan for Aquaculture Economic Development outlines actions that federal agencies can take within their existing statutory authorities and budgetary resources to support a robust, resilient, globally competitive, and environmentally sustainable domestic aquaculture sector. Effective implementation of this plan will require a significant amount of public-private collaboration with a diverse set of stakeholders. The Economic Development Task Force of the Subcommittee on Aquaculture (SCA) prepared this plan using input from stakeholders and the general public, and in collaboration with experts from numerous federal agencies.¹ It complements two other National Science and Technology Council (NSTC) strategic plans focused on aquaculture—the [National Strategic Plan for Aquaculture Research](#) and the [Strategic Plan to Enhance Regulatory Efficiency in Aquaculture](#). Together, these three plans comprise an update to the National Aquaculture Development Plan and lay out a framework to support expansion of the domestic commercial and conservation aquaculture sectors.

The plan supports both the viability and expansion of existing aquaculture operations and encourages new entrants by addressing needs across the seafood supply chain and diverse production systems. The proposed actions serve as points of intersection between climate-smart food production, public-private partnerships, blue economy, community resilience and health, workforce development, working waterfronts, urban and rural development, and seafood supply chains.

The aquaculture industry encompasses a broad variety of practices, species, and operational structures, so this plan offers a number of approaches that acknowledge and support this diversity. There is no one-size-fits-all approach to aquaculture development; therefore this plan includes a wide range of actions tailored to the specialized needs of diverse aquaculture operations to assist in industry growth. This plan outlines four strategic goals to guide interagency collaborative efforts, coordinated through the SCA, to meet the nation’s aquaculture priorities:

Goal 1. Encourage Industry Investment

Goal 2. Support Infrastructure and Workforce Development

Goal 3. Expand Market Opportunities for U.S. Aquaculture Products

Goal 4. Support Aquaculture Communications and Literacy

The plan outlines objectives under each goal that federal agencies have identified to implement over the next five years. Numerous federal and non-federal programs have mission areas that intersect with the goals and objectives of this plan. Some programs and initiatives are specific to aquaculture, but many others have a broader scope for which aquaculture entities are relevant and eligible. Effective implementation of this plan will require coordinated efforts among existing and new federal and non-federal partners, including states and the private sector.

¹ Department of Commerce [the National Oceanic and Atmospheric Administration (NOAA), Economic Development Administration (EDA), and Minority Business Development Agency (MBDA)]; Small Business Administration (SBA); U.S. Environmental Protection Agency (EPA); several agencies of the U.S. Department of Agriculture [National Institute of Food and Agriculture (NIFA), Agricultural Marketing Service (AMS), Rural Development (RD), and Economic Research Service (ERS)]; the Department of the Interior’s U.S. Fish and Wildlife Service (USFWS); U.S. Food and Drug Administration (FDA); and the Department of State.

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Introduction

Seafood is an excellent source of nutrients essential for human health and well-being. The term “seafood” includes all wild and farmed aquatic organisms raised for food production, whether harvested in marine or freshwater environments. Federal nutrition guidelines recommend that Americans increase their seafood consumption to about 8 oz per week²; in 2021, Americans consumed an average of 6.3 oz of seafood per week.³ Aquaculture is an increasingly important way to produce seafood. Globally, it has expanded rapidly over the last several decades, and continues to grow faster than other major food production sectors. Aquaculture now accounts for more than half of the world’s seafood supply; in contrast, global wild seafood catch has been largely stable for decades. By 2030, seafood production is forecast to increase by 15 percent, with broad acknowledgement that this growth will come mainly from aquaculture.⁴

There is substantial untapped potential to expand aquaculture production in the United States. In contrast to the strong growth in aquaculture globally, domestic aquaculture production has remained relatively static since 1995.^{5,6} The United States has outsourced our seafood supply, and the concomitant economic benefits, to other countries. In 2022, the United States ranked number 18⁷ in global aquaculture production behind many smaller countries, and our seafood trade deficit has risen to \$17 billion in 2020.⁸ Although domestic wild capture fisheries could provide some increased seafood production, most increases in domestic seafood production will likely come from aquaculture.

In the context of global, climate-resilient food systems, aquaculture is one of the most resource-efficient ways to produce animal protein,^{9,10,11} and some forms of aquaculture provide ecosystem services that may enhance the nation’s natural capital.¹² With limited arable land and fresh water

² USHHS, Office of Disease Prevention and Health Promotion, USDA Center for Nutrition Policy and Promotion (2020). *Dietary Guidelines for Americans (2020-2025)*. <https://www.dietaryguidelines.gov>

³ DOC-NOAA National Marine Fisheries Service. *Landings*. <https://www.fisheries.noaa.gov/foss>

⁴ UN Food and Agriculture Organization (2022). *The State of World Fisheries and Aquaculture 2022 - Towards Blue Transformation*. Rome, Italy. <https://www.fao.org/documents/card/en/c/cc0461en>

⁵ DOC-NOAA National Marine Fisheries Service (2022). *Fisheries of the United States, 2020*. <https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-united-states>;

⁶ U.S. Department of Commerce, NOAA Current Fishery Statistics No. 2020.; DOC-NOAA National Marine Fisheries Service (2017) *Fisheries of the United States, 2016*. <https://www.fisheries.noaa.gov/resource/document/fisheries-united-states-2016-report>

⁷ UN Food and Agriculture Organization (2022). *The State of World Fisheries and Aquaculture 2022*.

⁸ DOC-NOAA National Marine Fisheries Service (2022). *Fisheries of the United States, 2020*. <https://media.fisheries.noaa.gov/2022-05/Fisheries-of-the-United-States-2020-Report-FINAL.pdf>

⁹ Froehlich, H. E., Runge, C. A., Gentry, R. R., Gaines, S. D., & Halpern, B. S. (2018). *Comparative terrestrial feed and land use of an aquaculture-dominant world*. *Proceedings of the National Academy of Sciences*, 115(20), 5295–5300. www.pnas.org/cgi/doi/10.1073/pnas.1801692115

¹⁰ Hilborn, Ray, Jeannette Banobi, Stephen J Hall, Teresa Pucylowski, and Timothy E Walsworth (2018). *The environmental cost of animal source foods*. *Front Ecol Environ* 16(6): 329–335, doi: 10.1002/fee.1822

¹¹ Halpern, B.S., Frazier, M., Verstaen, J. et al. (2022). *The environmental footprint of global food production*. *Nat Sustain* 5, 1027–1039. <https://doi.org/10.1038/s41893-022-00965-x>

¹² DOC-NOAA National Marine Fisheries Service (2020). *Fact Sheet: Aquaculture Provides Beneficial Ecosystem Services*. <https://www.fisheries.noaa.gov/resource/outreach-materials/fact-sheet-aquaculture-provides-beneficial-ecosystem-services>

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to expand terrestrial farming, human populations will increasingly turn to the ocean and technologies that efficiently use space, water, and nutrients to source food.¹³ As part of a suite of actions to enhance community resilience and to enhance resilience of U.S. and global seafood in the face of climate change, the White House Ocean Climate Action Plan (OCAP)¹⁴ calls for expanding sustainable U.S. aquaculture production. Moreover, the United States has committed to a historic effort to achieve 100 percent sustainable ocean management by 2025 through its participation in the High Level Panel for a Sustainable Ocean Economy,¹⁵ which includes a goal for aquaculture development to meet national and local food needs. Like any human activity, seafood farming has environmental effects. However, increased knowledge, refined husbandry practices, and technological advancements over the past decades now allow for safe and sustainable seafood farming while maintaining healthy ecosystems.^{16,17,18}

The United States has substantial potential to sustainably increase aquaculture production. The United States possesses large marine, freshwater, and land resources suitable for aquaculture, has strong relevant regulatory and research infrastructure, and has one of the largest seafood markets in the world. As of 2020, aquaculture accounts for just 7 percent of total domestic seafood production by volume, yet represents 24 percent¹⁹ of the value of all domestic seafood products, highlighting the substantial potential economic value of aquaculture's growth in the United States.

The market and supply chain disruptions caused by the COVID-19 pandemic highlighted the need to expand options for local and regional seafood production and supply chain development to support local labor market opportunities, especially in underserved and rural communities. Increasing domestic aquaculture production and processing will strengthen and diversify our seafood supply chains, thereby increasing community resilience to address future economic and environmental disruptions. The U.S. aquaculture industry is well positioned to expand using a wide variety of responsible farming and production methods to grow finfish, shellfish, algae, and plants on land and in freshwater, estuarine, and marine water bodies. Benefits would include ensuring sustainable and climate-resilient seafood supplies by farming more of our seafood under robust domestic management regimes, creating farming and seafood jobs (especially in rural and underserved communities), and supporting local economies and working waterfronts.

¹³ UN Food and Agriculture Organization (2020). *The State of World Fisheries and Aquaculture*. Rome, Italy. <https://doi.org/10.4060/ca9229en>

¹⁴ White House, Ocean Policy Committee (2023). *U.S. Ocean Climate Action Plan*. https://www.whitehouse.gov/wp-content/uploads/2023/03/Ocean-Climate-Action-Plan_Final.pdf

¹⁵ *The Ocean Panel*. High Level Panel for a Sustainable Ocean Economy. <https://oceanpanel.org/>

¹⁶ Stentiford, G.D., Bateman, I.J., Hinchliffe, S.J. et al. (2020). *Sustainable aquaculture through the One Health lens*. *Nat Food* 1, 468–474. <https://doi.org/10.1038/s43016-020-0127-5>

¹⁷ Clavelle, Tyler, Sarah E. Lester, Rebecca Gentry, Halley E. Froehlich (2019). *Interactions and management for the future of marine aquaculture and capture fisheries*. *Fish Fish*. 2019; 20: 368– 388. <https://onlinelibrary.wiley.com/doi/abs/10.1111/faf.12351>

¹⁸ Price, Carol Seals, James A. Morris Jr., National Centers for Coastal Ocean Science (U.S.) (2013). *Marine cage culture & the environment: Twenty-first Century science informing a sustainable industry*. NOAA technical memorandum NOS NCCOS; 164. <https://repository.library.noaa.gov/view/noaa/2712>

¹⁹ DOC-NOAA National Marine Fisheries Service (2022). *Fisheries of the United States, 2020*.

Goal 1. Encourage Industry Investment

Investment in domestic aquaculture can involve substantial risk to potential investors for several reasons, including:

- Complicated and uncertain permitting
- The need to adopt new technologies
- Uncertainty about accessibility to risk management programs and services

Through the actions listed in this goal, federal partners can help aquaculture operations become more risk-averse and incentivize investment in the industry.

Objective 1.1: Enhance Regulatory Efficiency

Industry participants have repeatedly indicated that one of the largest barriers to investment in aquaculture—especially in coastal and offshore environments—is complicated, lengthy, and uncertain regulatory processes. These barriers disproportionately affect small-scale and start-up operators who often lack resources to overcome them. Efficient and predictable permitting would significantly reduce this risk and related costs.

The SCA established the Regulatory Efficiency Task Force to develop a strategic plan for interagency science and technology coordination to improve regulatory efficiency, research and technology development, and economic growth. The *Strategic Plan to Enhance Regulatory Efficiency in Aquaculture* outlines actions that federal agencies are taking or plan to take to create a more efficient, timely, coordinated, predictable, and science-informed regulatory process, while fulfilling conservation, public health, and other legal requirements.²⁰ The federal actions include developing a national aquatic health management approach, creating programmatic approaches to permitting (coordinated among several federal agencies), establishing regional interagency coordinating groups and processes for permits and authorizations of aquaculture, and identifying Aquaculture Opportunity Areas in state and federal marine waters.

To enhance regulatory efficiency in aquaculture, federal agencies will implement the following action:

Action 1.1.1 Federal agencies will implement actions identified in the *Strategic Plan to Enhance Regulatory Efficiency in Aquaculture*.

Objective 1.2: Increase Access to Capital

Aquaculture operations require capital to both launch and expand operations. Capital is necessary to support expenditures across the supply chain, including production, harvest, processing, storage, and transportation. Access to capital is often most constrained within traditionally underserved and underrepresented communities, an overlooked opportunity for novel, place-based aquaculture investment initiatives.

²⁰ National Science and Technology Council, Subcommittee on Aquaculture. *Strategic Plan to Enhance Regulatory Efficiency in Aquaculture* (2022).
https://www.ars.usda.gov/sca/Documents/2022%20NSTC%20Subcommittee%20on%20Aquaculture%20Regulatory%20Efficiency%20Plan_Final%20508%20compliant.pdf

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A range of federal agencies provide capital directly to the aquaculture sector. For example, NOAA offers specific loan programs for the aquaculture and fishing industry²¹ and the USDA offers a wide range of agricultural development programs available to the aquaculture industry.^{22,23,24} Additionally, several other agencies (e.g., Small Business Administration (SBA), Minority Business Development Agency (MBDA), and Economic Development Administration (EDA)) offer loan and grant programs that are not specific to economic development of the agriculture or seafood sectors, but consider aquaculture entities eligible. The NOAA Fisheries Office of Aquaculture, in consultation with the SCA, prepared the *Guide to Federal Aquaculture Grant and Financial Assistance Services (2021)* in an effort to communicate more effectively these types of opportunities to aquaculture stakeholders.²⁵ This comprehensive list highlights federal grants and financial assistance programs available to aquaculture operations. Federal partners intend to update this guide annually to provide the most up-to-date information to aquaculture stakeholders.

To enhance access to capital, federal agencies will implement the following actions:

Action 1.2.1 NOAA will periodically update and publish the *Guide to Federal Aquaculture Grant and Financial Assistance Services* to include all relevant grant and loan programs in collaboration with federal partners, including FDA and USDA (RD, FSA, NRCS, NIFA).

Action 1.2.2 NOAA, SBA, MBDA, and USDA (FSA, NIFA, RD, AMS) will facilitate access to federal grant and loan programs through (1) outreach and engagement with diverse aquaculture stakeholder communities (e.g., tribal groups, fishing communities, and rural communities) to learn about their needs, inform them of opportunities, and increase awareness of federal programs; and (2) policy recommendations as appropriate to increase eligibility and accessibility of aquaculture operations to federal grants and loans.

Action 1.2.3 SBA, MBDA, and USDA (NIFA, RMA, RD) will support new entrants to the aquaculture sector—including underrepresented communities and veterans—through business and strategic planning and micro-start-up financing, such as connecting aquaculture operations to MBDA’s Business Center network & Capital Readiness Program (CRP) interested in the seafood sector.

Action 1.2.4 USDA (NIFA, RD) and NOAA will work to improve access and impact of the extension services (e.g., Land Grant universities, cooperative state extension programs, and Sea

²¹ DOC-NOAA National Marine Fisheries Service. *Fisheries Finance Program*.

<https://www.fisheries.noaa.gov/national/funding-and-financial-services/fisheries-finance-program>

²² USDA Farm Service Agency. *Farm Loan Programs*. <https://www.fsa.usda.gov/programs-and-services/farm-loan-programs/index>

²³ USDA Rural Development. *Business & Industry Loan Guarantee Program*. <https://www.rd.usda.gov/programs-services/business-programs/business-industry-loan-guarantees>

²⁴ USDA Rural Development. *Value-Added Producers Grants*. <https://www.rd.usda.gov/programs-services/business-programs/value-added-producer-grants>

²⁵ NOAA Fisheries. *Guide to Federal Aquaculture Grant and Financial Assistance Service (2021)*.

<https://www.fisheries.noaa.gov/resource/document/guide-federal-aquaculture-grant-and-financial-assistance-services-2021>

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Grant programs) to help new businesses develop business plans and submit credit and grant applications.

Action 1.2.5 USDA (NIFA, RMA, RD, AMS), NOAA, MBDA, SBA, and NSF will support investor “pitch sessions,” business incubators and accelerators, and extension programming focused on increasing investor awareness and interest in aquaculture, particularly for investment opportunities in diverse and underserved communities.

Action 1.2.6 NSF, USDA (NIFA), and SBA will increase engagement with aquaculture stakeholders to increase awareness of the NSF Innovation Corp (I-Corps)²⁶ and Small Business Innovation Research (SBIR) and Technology Transfer (STTR) programs²⁷ to accelerate the transition of basic research and technologies to commercialization.

Objective 1.3: Increase Incentives Associated with Enhancing Natural Capital

Nature provides society with ecosystem services that economists consider to be a form of capital.²⁸ To capture a more holistic view of the economic opportunity of aquaculture, environmental organizations, investors, and financial entities are increasingly interested in exploring concepts of Natural Capital Accounting²⁹ and Environmental, Social, and Corporate Governance.^{30,31} Scientists and investors realize how heavily the economy relies on natural resources, and how economic activities change nature’s ability to provide services. The federal government is actively exploring ways to expand the national economic accounting system to provide new information to capture links between nature and the economy. Aquaculture operations provide ecosystem services that may enhance natural capital.³²

Some types of commercial aquaculture provide ecosystem services or other benefits beyond the primary goal of food production.³³ Examples include improved water quality in coastal areas

²⁶ National Science Foundation. *Major Initiatives: NSF’s Innovation Corps (I-Corps)*
<https://new.nsf.gov/funding/initiatives/i-corps>

²⁷ U.S. Small Business Administration. *America’s Seed Fund*. <https://beta.www.sbir.gov/>

²⁸ World Bank Group. *Natural Capital*. <https://www.worldbank.org/en/topic/natural-capital#1>

²⁹ World Bank Group (2021). *Accounts to Policy: WAVES Closeout Report—Wealth Accounting and Valuation of Ecosystem Services Global Partnership (2012-2019)*. Washington, D.C.: World Bank Group.
<http://documents.worldbank.org/curated/en/779351636579119839/From-Accounts-to-Policy-WAVES-Closeout-Report-Wealth-Accounting-and-Valuation-of-Ecosystem-Services-Global-Partnership-2012-2019>

³⁰ Peritus Capital. <https://www.perituscap.com/>

³¹ O’Shea et al. (2019). *Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems*. The Nature Conservancy and Encourage Capital.
https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_EncourageCapital_TowardsABlueRevolution_FINAL.pdf

³² White House (2023). *National Strategy to Develop Statistics for Environmental-Economic Decisions: A U.S. System of Natural Capital Accounting and Associated Environmental-Economic Statistics*.
<https://www.whitehouse.gov/wp-content/uploads/2023/01/Natural-Capital-Accounting-Strategy-final.pdf>

³³ Alleway, H.K., Gillies, C.L., Bishop, M.J., Gentry, R.R., Theuerkauf, S.J., and Jones, R. (2019). *The Ecosystem Services of Marine Aquaculture: Valuing Benefits to People and Nature*. *BioScience* 69, 59-68.

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(e.g., water filtration,³⁴ nutrient absorption,³⁵ and enhanced denitrification³⁶ by farmed shellfish, nutrient assimilation by farmed seaweed³⁷), habitat provisioning services provided by inland aquaculture ponds (e.g., for migratory birds) and by marine aquaculture gear³⁸ (e.g., to juvenile fish³⁹), potential enhancement of recruitment to wild populations from increased larval production,⁴⁰ and the potential stabilization and armoring of shorelines against wave energy (e.g., shellfish beds⁴¹ and oyster reefs⁴²). In some cases, these benefits may be quantified and used to inform incentives and subsidies to help offset aquaculture production costs. Aquaculture can provide additional ecosystem services when used as a tool for restoring or enhancing a range of habitats and species, including for sport fishing, recovery of threatened and endangered species,⁴³ and reef restoration.⁴⁴ Federal agencies can expand research to better understand and quantify these services in the context of natural capital, and work with state and other partners on methods to incorporate them into tax and other incentives for the aquaculture industry, possibly allowing aquaculture producers to take this information “to the bank” to provide additional investment opportunities.

Consistent with a natural capital framework, there are a variety of federal financial assistance programs and technical assistance available to farmers to improve our nation’s natural environment. These include incentives related to agriculture engineering for aquaculture infrastructure, water quality in areas of clean water inputs and nutrient management outputs,

³⁴ Barr, J.M., Munroe, D., Calvo, L., Kreeger, D., Cheng, K.M., Rose, J.M., Bayer, S. (in press - Estuaries and Coasts). Seasonal feeding behavior of aquacultured Eastern Oyster (*Crassostrea virginica*) in the Mid-Atlantic.

³⁵ Lindahl, O., Hart, R., Hernroth, B., Kollberg, S., Loo, L.-O., Olrog, L., Rehnstam-Holm, A.-S., Svensson, J., Svensson, S., and Syversen, U. (2005). Improving marine water quality by mussel farming - a profitable solution for Swedish society. *Ambio* 34, 129-136; Rose, J.M., Bricker, S.B., Tedesco, M.A., and Wikfors, G.H. (2014). A Role for Shellfish Aquaculture in Coastal Nitrogen Management. *Environmental Science & Technology* 48, 2519-2525; Petersen, J.K., Hasler, B., Timmermann, K., Nielsen, P., Tørring, D.B., Larsen, M.M., and Holmer, M. (2014). Mussels as a tool for mitigation of nutrients in the marine environment. *Marine Pollution Bulletin* 82, 137-143.

³⁶ Ray, N.E., and Fulweiler, R.W. (2021). Meta-analysis of oyster impacts on coastal biogeochemistry. *Nature Sustainability* 4, 261-269.

³⁷ Kim, J.K., Kraemer, G.P., and Yarish, C. (2014). Field scale evaluation of seaweed aquaculture as a nutrient bioextraction strategy in Long Island Sound and the Bronx River Estuary. *Aquaculture* 433, 148-156.

³⁸ Tallman, J.C., and Forrester, G.E. (2007). Oyster Grow-Out Cages Function as Artificial Reefs for Temperate Fishes. *Transactions of the American Fisheries Society* 136, 790-799.

³⁹ Mercado-Allen, R., Auster, P.J., Clark, P., Dixon, M.S., Estela, E., Liu, Y., Milke, L., Phillips, G., Redman, D., Smith, B.C., Verkade, A., and Rose, J.M. (2023). Oyster aquaculture cages provide fish habitat similar to natural structure with minimal differences based on farm location. *Frontiers in Marine Science* 10.

⁴⁰ Varney, R.L., Watts, J.C., and Wilbur, A.E. (2018). Genetic impacts of a commercial aquaculture lease on adjacent oyster populations. *Aquaculture* 491, 310-320.

⁴¹ Meyer, D.L., Townsend, E.C., and Thayer, G.W. (1997). Stabilization and Erosion Control Value of Oyster Cultch for Intertidal Marsh. *Restoration Ecology* 5, 93-99.

⁴² La Peyre, M.K., Humphries, A.T., Casas, S.M., and La Peyre, J.F. (2014). Temporal variation in development of ecosystem services from oyster reef restoration. *Ecological Engineering* 63, 34-44.

⁴³ Rogers-Bennett, L., Aquilino, K.M., Catton, C.A., Kawana, S.K., Walker, B.J., Ashlock, L.W., Marshman, B.C., Moore, J.D., Taniguchi, I.K., Gilardi, K.V., and Cherr, G., N. (2016). Implementing a Restoration Program for the Endangered White Abalone (*Haliotis sorenseni*) in California. *Journal of Shellfish Research* 35, 611-618.

⁴⁴ Brumbaugh, R.D., Sorabella, L.A., Johnson, C., and Goldsborough, W.J. (2000). Small Scale Aquaculture as a Tool for Oyster Restoration in Chesapeake Bay. *Marine Technology Society Journal* 34, 79-86.

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energy conservation engineering, water management engineering for water conveyance systems, and wildlife enhancement.⁴⁵ For example, the USDA Natural Resources Conservation Service (NRCS) provides technical expertise and conservation planning for farmers (including oyster farmers), ranchers, and forest landowners wanting to make conservation improvements to their land.⁴⁶ In addition, USDA Rural Development (RD) has programs to support energy efficiency improvements and install renewable energy systems.⁴⁷ In addition, USDA RD has programs to support energy-efficient renewable energy systems on farms.

Beyond the ancillary benefits to natural capital from seafood farming, aquaculture is a tool that can be used to specifically enhance natural capital as a primary objective. Algae culture (seaweeds and microalgae) is emerging as a potential source of valuable products and services beyond those for food, including biofuels, pharmaceuticals, and the potential to reduce greenhouse gas emissions through carbon sequestration. Algae culture is therefore the source of increased federal research. The Department of Energy's Macroalgae Research Inspiring Novel Energy Resources (MARINER) Program seeks to develop the technologies capable of providing economically viable, renewable biomass for energy applications without the need for land, fresh water, and synthetic fertilizers, to ultimately expand macroalgae use beyond human consumption.⁴⁸

Additional ecosystem services are provided through aquaculture: restoring or enhancing a range of habitats and species, including for sportfishing,⁴⁹ endangered species recovery,^{50,51} and enhancing coastal habitats such as oyster reefs.⁵²

⁴⁵ U.S. Department of Agriculture (2021). *Aquaculture is Agriculture Colloquium*.

<https://www.usda.gov/sites/default/files/documents/aquaculture-agriculture-colloquim.pdf>

⁴⁶ U.S. Department of Agriculture, Natural Resources Conservation Service. *Getting Assistance*.

<https://www.nrcs.usda.gov/>

⁴⁷ U.S. Department of Agriculture, Rural Development. *Rural Development Energy Programs*.

<https://www.rd.usda.gov/programs-services/energy-programs>

⁴⁸ Department of Energy, Advanced Research Project Agency - Energy (19 Sept 2017). *Macroalgae Research Inspiring Novel Energy Resources (MARINER) Program*. <https://arpa-e.energy.gov/technologies/programs/mariner>

⁴⁹ U.S. Fish and Wildlife Service [Sportfish Restoration Program](#) provides funds to fish and wildlife agencies of the states, the District of Columbia, and U.S. territories for fishery projects, boating access, and aquatic education.

⁵⁰ The U.S. Fish and Wildlife Service National Fish Hatchery System includes 71 national fish hatcheries across the country that raise fish (and other aquatic species like frogs and mussels) to support conservation. U.S. Fish and Wildlife Service (2022). *Meet Your National Hatchery Service*. <https://www.fws.gov/story/meet-your-national-fish-hatchery-system>

⁵¹ NOAA supports stock enhancement to rebuild populations of various ESA-listed species, including white abalone and several populations of Pacific salmon. Species Directory: USDOC - NOAA National Marine Fisheries Service (31 May 2023). *White Abalone - Conservation & Management*. <https://www.fisheries.noaa.gov/species/white-abalone#conservation-management>; USDOC - NOAA National Marine Fisheries Service, Northwest Fisheries Science Center (1 June 2023). *Fisheries Enhancement and Conservation in the Pacific Northwest*. <https://www.fisheries.noaa.gov/west-coast/science-data/fisheries-enhancement-and-conservation-pacific-northwest>

⁵² U.S.-DOC NOAA National Marine Fisheries Service, Office of Habitat Conservation (4 February 2022). *Habitat Conservation, Oyster Reef Habitat*. <https://www.fisheries.noaa.gov/national/habitat-conservation/oyster-reef-habitat>

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To increase incentives to aquaculture producers, federal agencies will implement the following actions:

Action 1.3.1 NOAA and USDA (NIFA, ARS, RD, ERS) will support research to better understand and quantify how aquaculture operations may contribute to enhancing the nation's natural capital through, for example, enhancing coastal water quality and providing habitat to wild populations.

Action 1.3.2 EPA will work with other federal partners to explore how federal tax credit programs could be optimized to provide working capital to aquaculture to encourage investment in diverse and underserved communities. Examples include the New Market Tax Credit Program administered by the Community Development Financial Institutions Fund⁵³; Opportunity Zones established under the Tax Cuts and Jobs Act of 2017⁵⁴; and EPA tax credit programs for coastal brownfield sites.⁵⁵

Action 1.3.3 NOAA, USDA-NRCS,⁵⁶ and USFWS will continue to collaborate with other federal and state agencies, the aquaculture industry, ENGOs, and regional fishery management councils and commissions to explore using aquaculture techniques for aquatic habitat and species restoration, conservation, and enhancement goals.

Action 1.3.4 NOAA will continue exploring research and management tools to better understand and incorporate the habitat value of aquaculture operations for consideration in management decisions.

Action 1.3.5 OSTP, USDA, and NOAA will facilitate engagement and provide subject matter expertise between the aquaculture sector, federal partners (e.g., the Interagency Policy Working Group focused on natural capital and the Ocean Policy Committee), and private investment groups to make connections with and leverage opportunities related to Natural Capital Accounting, climate adaptation and mitigation solutions, and environmental, social, and corporate governance.

Objective 1.4: Increase Access to Federal Risk Management Services

Several USDA agencies administer programs to protect farmers and ranchers against declines in crop yield and/or revenue due to weather, disease, and other factors.⁵⁷ For example, USDA's Risk Management Agency (USDA RMA) makes federal crop insurance available and accessible to agricultural producers in order to strengthen the economic stability of farmers and rural communities. USDA RMA manages the Federal Crop Insurance Corporation (FCIC) to provide

⁵³ U.S. Department of Treasury, Community Development Financial Institutions Fund (2022). *New Markets Tax Credit Program*. <https://www.cdfifund.gov/programs-training/programs/new-markets-tax-credit>

⁵⁴ Tax Cuts and Jobs Act of 2017, Pub. L. 115-97. <https://www.congress.gov/bill/115th-congress/house-bill/1/text>

⁵⁵ U.S. Environmental Protection Agency (Aug 2014). *A Guide to Federal Tax Incentives for Brownfields Redevelopment*. https://www.epa.gov/sites/default/files/2014-08/documents/tax_guide.pdf

⁵⁶ USDA Natural Resource Conservation Service. *NRCS Financial Assistance Program Data*. <https://www.farmers.gov/data/financial-assistance/overview>

⁵⁷ USDA Rural Development (Jan 2022). *Disaster Resiliency and Recovery Resources Guide*. https://www.rd.usda.gov/sites/default/files/rd_disastertoolkit-final508.pdf

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crop insurance products to farmers and ranchers through a public-private partnership with Approved Insurance Providers (AIP), who in turn sell and service federal crop insurance policies. USDA RMA currently has several insurance policies that are specifically designed to help aquaculture.⁵⁸ Additionally, USDA's Farm Service Agency (FSA) recently expanded a policy/program that made harvested finfish and other aquatic species eligible for the Emergency Assistance for Livestock, Honey Bees, and Farm-raised Fish Program (ELAP).⁵⁹

To increase access to federal risk management services, federal agencies will implement the following actions:

Action 1.4.1 USDA (RD, FSA) will explore methods to expand accessibility for aquaculture operations to receive federal disaster relief grants.

Action 1.4.2 USDA (RMA, FSA, ERS) will increase outreach to the aquaculture sector to better assess risks and risk management strategies, and to increase the accessibility of risk management tools.

Objective 1.5: Improve Economic and Social Impact Data and Analyses – Increasing Accessibility and Quality of Aquaculture Market and Economic Data

The U.S. aquaculture industry lacks adequate market and cost data that are easily available to other types of agriculture.⁶⁰ The availability of reliable and timely economic data on aquaculture costs, revenue, production, and trade is vital in supporting the economic development of the U.S. aquaculture industry. These data inform current and potential producers of the expected returns on investments in aquaculture infrastructure and the costs of inputs, while also facilitating modeling of market development and the impact of market disruptions. As such, the availability of these data is necessary to secure capital to finance aquaculture development, which is particularly important for new entrants to the aquaculture sector. Additionally, import and export data communicate market information to inform producer decision-making.

Several federal and state data products currently report economic data on the U.S. aquaculture industry. The USDA's National Agricultural Statistics Service (USDA NASS) regularly conducts the *Census of Aquaculture* that provides state- and national-level data on production volumes and methods, water sources, and sales.⁶¹ Additionally, USDA NASS releases biannual state-level data on catfish production and annual state-level data on trout production.⁶² Prior to 2015, USDA NASS released monthly national data on catfish processing that included

⁵⁸ USDA Risk Management Agency (Sept 2022). *National Factsheet on Aquaculture (Oysters, Clams, WFRP)*. <https://www.rma.usda.gov/Fact-Sheets/National-Fact-Sheets/Aquaculture-Oysters-Clams-WFRP>

⁵⁹ USDA Farm Service Agency (13 May 2021). *USDA Expands Aquaculture Disaster Assistance to Include Fish Raised for Food*. <https://www.fsa.usda.gov/news-room/news-releases/2021/usda-expands-aquaculture-disaster-assistance-to-include-fish-raised-for-food>

⁶⁰ *Aquaculture is Agriculture Colloquium, 2021*.

⁶¹ USDA National Agricultural Statistics Service. *Surveys - Census of Aquaculture*. https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Census_of_Aquaculture/index.php

⁶² USDA Economics, Statistics, and Market Information System. *Catfish Production Data*. <https://usda.library.cornell.edu/concern/publications/bg257f046?locale=en>; USDA Economics, Statistics, and Market Information System. *Trout Production Data*. <https://usda.library.cornell.edu/concern/publications/t722h882h?locale=en>

information on prices received as well as imports and exports.⁶³ The U.S. Department of Commerce's Census Bureau continues to release monthly import and export data through their *Foreign Trade Statistics* data product.⁶⁴ NOAA produces *Fisheries of the United States* reports that document the economic performance of the nation's commercial and recreational fisheries,⁶⁵ but this does not include the economic data for aquaculture. In addition to these resources, a number of state natural resource agencies track aquaculture production for several species groups, such as marine shellfish. Currently, information regarding economic data is also disseminated to the industry via established Land and Sea Grant extension programming.

To improve economic and social data and analysis, federal agencies will implement the following actions:

Action 1.5.1 NOAA and USDA NASS will work to improve and better harmonize federal and state aquaculture data collection activities on species of major economic importance to the United States, including through data sharing agreements respecting established confidentiality and data sharing requirements.

Action 1.5.2 USDA NASS will explore opportunities to increase participation, and the scope and frequency of data collected in the *Census of Aquaculture* to include information on the capital and labor associated with aquaculture production.

Action 1.5.3 USDA NASS and NOAA will explore expanding their data reports and products to include other major aquaculture commodities, such as clams and oysters, to communicate information on prices received for aquaculture output and the seasonal variation in prices.

Action 1.5.4 NOAA and USDA (NIFA, NASS, ERS, RMA) will continue to collaborate with the U.S. Department of Labor's Bureau of Labor Statistics as they work to develop a producer price index for the aquaculture sector.

Action 1.5.5 NOAA will work with academic and other partners on studies and other research to develop and refine projections of future aquaculture prices.

Action 1.5.6 NOAA and USDA NIFA will explore ways to amplify the reach and impact of Land and Sea Grant extension to improve collection and dissemination of economic and financial management information to the aquaculture industry.

⁶³ USDA Economics, Statistics, and Market Information System. *National Catfish Production Data Report (2014)*. <https://usda.library.cornell.edu/concern/publications/3f462541v?locale=en>

⁶⁴ U.S. Census (2023). *Current US International Trade in Goods and Services (FT900)*. https://www.census.gov/foreign-trade/Press-Release/current_press_release/index.html

⁶⁵ DOC-NOAA National Marine Fisheries Service, Office of Sustainable Fisheries. *Reports - Fisheries of the United States*. <https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-united-states>; DOC-NOAA National Marine Fisheries Service, Office of Sustainable Fisheries. *Reports - Fisheries Economics of the United States*. <https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-economics-united-states>

Action 1.5.7 Federal partners will coordinate on options to improve quality and accessibility of international trade data, including exploring ways to better distinguish aquaculture from wild-caught products.

Action 1.5.8 USDA and NOAA will explore how to develop economic/market valuation data to benefit the domestic aquaculture industry following disasters (e.g., natural disasters such as hurricanes and pandemics), allowing for more accurate and expedited loss assessments.

Goal 2. Support Infrastructure and Workforce Development

A skilled labor force working on modern equipment in modern facilities is necessary to bolster the productivity, efficiency, and competitiveness of U.S. seafood and aquaculture industries. In this goal, federal partners are exploring ways to efficiently communicate opportunities that encourage and bolster workforce development, physical infrastructure, and innovative research and development. This may include engaging with ongoing efforts to create and establish national clearinghouses for training resources and to help bring aquaculture initiatives into concert with extension efforts in other aspects of U.S. agriculture. For each of the objectives and actions below, federal agencies will work with private industry partners to identify where and how to direct efforts, and expand lines of communication between private and public stakeholders to address common challenges.

Objective 2.1: Educate and Train a Skilled and Diverse Aquaculture Workforce

Workforce development refers to training offered to existing and potential workers to provide the skills necessary to improve efficiency and knowledge for the worker while maintaining competitiveness of businesses in the industry. Workforce development is a long-term approach to ensure opportunities and incentives for professional growth of workers and is essential to the sustainability of businesses. Through workforce development, individuals can obtain subject matter expertise and explore related fields to increase the knowledge and skill base of existing businesses, creating potentially beneficial nexuses between stakeholders.

The aquaculture sector encompasses a wide range of species, systems, and products. To develop the aquaculture sector, a well-trained workforce is necessary to meet industry needs throughout the farming and seafood supply chain. Federal agencies can foster and strengthen partnerships with aquariums, existing aquaculture enterprises, and educational institutions to support specialized training programs alone or as part of certificates, and two- and four-year degrees that provide the education and skills required to pursue careers in aquaculture—e.g., community colleges with technical/vocational programs, minority serving institutions (MSIs), and other institutions of higher education with agricultural programs with a focused curriculum on the agricultural industry. The intention is to bolster training programs across the farming and seafood supply chain, in sectors including business planning and entrepreneurship, engineering and marine sciences (within STEM), trade management, regulatory compliance, and seafood processing and inspection. Efforts also should be made to establish and expand apprenticeship and internship opportunities with the industry to bolster training opportunities across the farming and seafood supply chain, as many of the essential skills and knowledge needed for this sector are transferable to other farming and seafood sectors. Aquaculture workforce development can provide unique, cross-sectional opportunities to help overcome scientific, regulatory, and market challenges.

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The goal is to support a diverse labor pool to meet the varying needs of multiple scales of aquaculture operations. As a first step, acknowledging up front the challenges and constraints on potential entrants into the aquaculture community can help open accessibility to these training opportunities. Federal agencies acknowledge that workforce needs are region-specific, and plan to work with local partners to support location-specific efforts.

To support workforce development, federal agencies will implement the following actions:

Action 2.1.1 NOAA and USDA NIFA will work with industry stakeholders to identify current and future aquaculture workforce needs (including the critical skills for each area of the farming and seafood supply chain) and identify training and education pathways required to fill those needs. Education pathways can include sponsored work-study, apprenticeships, and internship opportunities.

Action 2.1.2 NOAA and USDA NIFA will support the development of regional or sector-based (e.g., catfish industry) occupational standards and certificate programs. They will also explore farm-driven workforce development programs to foster essential skills to develop the aquaculture sector.

Action 2.1.3 NOAA and USDA NIFA will promote and support the coordination of local and regional programs that aim to support and connect qualified applicants to employment opportunities throughout the farming and seafood supply chain, emphasizing engagement with programs and institutions focusing on traditionally underserved communities (as well as incorporating traditional ecological knowledge), veterans and their families, tribal communities, other groups not traditionally represented in the farming or seafood sector, and interested students from landlocked, rural, and urban communities. This includes improvements in the promotion of and accessibility to grant opportunities by offering assistance throughout the application process.

Action 2.1.4 NOAA and USDA NIFA will explore workforce recruitment and training opportunities to attract students into the aquaculture industry throughout the country, using the USDA NIFA Veterinary Medicine Loan Repayment Program (VMLRP) as a model.⁶⁶

Action 2.1.5 USDA APHIS will continue to expand the training modules on aquatic animal health that are intended for USDA-accredited veterinarians but are freely available to all. Accredited veterinarians must maintain continuing education accreditation status.

Action 2.1.6 USDA APHIS will work with contractors and partners to develop aquatic animal health training and education modules for the advancement of knowledge for farmers, regulators, and animal health professionals.

Objective 2.2: Develop and Encourage the Adoption of New Technologies

Growth of U.S. aquaculture production and the continued development of a diverse, sustainable, and resilient domestic aquaculture industry relies on innovation and technological advancement. U.S. aquaculture encompasses a diverse portfolio of production species and systems. This creates

⁶⁶ The VMLRP helps eligible veterinarians working in aquaculture to offset a significant portion of debt incurred in pursuit of their veterinary medical degrees in return for their service in certain high-priority veterinarian shortage situations. USDA National Institute for Food and Agriculture. *Veterinary Medicine Loan Repayment Program*. <https://www.nifa.usda.gov/grants/programs/veterinary-medicine-loan-repayment-program>

a myriad of challenges and opportunities facing producers across the United States, each of which requires adopting novel tools, technologies, and solutions to minimize risk, maximize productivity, and ensure sustainability and profitability. Additional investments are required across a range of culture systems, including inland ponds and raceways, offshore and coastal aquaculture, integrated multi-trophic aquaculture (IMTA), and recirculating aquaculture systems (RAS).

The federal government supports key actions along the entire chain of aquaculture innovation, from research funding and product development to commercialization. For example, USDA's National Institute for Food and Agriculture (USDA NIFA), via its Small Business Innovation Research (SBIR) grant program, and the USDA's Rural Development (USDA RD) have prioritized commercialization of on-farm automation, such as the automatic flipping of oyster culture bags, which provides for a desirable deep cup and easier food service handling. In addition, NOAA Sea Grant and USDA's Agricultural Research Service (USDA ARS) have supported research focused on the development of culture methods for candidate species and culture technologies, such as RAS. In turn, the mechanism to transfer novel technologies to the industry is in place due to the efforts by the USDA NIFA Land Grant Cooperative Extension Service, USDA ARS, and NOAA Sea Grant Extension Network. The Extension component is a large part of why the United States leads in science and technology generally, serving as a professional connection between research institutes and the end-users of scientific information.⁶⁷

To support development and adoption of new technologies, federal agencies will implement the following actions:

Action 2.2.1 NOAA and USDA NIFA will explore the extent of federal aquaculture investments in aquaculture technology development and transfer, and identify regulations or policies that may hamper the adoption or implementation of promising new technologies.

Action. 2.2.2 NOAA and USDA (NIFA, APHIS) will work with industry to identify high-priority areas for focusing tech development. These discussions could support the broader effort to get industry input on federal grant priorities (e.g., USDA ARS stakeholder prioritization efforts).

Action 2.2.3 USDA NIFA Land Grant extension, Extension Foundation, and NOAA Sea Grant will collaborate with partners around the topics of technology transfer, user training, and product implementation on aquaculture farms to ensure federally supported innovation research effectively generates short- and long-term benefits for domestic aquaculture producers.

Action 2.2.4 NOAA and USDA NIFA will support efforts to expand and broaden access to worker training resources among stakeholder groups and other partners (e.g., extension agents) to enable more rapid adoption of novel tools and technologies.

Objective 2.3: Increase Investment in Physical Infrastructure

To effectively and sustainably develop the aquaculture sector, bolstering sufficient investment in development and maintenance of physical infrastructure is of paramount importance. Federal

⁶⁷ NSTC Subcommittee on Aquaculture (2022). *National Strategic Plan for Aquaculture Research*. Goal 2. https://www.ars.usda.gov/sca/Documents/2022%20NSTC%20Subcommittee%20on%20Aquaculture%20Research%20Plan_Final%20508%20compliant.pdf

agencies plan to strengthen the use of public-private partnerships in the aquaculture sector to drive an increase in investment in physical infrastructure through increased cost-effectiveness, more efficient risk allocation, and the attraction of third-party funding.

The intention of attracting increased investment toward physical infrastructure in the aquaculture sector is to enable and support the development and expansion of upstream facilities (e.g., hatcheries and nurseries), as well as downstream aquaculture infrastructure (e.g., port facilities and cold storage facilities). Such infrastructure developments will lead to increased supplies of seed and fingerlings, as well as generally increased processing capacities that promote higher growth in employment and business development. Given the coastal proximity of some aquaculture infrastructure, it is imperative to incorporate climate resiliency considerations into ongoing and future infrastructure projects in order to increase the lifespan of such developments.

To support investment in physical infrastructure, federal agencies will implement the following actions:

Action 2.3.1 USDA (AMS, RD) and EDA will explore ways to increase private investment and optimize federal assistance for public infrastructure development, including by helping communities to catalyze public-private partnerships that create jobs and foster economic resilience and prosperity. This action will help to increase access to capital to develop and modernize infrastructure projects, including for retail markets and production and manufacturing facilities.

Action 2.3.2 NOAA, USDA NIFA, and EDA will support and encourage the development, maintenance, modernization, and expansion of upstream aquaculture infrastructure, such as broodstock centers, hatcheries, and nurseries (e.g., to increase supply of shellfish seed and fingerlings), and downstream aquaculture infrastructure (e.g., port facilities, processing capacity, and cold storage).

Action 2.3.3 EDA will initiate and continue efforts to incorporate climate resilience and environmental considerations into economic development planning and projects involving the development and maintenance of physical infrastructure relating to aquaculture. EDA will assist in this capacity by enhancing its emphasis on resilience principles, as well as robust Strengths-Weaknesses-Opportunities-Threats (SWOT) analyses and needs assessments regarding infrastructure modernization, efficiency, and changing workforce needs in Comprehensive Economic Development Strategy (CEDS)⁶⁸ plans.

Action 2.3.4 Federal agencies will work with state agencies to identify and more broadly disseminate existing funding opportunities applicable to aquaculture-related infrastructure projects. Increased awareness of such funding opportunities can decrease barriers to underserved communities seeking infrastructure funding and help to connect funding to communities in need, as well as increase outreach to industry and other stakeholders to more widely spread awareness of infrastructure development opportunities.

⁶⁸ U.S. Economic Development Administration. *Comprehensive Economic Development Strategy (CEDS)*: <https://www.eda.gov/grant-resources/comprehensive-economic-development-strategy>

Objective 2.4: Establish Test Beds, R&D Consortiums, and Pilots

To support the existing and growing U.S. aquaculture industry, there is a need to establish and expand test beds⁶⁹ and pilot operations, and continue establishment of research and development (R&D) consortiums. Such sites provide the means for research efforts to be conducted under commercial conditions, and also facilitate training and workforce development opportunities and, in some locations, possibly revitalize vacant or underused processing facilities. These sites can be essential means of refining methods and technologies in advance of full-scale investments and commercialization. There is a trend in the United States to expand R&D consortiums. NOAA Sea Grant’s funding opportunity in 2019 established 11 “Aquaculture Collaboratives” (commonly referred to as “hubs”) focusing on various topics, including land-based salmon production, seaweed aquaculture, indigenous aquaculture practices, and shellfish breeding.⁷⁰ These hubs have connected research, extension, and industry personnel on a regional and national basis. Additional R&D consortiums can serve to advance sectors of the emerging U.S. aquaculture industry by facilitating collaborative research involving industry input.

To support test beds, R&D consortiums, and pilots, federal agencies will implement the following actions:

Action 2.4.1 NOAA and USDA (NIFA, ARS) will formulate and implement an interagency plan to prioritize and support new and existing R&D consortiums, test beds, and pilot facilities through coordinated funding opportunities. Planning should be conducted in collaboration with industry and other partners, and should consider international models of test beds and pilot facilities that have been developed in South Korea,⁷¹ Norway,⁷² Scotland,⁷³ and Portugal.⁷⁴

Action 2.4.2 NOAA and USDA NIFA will encourage and leverage public-private partnerships between universities—which include HBCUs, tribal institutions, and Hispanic-serving

⁶⁹ Test beds—also referred to as demonstration centers—and pilot aquaculture facilities are currently limited in the United States.

⁷⁰ NOAA Sea Grant. *Sea Grant 2019 National Aquaculture Initiative Funded Projects and Program*: <https://seagrant.noaa.gov/Portals/0/Documents/Sea%20Grant%202019%20National%20Aquaculture%20Initiative%20Funded%20Projects%20and%20Programs%20Sept2019.pdf>

⁷¹ The National Institute of Fisheries Science, Pukyong National University in Busan, South Korea is constructing and intends to expand distribution of a recirculating aquaculture system (RAS) for cold-water fish farming for trout and salmon. National Institute of Fisheries Science (25 Feb 2022). *NIFS Has Provided Eco-Friendly Trout-farming Technology to Private Sector*. https://www.nifs.go.kr/eng/board/actionBoard0044View.do?MENU_ID=M0000329&BBS_ID=20201228045042656DOX&

⁷² SINTEF ACE is a full-scale laboratory located in Mid-Norway that develops and tests new aquaculture engineering research and technologies to aquaculture operations, mainly for salmon and seaweed sites. SINTEF. *Laboratory - ACE*. <https://www.sintef.no/en/all-laboratories/ace/>

⁷³ Researchers from the National Manufacturing Institute at Strathclyde University in Glasgow, Scotland have deployed remotely operated vehicles (ROVs) for underwater 3D scanning to develop virtual reality (VR) for diver safety training at north fish farms. Fadley, Keith. *Shetland Fish Farm Chosen as First Test Bed for Virtual Reality*. Scotland Business. <https://www.pressandjournal.co.uk/fp/business/scotland-business/4840882/shetland-fish-farm-chosen-as-test-bed-for-virtual-reality/>

⁷⁴ Portuguese companies RIASEARCH and SPAROS partner to provide industry with small batches of experimental aquafeeds and research to improve marine and shrimp nutrition. RIASEARCH. *About Us*. <https://www.riasearch.pt/about>

institutions—to promote and provide cost-effective opportunities for state-of-the-art research, research consortiums, and on-the-ground implementation of aquaculture development research.

Goal 3. Expand Market Opportunities for U.S. Aquaculture Products

This goal includes steps the federal government can take or support to expand aquaculture product consumption that could strengthen U.S. influence in the global seafood market.

Objectives include supporting new product development, further integrating domestic aquaculture products into the domestic and international seafood markets, and exploring ways the government can further support domestic farmed seafood products in federal nutrition assistance and commodity purchasing programs.

Many of the objectives below are equally relevant to both wild harvest and farmed seafood products. In some instances, there is a distinct benefit to taking a seafood-wide approach. Where appropriate, the actions in this goal reference “seafood” while still retaining the focus on aquaculture given the context of this overall plan.

Objective 3.1: Evaluate Technical and Economic Potential of New and Emerging Species

Numerous species are in various stages of technical readiness for commercial culture, and additional research will develop techniques to propagate and rear these and additional species in the future. For species with no, or limited, existing markets it will be important to evaluate not just the technical readiness of their commercial culture, but also their market potential. Such information will be valuable to help private and public sector researchers and investors make informed decisions about where to focus their attention and resources.

Currently, there are a limited number of marine finfish species commercially grown in the United States, but there are significant opportunities for expansion. A consortium of USDA, NOAA, academic partners, and private industry experts has identified 19 marine finfish species as candidates for new or expanded marine aquaculture industries in the United States.⁷⁵ In addition, seaweed culture for both human consumption and other uses (e.g., animal feed ingredients) is currently very small but is rapidly expanding, and the sector has the potential to bring numerous new product types to market.

Economic analyses of these species (e.g., profitability potential based on operating costs, market demands, and supplies from foreign and domestic fisheries and aquaculture) would help assess the potential economic viability of each species in the marketplace. Such information would be valuable as investors and farmers consider whether to try to develop new or expanded markets for these species.

To evaluate the potential of new and emerging species, federal agencies will implement the following actions:

Action 3.1.1 NOAA and USDA (APHIS, NIFA) will work with academic and industry partners on techno-economic analyses to explore the market potential for scaling various new and emerging aquaculture species to commercial production levels.

⁷⁵ Rexroad Jr, C.E., Rust, M.B., Riche, M., Wills, P., Davis, M. 2021. Opportunities for US Marine Finfish Aquaculture. *Journal of the World Aquaculture Society*. 1-8.
<https://onlinelibrary.wiley.com/doi/10.1111/jwas.12791>

Objective 3.2: Support New Product Development

Most aquaculture products grown in the United States are currently marketed as fresh or frozen. There is a trend of increasing demand for ready-to-cook and convenient-to-prepare food items across food types. The COVID-19 pandemic changed where and how people accessed, prepared, and consumed food. There is an increasing need and opportunity to expand the development of new or value-added and shelf-stable products.

Prior to the COVID-19 pandemic, about three-quarters of the seafood consumed in the United States were sold by restaurants.⁷⁶ As more consumers began eating at home in 2020, retail sales dramatically increased for fresh, frozen, and shelf-stable seafood.⁷⁷ Individuals and families had to find ways to eat without support from restaurants or school-lunch programs. People needed nutritious, easy-to-make meal options that offered convenience. Some in the seafood industry expect the convenience of purchasing, preparing, and consuming food will remain a key characteristic of new products post-pandemic.⁷⁸ For example, market analysts expect grab-and-go products, such as sushi, to appeal to busy, mobile consumers.^{79, 80}

Despite the potential for the development of new aquaculture products, various trade journals estimate the failure rate for new food products ranges from 70 to 95 percent. To achieve market success, new products should be innovative and meet specific needs, or solve specific problems end users have sourcing, preparing, and consuming food.⁸¹ In addition, it is important to note that developing and marketing new products is expensive. The cost of trade and marketing promotions to launch new products can run as high as 25 percent of the list price just to generate consumer awareness. Companies need healthy revenue streams to fund new-product introductions and to continually refine existing products to satisfy shifting consumer expectations. Marketing new products requires: (1) identifying customer needs and satisfying them profitably; (2) understanding the target customer so well that the product practically sells itself; and (3) acquiring, keeping, and growing customers by creating, communicating, and delivering superior value to target accounts.⁸²

⁷⁶ Cobe, Patricia. 2020. *Seafood Prices Reflect a Complex Supply Chain*. Restaurant Business Online. <https://www.restaurantbusinessonline.com/operations/seafood-prices-reflect-complex-supply-chain>

⁷⁷ Blank, Christine. 2022. *Seafood Industry Powers through the Pandemic with Ingenuity, Flexibility*. SeafoodSource. <https://www.seafoodsource.com/news/foodservice-retail/seafood-industry-powers-through-the-pandemic-with-ingenuity-flexibility>

⁷⁸ Maze, Chris. 2021. *How Important Is Customer Convenience in a Post-Pandemic Society?* SeafoodSource. <https://www.seafoodsource.com/news/foodservice-retail/how-important-is-customer-convenience-in-a-post-pandemic-society>

⁷⁹ Kearns, Madelyn. 2021. *Getting a Grip on Seafood's Rising Grab-and-go Segment*. SeafoodSource. <https://www.seafoodsource.com/news/foodservice-retail/getting-a-grip-on-seafoods-rising-grab-and-go-segment>

⁸⁰ In addition, a North Carolina study revealed that the prime value in having access to fresh seafood was being able to prepare fresh meals for home consumption. Individuals wanted enhancements to facilitate, not eliminate, meal preparation. Nash, Barry, Jane Harrison, and John Whitehead. 2021. *Consumer Demand for North Carolina Seafood*. North Carolina Sea Grant. <https://ncseagrant.ncsu.edu/wp-content/uploads/2021/03/Consumer-Demand-for-North-Carolina-Seafood.pdf>

⁸¹ Christensen, C. et al.,. 2016. *Competing Against Luck*. Harper Collins. Page xii.

⁸² Kotler, P. and K.L. Keller. 2016. *A Framework for Marketing Management*. Pearson Publishing. Page 2.

To support new product development, federal agencies will implement the following actions:

Action 3.2.1 NOAA and USDA ERS will support market research to better understand consumer preferences and expectations for economic value and convenience of seafood products.

Action 3.2.2 USDA (NIFA, ARS) will support food science research and development and market adoption of new and improved seafood product types. This includes developing shelf-stable products to protect or enhance the flavor, texture, color, appearance, and safety of products, as well as developing and deploying new post-harvest processing methods to increase consumer confidence to expand markets.

Action 3.2.3 NOAA and USDA (AMS, ARS, NIFA) will support and contribute to establishing and enhancing state and private-sector food science and technology extension programs where small businesses and extension agents can access guidance and hands-on assistance with business planning and developing value-added seafood.

Action 3.2.4 FDA, NOAA, and USDA will collaborate in developing or updating, as needed, requirements regarding product country of origin and nutritional labels on retail packages for aquaculture products.

Action 3.2.5 FDA will ensure new products introduced to the market meet processing, quality control, and seafood-safety specifications under FDA law and regulations.⁸³

Action 3.2.6 USDA (RD, NIFA) and FDA will support efforts to develop aquaculture products for uses other than human food (e.g., pet foods, pharmaceutical and medical products, bioplastics, and fertilizers).

Objective 3.3: Expand Domestic Market Opportunities

The United States has a significant opportunity to bolster domestic seafood consumption. The consumer market is dominated by imported products, half of which are farmed products. Less than a quarter of the U.S. population over 1 year of age consumes the recommended amount of seafood; however, consumers are gaining awareness of the contributions of seafood to a healthy diet. Consumer demand for value-based products, such as organic and sustainable seafood, continues to grow, and there is increasing interest in supporting local products and shortening supply chains, particularly in response to the COVID-19 pandemic.

Increasing domestic aquaculture production and increasing the amount of seafood consumed in the United States would have significant positive impacts for the seafood sector, human health, and local communities. In *Aquaculture is Agriculture: USDA's Role in Supporting Farmers of Fish, Shellfish, and Aquatic Plants*, the USDA outlines existing resources and recommendations to advance aquaculture in the United States.⁸⁴ The white paper's section on marketing highlights opportunities to expand domestic markets through federal purchasing programs and marketing standards. Additionally, producers—particularly small and beginning—are gravitating toward

⁸³ *Seafood Guidance Documents & Regulatory Information*. U.S. Food and Drug Administration. <https://www.fda.gov/food/guidance-documents-regulatory-information-topic-food-and-dietary-supplements/seafood-guidance-documents-regulatory-information>

⁸⁴ *Aquaculture is Agriculture Colloquium*, 2021.

local, ethnic, and regional markets.⁸⁵ Producers can more readily access these markets, scale their businesses over time, and retain a greater portion of the food dollar. In the pandemic, these markets became even more advantageous due to consumer accessibility and are now understood to play an essential role in developing resilient food systems.⁸⁶

To expand domestic opportunities, federal agencies will implement the following actions:

Action 3.3.1 NOAA will continue to engage with Congress on how the agency would facilitate a National Seafood Council to support a comprehensive, nationwide seafood marketing and public education campaign.

Action 3.3.2 FDA and USDA (FNS, AMS) will work with other federal and state health agencies to amplify federal messaging and outreach on the health benefits of eating seafood.

Action 3.3.3 NOAA Fisheries' Seafood Inspection Program will develop verified market labels for production practices and traceability that can help boost the price point and demand of domestically produced aquaculture products.

Action 3.3.4 USDA AMS will continue to explore the development of organic standards for aquaculture products.

Action 3.3.5 USDA (AMS, FNS) will continue to expand approved vendors and explore potential new forms of aquaculture products based on demand from USDA nutrition assistance programs.

Action 3.3.6 USDA will continue to educate staff and stakeholders that “aquaculture is agriculture.” This will include increasing outreach to aquaculture producers and industry on USDA programs and resources across the supply chain, and encouraging increased program utilization. This effort would promote commercial aquaculture industry and consumer literacy.

Action 3.3.7 USDA AMS will seek opportunities for seafood producers to increase participation in local and regional food systems. This will include increasing opportunities for seafood producers and harvesters to sell in local and regional markets, as well as other direct-to-consumer and indirect market channels.

Action 3.3.8 USDA APHIS, in consultation with relevant federal partners, will advance the comprehensive aquaculture health program standards (CAHPS) and the National Aquaculture Health Plan and Standards (NAHP&S). These efforts promote the health of U.S. farm-raised aquatic animals and, if program participation is recognized by state authorities for aquatic animal health, domestic movement of U.S. farm-raised aquatic animals will be streamlined and less burdensome for producers and exporters.⁸⁷

⁸⁵ Stoll, Joshua S, Harrison, Hannah L. et al. *Alternative Seafood Networks During COVID-19: Implications for Resilience and Sustainability*. Front. Sustain. Food Syst., 31 March 2021. Sec. Social Movements, Institutions and Governance, Volume 5 – 2021. <https://doi.org/10.3389/fsufs.2021.614368>

⁸⁶ *Id.*

⁸⁷ Domestic aquaculture operations may opt to implement CAHPS International in facilities outside the United States such that there are equivalent programs in networked facilities (i.e., premises that source animals from each

Objective 3.4: Promote Global Competitiveness of U.S. Seafood Products

U.S. wild-caught seafood volume alone cannot keep up with domestic consumer demand—as it has been stable for the last two decades—leading to a significant reliance on seafood imports. Cheaper imports and difficulty accessing foreign markets undermine potential growth and competitiveness of the U.S. seafood industry. The United States is the top importing country of seafood by value,⁸⁸ importing between 70 and 85 percent of consumed seafood by value (with at least 50 percent of the imported products being farmed seafood).⁸⁹ Domestically, 90 percent of seafood companies (both wild-caught and aquaculture) are small or medium enterprises (SMEs), and traditionally have lacked the tools to compete globally. Larger companies are disadvantaged in the global market due to inconsistent trade and tariff policies, non-tariff barriers to trade, and differences in international resource management practices.

Ensuring that sustainable U.S. fisheries exporters stay competitive will help increase food security and decrease reliance on illegal, unreported, and unregulated (IUU) fishing and forced labor. Our seafood industry has a critical role to play in enhancing public health and nutrition, creating jobs (especially in rural and underserved communities), and serving as a key part of a climate-resilient food strategy. In the larger context of seafood, aquaculture has the potential to significantly increase our domestic seafood production, which could lessen the reliance on foreign fish sources. Aquaculture development is key to expanding U.S. seafood revenue overall, as well as creating opportunities for the United States to compete in foreign markets currently served by the growth in foreign aquaculture products.⁹⁰ The U.S. government will advance trade policy, market access, and trade promotion to support legal and sustainable U.S. seafood products.⁹¹

USDA’s Foreign Agricultural Service (USDA FAS)⁹² and the U.S. Trade and Development Agency (USTDA) provide market information and conduct export promotion activities designed to help domestic producers identify and take advantage of global market opportunities. Through assessing market conditions, USDA FAS connects U.S. exporters to new markets by endorsing and supporting participation in reputable international trade shows, sponsoring international Trade Missions,⁹³ and hosting virtual trade events. USDA FAS also supports SMEs and tribal

other) and health status may be evaluated using the same standards. This opportunity may alleviate issues with varying state regulations for the importation of aquatic animals.

⁸⁸ *The State of World Fisheries and Aquaculture 2022*, Food and Agriculture Organization of the United Nations. <https://www.fao.org/3/cc0461en/online/sofia/2022/trade-of-aquatic-products.html>

⁸⁹ The top valued imported items included: shrimp, salmon filets and steaks, whole or eviscerated salmon (primarily Atlantic), whole or eviscerated tuna, and canned tuna. Shrimp remains the most overall valuable import accounting for 27% of the value of total edible imports. *Fisheries of the United States*, 2020.

⁹⁰ The top U.S. trading partners for imports are Canada, India, Indonesia, Chile, and China. The top markets for U.S. exports are: Canada, China, Japan, South Korea, and the Netherlands. *Fisheries of the United States*, 2020.

⁹¹ National Export Strategy 2023. *International Trade Administration*. <https://www.trade.gov/national-export-strategy>

⁹² USDA Foreign Agricultural Service. *USDA Foreign Agricultural Service Programs*. <https://www.fas.usda.gov/programs>

⁹³ USDA FAS-sponsored international trade missions open doors and deliver results for U.S. exporters, giving them the opportunity to forge relationships with potential customers, gather market intelligence, and, most importantly, generate sales. *Id.*

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communities by supporting outreach efforts, strategic planning resources, financial assistance programs,⁹⁴ and providing export training initiatives to increase awareness of specialty and indigenous products.⁹⁵

To promote global competitiveness of U.S. seafood, federal agencies will implement the following actions:

Action 3.4.1 NOAA, FDA, and USDA FAS international trade programs will collaborate on a coordinated approach to identify targeted actions to promote seafood industry exports, engage with the aquaculture industry on opening market access, and ensure responsible trade in support of broader goals for conservation and sustainable use of marine resources. This will include supporting interagency working groups focused on the seafood sector and trade.⁹⁶

Action 3.4.2 USDA FAS will work with industry and trade groups to promote both market research and information exchange to identify and pursue foreign market opportunities for seafood products, equipment, and aquaculture inputs (e.g., feeds).

Action 3.4.3 USDA FAS and SBA will work with U.S. Trade and Development Agency (USTDA), the U.S. Department of State, state agencies, regional partners, and private entities to promote resources and financial assistance programs for U.S. exporters seeking entry into foreign markets, including participation in federally endorsed trade shows and virtual webinars to increase awareness of international opportunities.

Action 3.4.4 NOAA will work with USDA FAS and FDA to improve interagency coordination to identify non-tariff trade barriers and unfair trade practices for fish and fish products, including aquaculture products.

Action 3.4.5 The USDA FAS regional offices will work with the U.S. Department of State to encourage harmonization of regional and national trade rules to increase transparency and predictability, which will reduce costs and risk to U.S. exporters.

Action 3.4.6 USDA APHIS, in consultation with federal partners, will advance the Comprehensive Aquaculture Health Program Standards (CAHPS) and the National Aquaculture

⁹⁴ Specific to SMEs, USDA FAS offers two financial assistance programs that provide repayment guarantees to reduce the risk for external investors to fund these types of enterprises: (1) the Export Credit Guarantee (GSM-102) and (2) the Facility Guarantee Program. Additionally, SBA offers the State Trade Expansion Program that provides financial awards to state and territorial governments to assist small businesses with export development. *Id*; US Small Business Administration. *State Trade Expansion Program*. <https://www.sba.gov/funding-programs/grants/state-trade-expansion-program-step>

⁹⁵ The USDA Market Access Program (MAP) funds the U.S. Sustainability Alliance, which provides online guidance and launched a public awareness campaign in 2022. USDA Foreign Agricultural Service. *USDA Foreign Agricultural Service Programs - Market Access Program (MAP)*. <https://www.fas.usda.gov/programs/market-access-program-map>. Also see USDA Foreign Agricultural Service. *USDA Foreign Agricultural Service Programs - Agricultural Trade Promotion Program*. <https://www.fas.usda.gov/programs/agricultural-trade-promotion-program-atp>

⁹⁶ U.S. Department of Commerce. *National Export Strategy (2023)*. <https://www.trade.gov/sites/default/files/2023-06/National-Export-Strategy-2023.pdf>

Health Plan and Standards (NAHP&S). These efforts promote the health of U.S. farm-raised aquatic animals and ensure that health requirements established by trading partners, foreign and domestic, are met.

Action 3.4.7 The U.S. Codex Office will facilitate, with federal partners, the development of consistent and established international standards, guidelines, and norms for aquaculture production, antimicrobial resistance, aquatic animal hygiene, and water quality.

Objective 3.5: Explore the Expansion of Seafood Purchases for Federal Nutrition Assistance Programs

The USDA Agricultural Marketing Service (AMS) purchases a variety of domestically produced and processed commodity food products through a competitive process among approved vendors, and the USDA Food and Nutrition Service (FNS) distributes the products to recipients of federal nutrition assistance programs. These programs promote the consumption of domestic products and provide nutritious food to people in need. Some examples of federal nutrition assistance programs include:

- National School Lunch Program
- Emergency Food Assistance Program
- Food Distribution Program on Indian Reservations

To explore expanding use of commodity purchase programs, federal agencies will implement the following actions:

Action 3.5.1 USDA (FNS, AMS) will continue and expand outreach to aquaculture producers (including those that qualify for Small Business Socioeconomic Programs⁹⁷) to disseminate relevant information about commodity purchase programs and criteria to be considered, and to explore the potential to expand purchases (quantity and variety) of seafood products.

Action 3.5.2 USDA (FNS, AMS) will engage with the DOD and FEMA to explore opportunities to secure more seafood in their commodity purchase programs.

Goal 4. Increase Aquaculture Engagement, Communications, and Literacy

Expansion of domestic aquaculture requires increasing community understanding and support (i.e., social license) for aquaculture development, especially for marine aquaculture in coastal communities. To this end, federal agencies (working with our partners) can help to increase awareness among various stakeholder communities about how modern, responsible aquaculture is good for people, the economy, and the planet.⁹⁸ Specific needs include increasing awareness of the economic benefits to local communities, how aquaculture practices have improved over

⁹⁷ USDA Agricultural Marketing Service. *Small Business Opportunities*. <https://www.ams.usda.gov/selling-food/small-businesses>

⁹⁸ DOC-NOAA National Marine Fisheries Service, Office of Aquaculture (6 Oct 2022). *NOAA Aquaculture Strategic Plan (2023-2028)*. <https://www.fisheries.noaa.gov/resource/document/noaa-aquaculture-strategic-plan-2023-2028>

the past decades, and the suite of robust science-based tools available to predict, minimize, and/or avoid potential environmental impacts and user conflicts. Different approaches are required to reach different audiences—the general public, stakeholders with a particular interest in aquaculture, indigenous and tribal communities, the media, and Congress.

Of note, the popular press commonly cites information from other countries and/or prior (and since improved) practices in the United States, yet does not address the potential positive impacts (e.g., climate-smart food production, jobs, and access to local seafood). This may lead to an exaggerated view of the potential negative impacts of aquaculture and suggests that U.S. managers (state and federal) lack effective policies to support the sustainable development of the sector. These misperceptions underpin much of the opposition to aquaculture and can create a challenging policy environment.

As federal agencies take steps to advance sustainable aquaculture, it is important to learn from the deep knowledge and experiences of local communities, notably tribes. Indigenous peoples across the United States have been stewards and a part of their environments for thousands of years. Throughout this time, they have amassed an immense amount of knowledge informed by unique ways of knowing and being that can be of great value to achieving the goals of this plan. Indigenous Traditional Ecological Knowledge (ITEK)⁹⁹ is a body of oral and written observations, practices, and beliefs that promote environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems. This knowledge can be invaluable in federal decision-making and internal management processes related to aquaculture development.¹⁰⁰

Objective 4.1: Increase Aquaculture Literacy and Engagement

Successful and efficient community outreach strategies are essential to increasing aquaculture literacy among various stakeholder communities, including the general public, environmental organizations, community development leaders, and Congress. Aquaculture-literate stakeholders can examine real-world issues related to aquaculture and think critically about how aquaculture can benefit the economy, environment, and overall culture of their communities. Aquaculture-literate stakeholders can better communicate about aquaculture in a meaningful way; understand that aquaculture operations can be an essential part of both urban and rural communities and their associated businesses, like working waterfronts; and are able to make informed and responsible decisions regarding aquaculture and its products.

Both NOAA and USDA have established communication and outreach strategies targeting researchers and industry stakeholders, including through Sea Grant Programs, Land Grant Institutions, program offices focused on communications and education, USDA Regional Aquaculture Centers, NOAA Science Centers, and associated partnerships. Although channels are in place to inform community members about aquaculture, efforts can be strengthened and expanded.

⁹⁹ ITEK is owned by indigenous peoples—including, but not limited to, Tribal Nations, Native Americans, Alaska Natives, and Native Hawaiians.

¹⁰⁰ NOAA Fisheries. *NOAA Guidance and Best Practices for Engaging and Incorporating Indigenous Knowledge in Decision-Making*. <https://www.noaa.gov/media/file/noaa-indigenous-knowledge-guidance-2023#:~:text=NOAA%20encourages%20the%20inclusion%20of.responsibilities%2C%20respect%20treaty%20rights%2C%20understand>

To increase aquaculture literacy, federal agencies will implement the following actions:

Action 4.1.1 Federal agencies will work with stakeholders and partners to routinely identify needs and gaps in aquaculture communications and stakeholder engagement.

Action 4.1.2 Federal agencies will develop and update common messages to help explain the benefits of sustainable aquaculture development, address frequent misperceptions, and put aquaculture in broader contexts (e.g., climate-smart food production and nutrition). This includes explaining the linkages between aquaculture and broader federal priorities and initiatives (e.g., USDA Local and Regional Foods, USDA Food System Transformation framework, USDA *Aquaculture is Agriculture*, NOAA’s New Blue Economy, and the High Level Panel for a Sustainable Ocean Economy).

Action 4.1.3 Federal agencies will leverage existing resources and ongoing efforts (e.g., common messages and outreach materials) across federal and state agencies, focusing on consolidating and coordinating broad community outreach efforts, to increase awareness of aquaculture (e.g., through federal websites and print and online resources). This will include encouraging partners such as state universities, NGOs, and aquaculture stakeholder organizations to adopt and/or adapt these resources and common messages for their audiences.

Action 4.1.4 Federal agencies will work with their Federal Public Affairs and Legislative Affairs offices to develop “explainers” for reporters and Congressional staff, and to develop relationships with publication agencies and reporters so that they can increasingly view federal agencies and our partners as trusted experts on aquaculture matters.

Action 4.1.5 NOAA and USDA NIFA will collaborate with partners—including aquariums, chefs, and postsecondary educators—to co-develop signage, messages, and curricula related to aquaculture and seafood, integrating aquaculture into broader agricultural and/or sustainable seafood topics.

Objective 4.2: Increase Community Engagement in Aquaculture Matters

In addition to the broad aquaculture literacy objective above, some stakeholder communities have a particular interest in aquaculture policy or science matters that require more in-depth information and discussion.¹⁰¹ Federal agencies can expand targeted outreach and engagement with diverse stakeholder communities to increase awareness and support for aquaculture, and to encourage better alignment of messages and strategies.

To increase community engagement, federal agencies will implement the following actions:

Action 4.2.1 Federal agencies will expand cooperative efforts toward enhancing aquaculture community awareness via in-person community functions, such as town hall meetings, scoping meetings, festivals and other events, and the creation of permanent information kiosks at chambers of commerce, aquariums, and other community centers.

Action 4.2.2 Federal partners will engage with tribal communities on relevant aquaculture priorities, decision-making, and policies. This will include ongoing conversations with tribal

¹⁰¹ Examples include commercial and recreational fishing groups, tribal governments, ports, seafood producers and processors, environmental NGOs, and communities where new facilities or other initiatives are being proposed.

groups to inform and educate communities about aquaculture development opportunities as well as using ITEK to inform aquaculture siting, practices, and technologies.

Action 4.2.3 Federal agencies will create more in-depth materials about specific topics of interest or concern for a given community (e.g., the intersection of aquaculture with climate change, potential regional economic benefits, and environmental impacts).

Action 4.2.4 Federal agencies will develop and expand efforts to engage with underrepresented groups (e.g., through Minority Serving Institutions) to increase their participation in the aquaculture sector through various initiatives, such as workforce development and education.

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