

Aquaculture *is* Agriculture Colloquium



*USDA's Role in Supporting Farmers of
Fish, Shellfish, and Aquatic Plants*

Workshop Co-Chairs

Peggy Biga, OCS

Caird Rexroad, ARS

Steering Committee

Richard Dirksen, OCS

Jeffrey Silverstein, ARS

Amrit Bart, NIFA

Timothy Sullivan, NIFA

Dan Northrup, BH

Paul Zajicek, NAA

George Chamberlin, GAA

Chad Causey, CFA

Authors

Peggy Biga, OCS

Caird Rexroad, ARS

Amrit Bart, NIFA

Timothy Sullivan, NIFA

Christopher Green, NIFA

Keith Fuglie, ERS

Gene Kim, NRCS

Jan Surface, NRCS

Andrew Jermolowicz, RD

Travis Thomason, NRCS

Alex Sereno, RMA

Christopher Vazquez, FSA

Kathleen Hartman, APHIS

Jason Suckow, APHIS

Thomas DeLiberto, APHIS

Willie Harris, APHIS

Fred Cunningham, APHIS

Ken Gruver, APHIS

Brian Dorr, APHIS

Leif Stevens, APHIS

Carl Schroeder, AMS

Angie Snyder, AMS

Jeff Waite, AMS

Jennifer Tucker, AMS

David Bowden, AMS

David Jackson, AMS

Christina Riley, FNS

Clayton Myers, OCE

Teung Chin, OCE

Table of Contents

Abbreviations	iii
Executive Summary	1
Introduction.....	1
Summary of USDA Mission Areas and Agencies Supporting Aquaculture.....	3
<i>Food Safety (FS) Mission Area</i>	3
<i>Marketing and Regulatory Programs (MRP) Mission Area</i>	3
<i>Food, Nutrition, and Consumer Services (FNCS) Mission Area</i>	3
<i>Farm Production and Conservation Service (FPAC) Mission Area</i>	3
<i>Trade and Foreign Agricultural Affairs (TFAA) Mission Area</i>	3
<i>Research, Education, and Economics (REE) Mission Area</i>	4
<i>Rural Development (RD) Mission Area</i>	4
Aquaculture Production Research.....	5
Listening Session Information	6
General Stakeholder Feedback.....	7
Next Steps and Recommendations.....	11
Aquatic Animal Health	12
Listening Session Information	12
General Stakeholder Feedback.....	13
Next Steps and Recommendations.....	14
Environmental Management.....	16
Listening Session Information	17
General Stakeholder Feedback.....	18
Next Steps and Recommendations.....	19
Aquaculture and Wildlife Interactions.....	21
Listening Session Information	22
General Stakeholder Feedback.....	22
Next Steps and Recommendations.....	23
Production Innovation and Technology.....	24
Listening Session Information	25
General Stakeholder Feedback.....	26
Next Steps and Recommendations.....	28

Product and Consumer Marketing	29
Listening Session Information	30
Stakeholder Feedback, Next Steps, and Recommendations	30
Supporting Aquaculture	32
Listening Session Information	34
General Stakeholder Feedback.....	34
Next Steps and Recommendations.....	36
Appendix 1: Aquaculture is Agriculture Webinar Agenda.....	37
Appendix 2: Listening Session and Webinar Participation	39
Appendix 3: USDA Agency Programs Supporting Aquaculture	40

Abbreviations

AFRI	Agricultural and Food Research Initiative
APHIS	Animal and Plant Health Inspection Service
AQUA	NIFA Aquaculture Special Program
AMS	Agricultural Marketing Service
ARS	Agricultural Research Service
BH	Benson Hill
CFA	Catfish Farmers of America
EPA	Environmental Protection Agency
ERS	Economic Research Service
FAS	Foreign Agricultural Service
FDA	Food and Drug Administration
FNS	Food and Nutrition Service
FNCS	Food, Nutrition and Consumer Services
FPAC	Farm Production and Conservation
FS	Food Safety
FSA	Farm Service Agency
FSIS	Food Safety Inspection Service
GAA	Global Aquaculture Alliance
MRP	Marketing and Regulatory Programs
NAA	National Aquaculture Association
NASS	National Agricultural Statistics Service
NIFA	National Institute of Food and Agriculture
NIH	National Institutes of Health
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NSF	National Science Foundation
OCE	Office of the Chief Economist
OCS	Office of the Chief Scientist
OPMP	Office of Pest Management Policy
RAC	Regional Aquaculture Center (Northeastern, North Central, Southern, Tropical and Subtropical, Western)
RBS	Rural Business-Cooperative Service
RD	Rural Development

REE	Research, Education, and Economics
RHS	Rural Housing Service
RMA	Risk Management Agency
RUS	Rural Utilities Service
SBIR	Small Business Innovative Research
TFAA	Trade and Foreign Agricultural Affairs
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
VS	Veterinary Services (APHIS)
WS	Wildlife Services (APHIS)

Executive Summary

Aquaculture is the production of aquatic organisms under controlled conditions throughout part or all their lifecycle. U.S. aquaculture production is growing because demands for healthy seafood products are increasing. However, global stocks of wild-caught seafood have remained stable over the last 20 years, and a growing world population projected to reach 9 billion in 2050 is expected to exacerbate the demand for seafood products. The U.S. Department of Agriculture (USDA) is providing leadership to ensure that a healthy, competitive, and sustainable aquaculture sector produces an abundant, safe, and affordable supply of seafood products. USDA activities include:

- supporting economic development that creates jobs and opportunities in rural communities;
- designing aquaculture production systems that use aquatic resources for farming while maintaining healthy ecosystems;
- supporting and conducting research, education, and extension activities that train a skilled work force;
- developing new aquaculture technologies, from improved genetics to on-land recirculating aquaculture systems;
- protecting and overseeing aquatic animal health; and,
- providing marketing programs that educate consumers on the nutritional benefits of seafood products and the sustainable management of responsible aquaculture production.

Given USDA's extensive portfolio of programs supporting aquaculture, the Office of the Chief Scientist (OCS), agencies in the Research, Education, and Economics (REE) mission area, and the USDA Working Group on Aquaculture sought to provide the domestic aquaculture industry an opportunity to communicate on how USDA can best serve this farming community. In November 2020, USDA agency representatives, as part of an *Aquaculture is Agriculture Colloquium*, held six virtual "Deep Dive" listening sessions and a plenary session summarizing priorities communicated in the six sessions. USDA's Animal and Plant Health Inspection Service-Wildlife Services (APHIS-WS) also hosted an additional webinar for shellfish farmers to discuss issues related to aquaculture and wildlife interactions. The colloquium's 6 sessions drew over 300 participants who attended at least one session to represent industry, academia, state agencies, tribal agencies, and federal agencies. This report reviews the priorities identified during the colloquium by aquaculture stakeholders, federal program managers, the research community, natural resource regulators, and others to help guide future program directions and potential investments.

Session topics and participant recommendations are summarized below. However, one overarching request was for *USDA to review all agricultural support programs and ensure eligibility for aquatic farmers of fish, shellfish, and seaweeds*. Other recommendations include:

Aquaculture Production Research

- Continue to support aquaculture production research to meet the needs of U.S. aquaculture's diverse industries and products and to establish the United States as a global leader (a top 10 nation) in aquaculture production within the next decade.

- Aquaculture production research must include efforts to educate consumers about the value of U.S. farm-raised seafood and marine plants; use technology to reduce financial risks to farmers; reduce U.S. reliance on imports; and increase domestically produced/processed species in the market.

Aquatic Animal Health

- APHIS must lead the federal government in developing a national plan that ensures consistency and integrity in verifying animal health, supports and expand markets, and facilitates animal movement and trade.¹
- USDA, as the National Veterinary authority, should be the lead agency for aquatic livestock health.
- Address aquatic animal interstate and international trade issues that are significant problems for U.S. aquaculture producers because of varied state health requirements and varied state oversight for aquaculture.
- Adapt the current federal paradigm for livestock health management in aquaculture to cover diverse aquaculture species (i.e., fish, crustaceans, and mollusks), production settings (extensive to intensive), and end uses (food to stock enhancement).
- Address diagnostic assay issues facing U.S. aquaculture producers and develop meaningful surveillance programs.
- Support increased accessibility to veterinarians knowledgeable in aquatic animal and aquaculture.
- Increase support to develop and approve vaccines and drugs, and remove regulatory burdens/redundancies.

Environmental Management

- Ensure USDA staff know that aquaculture is eligible for farm programs.
- Fill extension positions that are open due to retirements, and support extension funding to engage and connect with farmers with Land Grant and Sea Grant University research.
- Strengthen relationships between the National Oceanic and Atmospheric Administration (NOAA) and USDA, such as closer collaboration among USDA extension and Sea Grant Marine Extension professionals.
- Provide more clarity on the environmental management roles within USDA.
- Engage the U.S. Environmental Protection Agency (EPA) on water quality and water quantity regulations.
- Research and technology transfer are needed in the areas of effluent reduction and treatment, water quality, water conservation, and alternative materials and coatings, such as biodegradable, anti-biofouling, and/or eco-friendly production gear, containers, and packaging.
- Develop lifecycle analyses to characterize the environmental footprint of aquaculture.
- Have a “stamp” or logo which communicates to consumers that domestic seafood is produced in compliance with rigorous, environmentally responsible regulations.

¹ Since the Colloquium, APHIS has revised and distributed for agency review a national aquaculture health plan.

- USDA involvement in U.S. offshore aquaculture should include marine aquafeeds development, production technologies, fish health management, and the identification and mitigation of emerging pathogens, predators, and pests.
- Advocate for aquaculture as a climate resilient approach to protein production.
- Update the regulatory framework for genetically modified organisms and demonstrate the effectiveness of biotechnology for genetic improvement.
- Work with EPA and agencies that have the bulk of regulatory burden for pesticide issues and support water quality and environmental management.

Aquaculture and Wildlife Interactions

- USDA has an excellent facility for conducting bird experiments on freshwater ponds; this capacity should be extended to include open-water shellfish farms.

Production Innovation and Technology

- USDA's National Institute for Food and Agriculture (NIFA) should continually adjust program area priorities for aquaculture-specific requests for applications to address automation, non-invasive sampling, genetic improvement, closing lifecycles of non-domesticated species, and fish nutrition.
- USDA should support activities that expand educational and extension impact where possible.

Product and Consumer Marketing

- Work with industry to further expand the pool of approved vendors for aquaculture items procured by USDA's Agricultural Marketing Service (AMS) and to explore the potential for purchasing new forms of aquaculture items. Colleagues with AMS and USDA's Food and Nutrition Service (FNS) are interacting with federal nutrition program recipients to garner feedback about food preferences and demand. AMS is working directly with trade associations and individual companies to facilitate future purchases of aquaculture and seafood products.
- Work with the farming community to facilitate development of the AMS Process Verified Programs. AMS can help industry understand requirements, can provide feedback on draft programs, and independently audit final programs. This type of assistance would help consumers understand that domestic farmed seafood is produced in compliance with rigorous, environmentally responsible regulations.
- Engage with the aquaculture community to complete the development of organic production standards for aquaculture products.

Supporting Aquaculture

- Deliver programs and ensure they include aquaculture and aquaponics.
- Work at the state, regional and national level to promote aquaculture's eligibility for rural business programs.
- Work to broaden stakeholder engagement to include aquaculture producers.
- Work to update and enhance USDA insurance products for aquaculture producers.
- Work at the regional and national level to explain USDA programs to stakeholders and to develop strong relationships with aquaculture producers.
- Educate county, state, and national staff that aquaculture is agriculture.

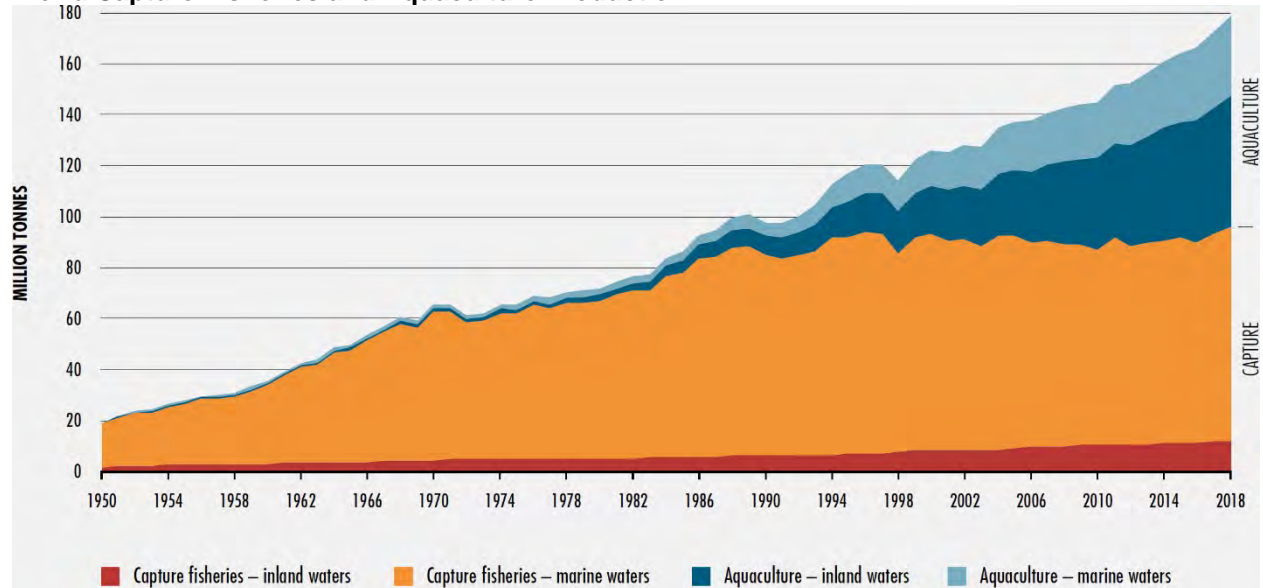
- Encourage stakeholders to become active in their local county offices by establishing a relationship with and/or running for county committees.
- Review programs such as USDA's Noninsured Crop Disaster Assistance Program (NAP) to determine if aquaculture producers are eligible to participate.

Recordings of the Webinar Presentation Files are posted here:
<https://www.usda.gov/topics/farming/aquaculture>

Introduction

Aquaculture is the production of aquatic organisms under controlled conditions throughout part or all their lifecycles. In 1980, Congress declared “... *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.*”

World Capture Fisheries and Aquaculture Production



NOTE: Excludes aquatic mammals, crocodiles, alligators and caimans, seaweeds and other aquatic plants.
SOURCE: FAO.

U.S. aquaculture production is growing because demands for healthy seafood products are increasing. However, global stocks of wild-caught seafood have remained stable over the last 20 years, and a growing world population projected to reach 9 billion in 2050 is expected to exacerbate the demand for seafood products. USDA is providing leadership to ensure that a healthy, competitive, and sustainable aquaculture sector can produce an abundant, safe, and affordable supply of seafood products. USDA activities include:

- supporting economic development that creates jobs and opportunities in rural communities;
- designing aquaculture production systems that use aquatic resources for farming while maintaining healthy ecosystems;
- supporting and conducting research, education, and extension activities that train a skilled work force and support the development of new aquaculture technologies;
- overseeing aquatic animal health; and

- providing marketing programs that educate consumers on the nutritional benefits of seafood products and the sustainable management of responsible aquaculture production.

The greatest constraints to the growth of U.S. aquaculture have been the inappropriate application of a regulatory environment designed for terrestrial agriculture and the lack of a comprehensive economic development plan. These constraints have prevented many segments of U.S. aquaculture from expanding to meet growing local demand for their products and competing effectively against imported products. In addition, some states regulate U.S. aquaculture using a framework designed for terrestrial agriculture, while other states regulate U.S. aquaculture using a framework designed for public-sector management of natural resources. Neither approach is useful for supporting or promoting the expansion of U.S. aquaculture.

Given USDA’s extensive portfolio of programs supporting aquaculture, the Office of the Chief Scientist, agencies in the Research, Education, and Economics mission area, and the USDA Working Group on Aquaculture sought to provide the domestic aquaculture industry an opportunity to communicate on how USDA can best serve this farming community. In November 2020 USDA agency representatives, as part of an *Aquaculture is Agriculture Colloquium*, held six virtual “Deep Dive” listening sessions (in addition to an APHIS-WS special webinar for shellfish farmers) to engage stakeholders on the subjects below (Table 1).

Deep Dive Topic	Event Information
Aquaculture Production Research	November 30, 2020: hosted by NIFA and co-hosted by ARS
Aquatic Animal Health	November 10, 2020: hosted by APHIS and co-hosted by ARS and NIFA
Environmental Management	November 9, 2020: hosted by NRCS and co-hosted by APHIS, ARS, NIFA, and OCE
Production Innovation and Technology	November 20, 2020: hosted by NIFA and co-hosted by ARS and ERS
Product and Consumer Marketing	November 20, 2020: hosted by AMS and FNS
Supporting Aquaculture	November 16, 2020: hosted by RD, FSA, and RMA
Bird Management and Coastal Shellfish Production	February 17, 2021: Hosted by APHIS-WS

Table 1. Deep Dive Session topics, dates, and host agencies.

These sessions were attended by 265 unique participants representing USDA, other government agencies, academia, and the private sector (see Appendix 1). On December 11, 2020, USDA hosted a “*Aquaculture is Agriculture: USDA’s Role in Supporting the Farmers of Fish, Shellfish, and Aquatic Plants*” webinar that was attended by 303 participants. This webinar also included plenary presentations from USDA leadership and industry representatives and report - outs from listening session hosts on feedback provided to USDA (Appendix 2). This white paper summarizes these events and stakeholder recommendations for how USDA can best serve aquaculture stakeholders. Recordings of the Webinar Presentation Files are posted to <http://www.USDA.gov/topics/farming/aquaculture>

The Colloquium provided context for both stakeholders and USDA leadership on how to strengthen domestic aquaculture. USDA leaders and scientists heard directly from aquaculture stakeholders—farmers, scientists, and supporting industries—on prioritized industry research needs, critical needs for resource investments, and how accountability for these investments could be evaluated.

Summary of USDA Mission Areas and Agencies Supporting Aquaculture

USDA representatives participate in interdepartmental coordination activities through the National Science and Technology Council’s (NSTC) Subcommittee on Aquaculture (SCA), serving as Co-chair and providing leadership on various task forces. USDA coordinates activities within the Department through its Working Group on Aquaculture to:

- continually improve USDA customer service to the aquaculture community; and
- provide USDA support for a federal economic development initiative on aquaculture.

USDA primarily supports aquaculture through programs administered by 15 agencies across the following seven mission areas; more detailed information is provided in Appendix 3.

Food Safety (FS) Mission Area

Food Safety Inspection Service (FSIS) ensures that the Nation's commercial supply of meat, poultry, and egg products is safe, wholesome, and properly labeled and packaged.

Marketing and Regulatory Programs (MRP) Mission Area

Agricultural Marketing Service (AMS) and *Animal and Plant Health Inspection Service (APHIS)* facilitate domestic and international marketing of U.S. agricultural products, ensure the health and care of animals and plants and mitigate human-wildlife conflicts.

Food, Nutrition, and Consumer Services (FNCS) Mission Area

Food and Nutrition Service (FNS) harnesses the Nation's agricultural abundance to end hunger and improve health in the United States. Its agencies administer federal domestic nutrition assistance programs and the Center for Nutrition Policy and Promotion, which links scientific research to the nutrition needs of consumers through science-based dietary guidance, nutrition policy coordination, and nutrition education.

Farm Production and Conservation Service (FPAC) Mission Area

Farm Service Agency (FSA), *Natural Resources Conservation Service (NRCS)*, and *Risk Management Agency (RMA)* serve as USDA’s focal point for the nation’s farmers and ranchers and other stewards of private agricultural lands and non-industrial private forest lands. FPAC agencies implement programs designed to mitigate the significant risks of farming through crop insurance services, conservation programs, technical assistance, and with commodity, lending, and disaster programs.

Trade and Foreign Agricultural Affairs (TFAA) Mission Area

Foreign Agricultural Service (FAS) provides farmers and ranchers with opportunities to compete in the global marketplace. *Trade and Foreign Agricultural Affairs (TFAA)* is the Department’s lead on trade policy with primary responsibility to ensure USDA speaks with a unified voice on international agriculture issues domestically and abroad.

Research, Education, and Economics (REE) Mission Area

Office of the Chief Scientist (OCS), Agricultural Research Service (ARS), Economic Research Service (ERS), National Agricultural Statistics Service Research, (NASS) and National Institute of Food and Agriculture (NIFA) support research, education, and economic activities dedicated to the creation of a safe, sustainable, competitive U.S. food and fiber system, as well as strong communities, families, and youth through integrated research, analysis, and education.

Rural Development (RD) Mission Area

Rural Business-Cooperative Service (RBS), Rural Housing Service (RHS), and Rural Utilities Service (RUS) improve the economy and quality of life in rural America through loans, grants, and loan guarantees to help create jobs and support economic development and essential services.

Aquaculture Production Research

U.S. aquaculture is highly diverse. Some activities have been conducted for at least 150 years, while others have become part of the aquaculture industry only recently. As a result, research needs for well-established aquaculture (i.e., catfish, trout, salmon, shrimp, oysters) are different than research needs for emerging activities (i.e., marine finfish, seaweed).

U.S. aquaculture relies on federal investments to stimulate aquaculture research and development. Love et al. (2017)² analyzed federal research spending for aquaculture using a large database of 2,957 U.S. federal research grants awarded from 1990 to 2015. During that period, \$1.04 billion was spent on aquaculture research, with \$919 million from federal agencies and \$123 million in matching funds. By comparison, over the same period, the USDA's research and development (R&D) spending was \$41 billion. However, it is important to note that since 2000, federal grant funding for aquaculture has had a 37-fold return on investment. Currently, USDA primarily supports aquaculture production research through extramural programs administered by NIFA and intramural projects in ARS.

National Institute of Food and Agriculture (NIFA)

NIFA provides funding for aquaculture research, technology development, and extension programs, and its current aquaculture research and extension funding is highly diverse. NIFA's funding of scientific and technology transfer goals to support development of a globally competitive U.S. aquaculture industry include:

- improving the efficiency of U.S. aquaculture production and systems;
- improving the sustainability and environmental compatibility of aquaculture production;
- ensuring and improving the quality, safety, and variety of aquaculture products for consumers; and
- improving the marketing of U.S. aquaculture products.

NIFA funds aquaculture research projects through a combination of competitive grants, either formula grants or capacity grants. Over the past 5 years, NIFA has funded more than 220 competitive research projects, including more than \$90 million dollars invested in 57 Small Business Innovation Research (SBIR) ventures and 64 projects through Regional Aquaculture Centers (RACs). NIFA's Agriculture and Food Research Initiative (AFRI) supports foundational and applied research in genetics, reproduction, nutrition, health, production systems, and safety, with broad applicability that includes aquatic species and systems. Awards vary from \$100,000 in phase I of SBIR to \$10 million in the Sustainable Agriculture Systems program. NIFA annually invests approximately \$21 million in aquaculture research, education, and extension research and capacity efforts.

Agricultural Research Service (ARS)

Aquaculture research in ARS is conducted primarily through National Program 106 to support its vision of science-based use of our natural resources to meet the seafood demands of a growing

² Love, D.C., I. Gorski and J.P. Fry. 2017. An analysis of nearly one billion dollars of aquaculture grants made by the U.S. federal government from 1990 to 2015. *Journal of the World Aquaculture Society*. 48(5): 689-710.

global population and the mission of conducting research and delivering technologies that improve domestic aquaculture production efficiency and product quality while minimizing impacts on natural resources. Primary species of interest include catfish, rainbow trout, Atlantic salmon, hybrid striped bass, eastern and Pacific oysters, shrimp, and marine finfish. Research projects for each species include breeding and genetic improvement, nutrition, health, production systems, and product quality. In addition to National Program 106, ARS conducts aquaculture research on germplasm preservation and shellfish food safety. This annual \$48 million portfolio is administered through 10 laboratory locations with 14 projects performed by 62 ARS scientists and funded collaborations with 12 cooperating institutions. Research outcomes include:

- Providing improved genetic stocks and genome-enabled breeding strategies
- Management practices and production systems that improve farm efficiency, profitability, sustainability, animal health, and well-being
- New feed formulations based on sustainably sourced ingredients
- Diets optimized for growth and reproductive efficiency
- Tools and technologies for preventing losses to disease

Listening Session Information

On November 30, 2020, Amrit Bart and Christopher Green of NIFA led the *Aquaculture Production Research Deep Dive Listening Session* which had 79 participants. Email affiliations indicated that 22 attendees were from USDA, 11 were from other government agencies, 14 were from academia, and 32 were from the commercial sector. The Listening Session started with introductory information from Amrit Bart and Christopher Green from NIFA and Caird Rexroad from ARS; plenary and breakout discussion sessions followed. During the plenary session, the group discussed USDA support for aquaculture production research:

- what has worked, and
- what more is needed to take U.S. aquaculture to the next level.

After the plenary session, the group self-selected into three smaller groups to address more specific production research challenges associated with finfish, shellfish, and algae/seaweed production. Each group considered three questions:

- What are the most pressing production research needs?
- What can USDA do to help make research funding and results more accessible to the community?
- What should U.S. aquaculture look like in 10 years?

The following summarizes some of the salient points discussed and suggestions made during the November 30 plenary and breakout sessions.

General Stakeholder Feedback

What are some of the USDA-supported aquaculture production research topics and how have they been impactful? What role/s should the USDA and its agencies play to support production research to take aquaculture to the next level?

Deliberate and strategic investment in aquaculture is critical for taking the industry to the next level. For example, USDA supported aquaculture by investing in innovative initiatives during the late 1990s when the catfish industry was facing hardship. Deliberate investments by ARS and NIFA in high-intensity aeration, split-ponds, and hybrid catfish research through programs such as SBIR, RACs, and the Aquaculture-Specific Program (AQUA) competitive funding helped sustain the industry.

Research on diversifying U.S. aquaculture species is important for production expansion. This could be done using the European example where consortia projects are formulated on a single species of interest and projects are funded at different institutions to explore different production aspects, such as lifecycle, nutrition, breeding, culture system, and other areas. It is important for USDA to continue to support research and development of established species (i.e. catfish, trout, salmon, oysters) along with new and higher value species.

Funding for modern research labs, particularly those useful to the industry, is important to small scale producers. USDA's role in directing funding to innovators and assisting with expertise in areas that most farmers don't have access to is critical. Projects should be designed to work with commercial hatcheries and producers as much as possible. Closer communication and collaboration between USDA, university labs, producers, and hatcheries are critical to minimize competition—such as a government laboratory providing fingerlings when a commercial supplier is available—and the cost of developing and maintaining modern laboratories.

The program run by RACs, in which the industry develops problem statements and works with technical advisory teams from universities to formulate research questions, has resulted in excellent applied research projects. This type of methodology, in which industry has its share of input into research, is critical to the success of U.S. aquaculture. NIFA funding for aquaculture production research, however, has been flat for a long time (e.g. AQUA, RACs) and its stakeholders need to advocate more effectively for additional resources to support the needed work that comes out of these programs.

Coastal and open ocean/offshore aquaculture holds promise and its development will be necessary for significantly increasing production levels. This will require investments in basic infrastructure. There are clear roles for USDA and NOAA; USDA can conduct feed, seed, health, and systems research for offshore marine species, and NOAA can investigate and develop citing regulations. Some RACs have already been supporting hatchery research on targeted fish species that could be farmed in offshore cages, and this work could serve as a starting point for additional investigations. USDA has also supported shellfish production research on oyster herpes virus microvariant – 1 (OsHV-1) disease resistance, resilience to ocean acidification, and triploid oyster mortality. NOAA is conducting research to improve the production of sterile oysters, a novel approach that could lead to lower mortality. Projects like this provide opportunities for USDA (ARS/NIFA) to collaborate with NOAA scientists.

Significantly increasing domestic aquaculture production will require low-cost and high-quality fish feeds, and the feeds industry would like to see funding in alternative feed ingredients. There are ample opportunities in industry for co-production of quality feed products for aquaculture. For example, in an integrated system of a fish farm located next to an ethanol plant, the fish can consume the dried distillers' grains and solubles (DDGS) remaining after carbohydrate extraction for ethanol. The feed industry is hopeful that USDA will support research for alternative feed ingredients.

Language in requests for applications is critically important to ensure key applicant groups are not excluded. USDA funding announcements should be written to ensure the inclusion of 'aquaculture practitioners' who may not see themselves as 'industry' (e.g. tribal enterprise or nonprofits) but are nonetheless qualified and could make valuable contributions to research.

More high-quality proposals result in more funding, especially in the SBIR program. The industry appreciates the direct support SBIR provides to farmers and efforts are needed to disseminate information about the SBIR program to attract more high-quality applications.

Breakout Session: Finfish Production Research Feedback

What are the most pressing finfish production research issues, and what can USDA do to help make research funding and results more accessible to the community? What can USDA do to make production research funding or research results more accessible to the aquaculture community?

Year-round availability of affordable high-quality seed (eggs, larvae, fry, and fingerlings) is important to the growth of aquaculture. Robust hatchery systems for warmwater marine species are also needed. Seed production costs are high, particularly for novel species, and this is often a function of volume and hatchery systems (indoor vs. outdoors). High-volume production of seed is clearly impeded by lack of grow-out customers. While U.S. marine aquaculture needs more grow-out producers, the greatest opportunities exist in the access to coastal and open ocean production sites. USDA could help connect stakeholders through resources, conferences, or networking opportunities.

Research on broodstock nutrition is very important; much work is needed on warmwater marine finfish grow-out diets that are specifically formulated for recirculating aquaculture systems. Many hatcheries are now using feed containing fresh fish and shrimp supplemented with vitamins, but this contains feed quality risks and biosecurity risks from fish or shrimp that may carry disease. It is difficult to commercially produce small quantities of feed for specific broodfish species, but a commercial base broodfish feed would be incredibly valuable; USDA could help coordinate this work to prevent duplication.

Half the weight of all catfish processed leaves the plant as offal waste and is processed into ingredients such as fish meal and fish oil. USDA should continue to fund research that designs collection systems and value-added markets of individual offal components. Many commercial species in Iceland and Norway use processing waste to produce oil and fish meal. There needs to be an industry solution to attain commercial volumes of single offal components (eggs, bladders, skin, etc.) to market.

One of the higher costs of production is energy and electricity for pumps, cooling, lighting, and other system components. Studies on alternative low-cost energy sources and increasing energy efficiency will help producers. Funding for research on bioenergetics and optimizing systems for specific culture system is also needed. Studies on optimizing the production process for novel marine finfish species is also needed.

Aquaculture operations have limited tools for disease diagnostics and treatment, and many private farms cannot afford to conduct disease work. USDA and NOAA should continue to fund more collaborative research in developing disease prevention (vaccines) and treatment options.

Breakout Session - Shellfish Production Research Feedback

What are some of the most pressing issues in shellfish production research and where should USDA focus?

There is an enormous opportunity for shellfish culture (oysters, mussel offshore using longlines) in U.S. waters. Consistent with recent Executive Order 13921 to expand offshore aquaculture (Aquaculture Opportunity Areas), the industry would like to see USDA invest more on research on domestic shellfish production. The shellfish industry is looking to innovate and mechanize to reduce labor. There are lessons about this type of innovation overseas, such as automated aquaculture in New Zealand, Denmark, Finland, and the Netherlands. USDA should look for ways to help the industry develop collaborative partnerships with institutions that have the history and expertise in developing modern aquaculture infrastructures.

Climate change is already affecting the hydrologic parameters, such as water flow and water chemistry, of shellfish production. USDA should focus on proposals to carry out research on shellfish heat tolerance/disease resistance. One key concern is the recent oyster herpes virus microvariant outbreak that wiped out oyster industries in some countries, and practitioners are hoping for ARS/NIFA funding on research to produce disease resistant oysters.

Another pressing problem today for oyster hatcheries is triploid survival. Mass mortality from heat and/or diseases are becoming common. Breeding oysters resilient to changing climate conditions could be one of the research priority areas for USDA.

Coastal production systems (estuaries) are having major problems with burrowing shrimp (ghost and mud shrimp). Pest control is a challenge, and a USDA program designed to address native aquatic pest species could be important to the industry looking ahead. ARS funding has provided some assistance with burrowing shrimp, but more is needed. In addition, the non-native European green crab has become a problem in some production areas.

There are an overwhelming number of grant programs at USDA that support aquaculture. Some are housed in competitive grant sites and others are capacity grants located elsewhere. A communication platform that brings all relevant information together, particularly grant funding opportunities, would be extremely useful. A one-pager that introduces all resources available, including ongoing and upcoming RFAs with deadlines, would be helpful. Dissemination of information should not be limited to the current NIFA listserv, but should also include industry listservs and other relevant outlets.

Breakout Session – Algae and Seaweeds Production Research Feedback

What are some of the most pressing issues in algae and seaweed production research and where should USDA prioritize its funding support?

Algae and seaweeds include marine algae (which grows in saltwater only), kelp (a type of brown macroalgae), sea lettuce (a type of green macroalgae), and other types of seaweed. There are opportunities to grow seaweeds in tanks as well as in open water. Warming water temperatures and heat waves associated with climate change can harm macroalgae production, and producers need information on how to mitigate this harm. Seaweeds for cosmetics seem to grow well in tanks; producers are cautious about open ocean farming, but are receptive to more near-shore farming. More research should be allocated to determine how farmers could transition from traditionally grown open water system to tank-based facilities.

Offshore seaweed production is facing challenges. North Atlantic right whale protections are a concern for growing kelp offshore, and upcoming regulations in California will protect gray and humpback whales. Whale entanglements are currently occurring with crab pot fisheries and similar issues could arise for future seaweed farms established in offshore waters, since whales forage in seaweed forests.

Some technical literature is available on seaweed and algae reproduction and growth. However, more focused research is needed on mass production, integrated production, and production optimization in different environmental and culture conditions. Practitioners are also greatly interested in studies on markets and marketing.

Kelp growth in coastal environments is highly variable from year to year, which results in inconsistent production. Bull and sugar kelp, for example, are sensitive to upwelling conditions—strength, temperature, light access, and water nutrients—that change over time. Seaweed farmers also are challenged by the extremely unpredictable nature of production, and some farmers in Washington deal with this uncertainty by planning for low nutrient/low production years. Studies are needed on developing strains of algae and seaweed for optimized production in different environmental and culture conditions.

Research is still needed on macroalgae breeding and growth, and research results need to translate into applications that enhance growth, mass-production, and farming practices. Research is needed on developing predictive models that can help farmers adapt to changing climate parameters, and USDA could help fund this research.

Sea lettuce grown in U.S. waters has a higher nutritional value than sea lettuce from Asia or South America and could be produced commercially. More information is needed about its high nutrient levels, ways to enhance yields, and how different environmental factors in U.S. waters affect product quality.

Not much is known about nutritional value of seaweed. A focused set of studies on the nutritional value of seaweed will help in marketing seaweeds. Research is needed to support opening and expanding marketing opportunities that promote the nutritional benefits and ecosystems services of seaweed. USDA can play a role by conducting and funding studies on seaweed nutrition research gaps.

There is tremendous interest in the Pacific Northwest to farm seaweed. One area of interest is in the mitigation of ocean acidification, which can harm shellfish production. Seaweed is known to clean polluted waters through nutrient uptake, so its potential role in restoring environmental quality could enhance its profile both as a food product and as a beneficial environmental agent. Seaweed and algae might be used to create fertilizer and improve soil quality, and their use in animal feed has resulted in improved reproduction and health and reduced GHG emissions in ruminant animals. As more evidence becomes evident on the benefits of algae and seaweed, there is likely to be higher market demand for its products.

Seaweed can take up undesirable chemicals (arsenic, PCBs etc.) and heavy metals from water. To determine optimal schedules for harvesting seaweed, information is needed about how levels of these contaminants may fluctuate over time. Washing seaweed can remove some of the contaminants, but there is limited guidance on procedures for this practice. Research is needed on pre-wash and post-wash protocols for seaweed and how these protocols affect nutrition and taste. USDA should focus on funding research on chemical residues in seaweed and harmful algal toxins associated with seaweeds, which would help alleviate food safety concerns and enhance marketing efforts. Preservation techniques and technologies for dried seaweed products should also be explored to improve processing, regulatory efficiency, and food safety.

Despite significant interest, the domestic market for algae and seaweed (including kelp) is limited, and domestic seaweed production far exceeds market demands. Many producers market their seaweed without public support. Offshore operations can mass produce seaweed, and the market for bulk seaweed is primarily for Asian markets, but there is a disconnect between large bulk production and existing markets. The United States needs to focus on developing the potential U.S. market for seaweed and microalgae, which could be marketed as Made-in-the-USA products. USDA needs to help create an aggressive marketing strategy for microalgae products. The leveraging point for U.S. seaweed is a cleaner, high-end nutritional products.

There is no verification program for seaweed. Industry standards currently do not exist, and the United States is a long way from developing national standards. Farmers are also unsure which government agencies are responsible for the oversight of seaweed and algae production.

Next Steps and Recommendations

NIFA and ARS should support aquaculture production research to meet the needs of the many plant and animal species and industries that exists within U.S. aquaculture. Participants agreed that in 10 years, the United States should be ranked as one of the top ten global aquaculture producers. USDA aquaculture production research must include efforts to inform consumers on the value of U.S. farm-raised seafood, including marine plants; must help reduce risks to farmers; must help reduce reliance on imports; and must support the increased production of domestically produced/processed species for the market.

Aquatic Animal Health

Animal production losses and associated costs due to pests and pathogens have economic and ecological impacts across the aquaculture sector. In addition to direct production losses, disease can have broader indirect impacts on surrounding ecosystems, public perceptions, demands for cultured products, and policy decisions. Accordingly, USDA focuses on understanding priority disease issues and developing tools and capabilities to proactively address them.

USDA houses several agencies that have critical regulatory and non-regulatory roles in overseeing and supporting the health of aquaculture as a livestock farming practice and the health of the aquatic animals cultured for a diversity of end uses, such as human consumption, pets and public display, recreation, conservation, and research. These agencies include NIFA, ARS, and APHIS operational units Veterinary Services (VS), Animal Care (AC), Wildlife Services (WS), and Plant Protection and Quarantine (PPQ) for aquaculture plants such as marine macroalgae, or seaweeds.

Animal and Plant Health Inspection Service (APHIS)

APHIS protects the health of U.S. agriculture and natural resources against invasive pests and diseases, regulates genetically engineered crops, administers the Animal Welfare Act, and helps people and wildlife coexist. APHIS also certifies the health of U.S. agricultural exports and resolves phytosanitary and sanitary issues to open, expand, and maintain markets for U.S. plant and animal products.

National Institute of Food and Agriculture (NIFA)

NIFA supports extramural aquatic animal health research programs that aim to better understand the biology of disease; develop disease prevention strategies, diagnostics and surveillance protocols; and generate data to support the labelling of drugs for minor use species.

Agricultural Research Service (ARS)

As a part of its research portfolio, ARS conducts intramural research on fish and shellfish health, primarily targeting alternatives to antibiotics via genetic improvement or vaccines that reduce or eliminate the impacts of bacterial and viral pathogens and pests.

Listening Session Information

On November 10, 2020, Kathleen Hartman of APHIS hosted the *Aquatic Animal Health Deep Dive Listening Session*. The listening session had 109 participants; email affiliations indicated that 31 attendees were from USDA, 21 were from other government agencies, 17 were from academia, and 40 were from the commercial sector.

The session started with introductions from Kathleen Hartman from APHIS, Caird Rexroad from ARS, and Amrit Bart and Timothy Sullivan from NIFA. Session registrants were provided “think tank” questions prior to the event and during the session three break-out discussion rooms were created to facilitate small group discussions based on these questions.

General Stakeholder Feedback

What is APHIS' role for aquatic animal health – is it or should it be different than our role for other “traditional” livestock?

Participants indicated strong support for APHIS to serve as the lead federal department for aquatic animal health oversight and indicated USDA needs to “lean in” into this role more than it has to date. USDA fills this role for “traditional” livestock species such as cattle, poultry, and swine through surveillance and eradication programs, biosecurity guidance, import controls, and emergency response and planning. However, given the diversity of aquaculture—the number of species in production (from vertebrates to invertebrates), varied production methods and settings, and numerous end uses of aquatic plants and animals—participants recognized that aquaculture does not fit well into current “traditional” livestock models. The variety of aquaculture enterprises challenges the sensibility of the traditional approach through pathogen-centric models, such as the tuberculosis and brucellosis programs for livestock and wildlife. Aquaculture requires a more comprehensive approach to managing livestock health.

What are the biggest obstacles for APHIS to be viewed as the federal lead for aquatic animal health?

Participants felt that the greatest challenges facing APHIS as the federal lead for aquatic animal health are limited resources, funding, and expertise allotted to APHIS for aquaculture oversight. In addition, the lack of an updated national approach, infrastructure, and strategy for addressing and responding to aquatic livestock health issues compromises leadership and impedes effective coordination and communication for advancing and supporting aquaculture health in the United States.

What gaps exist for APHIS to meet the needs of domestic aquaculture health needs?

Strengthening APHIS' leadership role and organization for aquatic animal health and improving communications with state agencies were identified as areas that need the greatest attention. Addressing both issues will be a pre-requisite to solving some of the long-term problems facing domestic industry sectors, such as the lack of consistent and meaningful health requirements for interstate movement of aquatic animals and pathogen testing standardization.

How can APHIS strengthen work with stakeholders/partners across such a diverse industry?

Participants stressed that it is important for APHIS to focus its efforts and policy development on industry problems and to create practical and applicable solutions. APHIS needs to develop meaningful guidance for stakeholders, improve communication and strengthen partnerships. Participants emphasized the need for APHIS to strengthen partnerships with states and promote risk-based approaches to support planning and advances in aquatic animal health.

If there were two things APHIS could do TODAY to protect/promote aquatic animal health – what would they be?

- Implement import health controls for aquatic animal pathogens that pose a threat to domestic aquatic livestock and natural resources.
- Work to increase the availability of biologics such vaccines and diagnostic kits to achieve early disease detection. Further, the regulatory process for biological approval for these

minor species should be competitive with, not more restrictive than, regulatory approval processes in foreign countries.

- Assist with strengthening the veterinary workforce through trainings, educational material, and guidance on best practices for veterinarians working with aquaculture clients.
- Conduct a needs assessment survey, like those performed by the National Animal Health Monitoring Service (NAHMS), for domestic aquaculture industry sectors.
- Continue to communicate, collaborate, and work with state agencies and foreign counterparts to improve efficient requirements regulations for aquatic animal movement both domestically and internationally.
- Create more opportunities for cooperative agreements, competitive awards that advance aquatic animal health programs, and technologies and opportunities for awards that promote investigating the seafood supply chain and improving the management of live animals to support wholesome seafood.
- Make indemnity funds available for farms that must cull diseased animals.
- Develop a new national aquaculture health plan that provides a comprehensive infrastructure to support aquatic animal health inspections, secures safe aquatic animal movement, and positions U.S. aquatic livestock and products as the safest, most nutritious and affordable in the world.³

Next Steps and Recommendations

- USDA should strongly support the concept that aquaculture ***IS*** agriculture/farming, and USDA should be the agency recognized as the lead for aquatic livestock health.
- USDA should address issues associated with aquatic animal movement (interstate) and trade (international) that are significant problems for U.S. aquaculture producers because of varied state health requirements and varied state oversight for aquaculture.
- USDA should adapt the current federal paradigm for livestock health management for aquaculture because of the diversity of aquaculture species (i.e., fish, crustaceans, and mollusks), production settings (extensive to intensive), and end uses (food to stock enhancement).
- USDA should address diagnostic assay issues facing U.S. aquaculture producers and develop meaningful surveillance programs, both on the farm and in aquaculture health zones.
- USDA should support the development of import health requirements to protect U.S. producers and their livestock (and/or natural resources) from the introduction of foreign animal pathogens.
- USDA should support increased accessibility to veterinarians knowledgeable in aquatic animal and aquaculture.
- USDA should increase support to develop and approve vaccines and drugs, and remove regulatory burdens/redundancies.

³ Since the Colloquium, APHIS has revised and distributed for agency review a national aquaculture health plan.

- USDA must lead the federal government in developing a national plan that provides consistency and integrity to verify animal health, supports and expands markets, and facilitates movement of animals.

Environmental Management

U.S. aquaculture is regulated by environmental protection laws that encourage producers to adopt efficient farming systems and help conserve natural resources. These systems optimally require limited space and fresh water, have low carbon footprints, and often provide restorative ecosystem services. The Clean Water Act is one of the key environmental protection laws protecting U.S. natural resources. However, other federal legislation also includes environmental protections, and states have been delegated Clean Water Act responsibilities and can be more restrictive as needed to address and mitigate regional issues and concerns.

Most pond production in the United States is in static ponds that release little to no discharge to the environment. These pond production practices are recognized by the EPA, and a National Pollutant Discharge Elimination System (NPDES) permit is not typically required due to their limited discharge. Raceway production of trout has been combined with extensive effluent treatment systems (i.e., quiescent zones, offline settling basins) that reduce nutrient release to the environment. Other “open” production systems must comply with Clean Water Act permitting and with extensive influent and effluent monitoring. In addition, most aquaculture farms engage in various water conservation practices to conserve resources and reduce pumping costs.

USDA has several direct roles in environmental management, primarily through APHIS’ role as the federal lead for animal health and wildlife conflicts. In contrast, the role of other USDA agencies/offices in environmental management is primarily an indirect role. This oversight includes:

- regulatory consultation with other federal and state agencies;
- voluntary conservation programs for farmers to conserve land and address natural resource issues on their land;
- intramural and extramural research programs that discover and transfer innovative solutions to reduce the impact of aquaculture on the environment (and vice versa), including support for federal laboratories, extramural research universities, and institutes; and
- networks of extension educators (i.e., USDA Cooperative Extension) that work closely with aquaculture farmers.

Animal and Plant Health Inspection Service (APHIS)

APHIS protects the health of U.S. agriculture and natural resources against invasive pests and diseases, regulates genetically engineered crops, administers the Animal Welfare Act, and helps people and wildlife coexist. APHIS also certifies the health of U.S. agricultural exports and resolves phytosanitary and sanitary issues to open, expand, and maintain markets for U.S. plant and animal products. APHIS’ Veterinary Services (APHIS VS) is the lead unit for preventing, controlling, and eliminating aquatic animal pathogens and pests and for oversight of aquaculture and aquatic livestock health programs. APHIS’ Wildlife Services (APHIS WS) provides federal leadership and expertise to resolve wildlife conflicts with humans and agriculture.

Office of Pest Management Policy (OPMP)

OPMP, housed in the USDA Office of the Chief Economist, plays a role in considering policy, risks, benefits, and alternatives for pest management and pesticides. OPMP provides expertise to USDA and other agencies on pesticides, including piscicides, anti-fouling agents, algicides, sanitizers, disinfectants, vertebrate repellents/control, herbicides, and anti-microbial active ingredients, usually associated with food and water processing. In addition, OPMP plays an important statutory role in periodic EPA Pesticide Registration Review through direct engagement with EPA, pesticide users (including federal agencies), registrants, and other stakeholders on proposed risk mitigations and impactful pesticide label changes, as needed.

Natural Resources Conservation Service (NRCS)

NRCS provides technical expertise, conservation planning, and financial assistance for farmers, ranchers, and forest landowners wanting to make conservation improvements to their land. These programs are voluntary and help agricultural producers (including aquaculture producers) better manage the land and natural resource concerns on their operations. This includes natural resource concerns potentially important for aquaculture, such as water management, wildlife enhancement, energy conservation, and engineering. [Local service centers](#) provide information on applying for NRCS technical and financial assistance.

Agricultural Research Service (ARS)

ARS conducts intramural research and delivers technologies that improve domestic aquaculture production efficiency, animal health and well-being, nutrition, genetic improvement, and product quality, while minimizing impacts on natural resources. Research under National Program 106, Aquaculture, is conducted on a variety of commercial aquaculture species. Current research includes shellfish and freshwater and marine finfish farmed across a diverse array of production systems, including ponds, raceways, re-use and recirculating tanks, and net pens.

National Institute of Food and Agriculture (NIFA)

NIFA addresses national needs for extramural aquaculture research, education, extension, and technology transfer to support U.S. aquaculture production. This includes administering the Regional Aquaculture Center program, which was established by statute in 1985, and funding aquaculture extension educators via Cooperative Extension at Land Grant Universities. NIFA's research investment addresses diverse freshwater and marine aquaculture research areas and species.

Listening Session Information

On November 9, 2020, USDA hosted the *Environmental Management Deep Dive Listening Session*, which was attended by 80 participants. Email affiliations indicated that 21 attendees were from USDA, 25 were from other government agencies, 7 were from academia, and 27 were from the commercial sector.

USDA representatives presented their efforts towards environmental management of U.S. aquaculture, including Gene Kim and Jan Surface from NRCS (Session Chairs), Teung F. Chin and Clayton Myers from OPMP, Kathleen Hartman from APHIS, Amrit Bart and Timothy Sullivan from NIFA, and Caird Rexroad from ARS. During the session, Session Chairs posted a series of thought-provoking questions to stimulate the conversation, especially from non-federal

stakeholders. Given the high number of attendees, participants broke into two randomly assigned sub-groups to discuss and receive feedback, which was recorded, summarized, and presented during the December webinar.

General Stakeholder Feedback

During the session, three general themes for USDA to address environmental management issues were presented on behalf of U.S. aquaculture. Attendees expressed support for USDA to view aquaculture as agriculture. Agriculture protection and “right to farm” issues are very important to both the established and growing portions of the industry, including small family farms that make up the majority of the U.S. aquaculture industry, which occurs primarily in freshwater and coastal environments. Currently, the emerging offshore aquaculture sector has only a few commercial operations.

Participant feedback on the need for continued/expanded USDA support is summarized below:

Stakeholders expressed the need for USDA capacity building and outreach to improve aquaculture knowledge and expertise throughout USDA agencies and at other federal agencies. This would improve assistance for aquaculture producers who apply for USDA farm programs and inform partner agencies in their regulatory process on the current practices and concerns of U.S. aquaculture.

Capacity building is needed for better customer service and informing the regulatory process. Knowledge and expertise on aquaculture is needed throughout the USDA universe, from local USDA service centers and Cooperative Extension agents and specialists to national headquarters, to better engage and educate federal and state regulatory partners to make better regulations.

USDA needs to support and increase regulatory engagement with federal and state environmental management agencies (EPA, U.S. Fish and Wildlife Service, state departments of natural resources) and conduct research and extension to address a broad suite of current and emerging environmental issues that limit U.S. aquaculture production and expansion. With the exception of animal health regulations, USDA does not have a direct regulatory authority as the federal lead for environmental aquaculture management, but it can improve the rule-making process by informing partner regulatory agencies about the current practices used by U.S. aquaculture to safeguard environmental protection. These current practices include adherence to all local, state, and federal regulations, the use of best management practices and voluntary conservation efforts, and implementation of new technology to reduce environmental impacts, all of which help U.S. aquaculture provide environmental benefits, comply with environmental requirements, and avoid the need for new, unnecessary environmental regulations.

USDA needs to use its data, outreach, and regulatory consultation on ‘bottlenecks’ that constrain aquaculture, including wildlife issues (e.g., bird and marine mammal depredation) and water quality and nutrient management. In addition, USDA should work more closely with Sea Grant and NOAA partners in coastal areas to further aquaculture interests.

USDA research, extension, and technology development is needed to address nutrients, water quality, and water quantity issues; and emerging aquaculture issues such as environmental issues in offshore aquaculture, sustainability associated with genetically modified organisms, and

climate resilience. USDA can also develop and support new co-funding opportunities to expand the scope of current request for proposals (e.g., aquafeeds for offshore aquaculture, aquaculture, and health policy).

The incorporation of aquaculture into a broader, food systems approach could better assess and optimize sustainable aquaculture production and its environmental footprint, and address public concerns and misconceptions about environmental sustainability of U.S. aquaculture. Fully understanding the sustainability footprint of aquaculture from seed to feed to farm to plate will facilitate connecting U.S. aquaculture to food systems and provide information that can be used to mitigate environmental issues outside the aquaculture farm (water quality, carbon, nutrient markets, etc.).

USDA interaction is needed with regulators at federal and state levels, especially with agencies that have regionally based interpretations of their roles in aquaculture issues. This can include co-funding programs and clear delineation and communication about the areas of responsibilities of each agency. More effort is needed to encourage USDA collaborations with additional partners (e.g., National Institutes of Health (NIH); National Science Foundation (NSF); NOAA on offshore aquaculture feeds).

There are opportunities to link aquaculture to health policy. Community-based, participatory research funding opportunities could include communities (e.g., develop local markets?)

The National Aquaculture Association (NAA) encourages USDA activities in on-farm and off-farm environmental management; integrating production system design, construction, management and maintenance to provide optimum growing conditions; and research on animal pathogens and pests, confinement, water conservation, eco-friendly materials and coatings, and feed production.

USDA needs to work with the U.S. Food and Drug Administration (FDA) on the authorities over genetically modified/transgenic/gene editing technologies, and investigate potential environmental savings from using these technologies in aquaculture production.

Work is needed on optimizing the use of genetic technologies in aquaculture. This includes breeding advances, biosecurity to avoid escape of genetically modified fish, and a regulatory and testing framework to address uncertainties about these technologies.

USDA pesticide registration work with EPA and agencies that have the bulk of regulatory burden for these issues help support water quality and environmental management.

Next Steps and Recommendations

- Ensure USDA staff know that aquaculture is eligible for farm programs.
- Fill extension positions that are open due to retirements and support extension funding to engage with farmers and connection to research from Land Grant and Sea Grant Universities.
- Work more closely with NOAA Sea Grant Marine Extension to build relationships between NOAA and USDA.
- Provide more clarity on environmental management roles within USDA in addition to OPMP activities.

- Engage EPA on water quality and water quantity regulations on behalf of U.S. aquaculture farmers.
- Review aquaculture discharge, which is currently considered as point source pollution, not a nonpoint source.
- Conduct or support research technological solutions to assess and mitigate nutrient concerns, including phosphorus reduction in feeds.
- Conduct research on improving water use efficiency, including the use of remote sensing/satellite imagery (e.g., Open ET, satellite-based data on evapotranspiration) to monitor aquaculture operations, similar to its use to visualize and measure crop water usage at individual field levels.
- Research and technology transfer are needed on effluent reduction and treatment, water quality, water conservation, off-flavor, and alternative materials and coatings, such as biodegradable, anti-biofouling, eco-friendly production gear, containers, and packaging.
- Calculate the environmental footprint of aquaculture to:
 - Optimize feed systems for aquaculture production (i.e., less feed required → less waste fish → less environmental impact).
 - Carbon footprints can be calculated, as well as the overall impacts, for the entire aquaculture seafood supply chain.
 - Calculate environmental benefits in conventional vs. recirculating aquaculture using different output traits: what is being saved/what is not being released
 - Connect “downstream” aquaculture production of shellfish and macroalgae to mitigate water quality issues from “upstream” agriculture and other sources. Develop solutions to reduce nutrients (e.g., multi-trophic aquaculture to produce finfish and seaweeds).
- USDA should have a U.S. “stamp” or logo communicating to consumers that domestic seafood is grown under rigorous regulations. This would convey where the seafood is sourced from, and verify government certifications of seafood quality, product integrity, and growing conditions. It would help consumers distinguish U.S. farm raised seafood from imported seafood. NAA has just become familiar with this farmer-agency program in New Zealand (see <http://www.aplusaquaculture.nz/sustainable-aquaculture>.)
- USDA can assist in offshore aquaculture environmental management by conducting research on aquafeeds on nutritional requirements in commercial species of interest (suitability analyses, consumer preference) raised in the offshore environment (temperatures, water circulation), and then assess feeds for nutritional benefits and how they might help reduce environmental impacts. This could be co-funded by USDA and other agencies (NOAA). Moving aquaculture offshore also could require research on emerging pathogens, predators (e.g., birds), and pests in this environment.

Aquaculture and Wildlife Interactions

As is the case with terrestrial agriculture, there are many opportunities for aquaculture to interact with wildlife. Birds are particularly known to cause damage through predation, transferring disease pathogens across farms, or negatively impacting water quality, such as raising coliform counts. Aquaculture is also regulated in terms of interactions with protected species, protected habitats, and wildlife activities, such as hunting and fishing. Examples include:

- Double-crested cormorants can consume up to 1.5 pounds of catfish per day on catfish farms, and producers incur annualized costs associated with deterring this predation. The value of fish consumed by the birds averages \$64.7 million; when multiplier effects are included, costs associated with double-crested cormorant control on total economic output averages \$70.8 million every year.
- Scaup predation at freshwater baitfish farms can reduce overall profit margins by \$251 per acre (years with few birds) to \$300 per acre in colder years when greater numbers of birds arrive to feed on baitfish. Producers also must incur expenses to deter scaup predation. For a median-sized golden shiner farm of 800 acres, these combined costs can result in losses of \$200,800 per farm in years with few birds and \$240,000 per farm in years with high bird pressure.
- Diving ducks can dive 60 feet to eat their body weight in shellfish, requiring farmers to use barrier netting.
- Migrating routes of the red knot, which is listed as threatened, include the Delaware Bay, where the birds feed on horseshoe crab eggs. Shellfish farms suspected of interfering with foraging behavior were forced to move.
- Planned shellfish farm leases have been denied due to black duck habitat and duck hunting interests.
- At least two proposed shellfish farms have been blocked by concerns that birds might be attracted to the farms and collide with aircraft at nearby airports
- Shellfish aquaculture has been associated with impacts on eelgrass, which is a food source for brandts in California; as a result, farms needed to move or reduce acreage.
- Birds roosting on shellfish production gear cause water quality issues.
- Marine mammals damage net pens directly in attempting to access farmed fish or indirectly by hauling out on fish and shellfish floating structures.

APHIS Wildlife Services (APHIS WS)

APHIS WS provides wildlife damage management assistance to aquaculture producers in 14 States. This included assistance to anglers, baitfish, and crawfish producers; catfish farmers; fish hatcheries; sport fish producers for pond stocking; and tropical fish producers. The agency assists fish farms with federal and state permitting to control piscivorous birds, recommends non-lethal hazing techniques, loans non-lethal hazing equipment, and discourages bird congregations near fish farms. APHIS WS has extensive experience in rabies control, feral swine depopulation, mitigating bird strikes at airports, and minimizing crop damage, and recently hosted a webinar for shellfish farmers to discuss issues and potential mitigation strategies targeting the reduction of bird predation on catfish farms.

Listening Session Information

Although not a part of the *Aquaculture is Agriculture Colloquium*, this is an important topic that USDA and its partners must address. On Wednesday February 17, 2021, APHIS WS hosted a webinar titled *Bird Management and Coastal Shellfish Production*. Jason Suckow welcomed 204 participants, and was followed by Willie Harris, who presented an overview of WS programs. Industry representatives Bob Rheault and Bill Dewey provided an industry perspective, and then WS experts Ken Gruver, Fred Cunningham, and Brian Dorr discussed potential solutions.

General Stakeholder Feedback

Stakeholder feedback was received at the webinar and in follow-up email communications, primarily focusing on strategies for reducing the impacts of birds on coastal shellfish production. Many strategies known to be effective are not practical:

- Lethal methods of reducing the impacts of birds on shellfish production are not acceptable options.
- Repelling birds with pyrotechnics is annoying to owners of coastal waterfront homes, and some birds are protected species. Green lasers and drones are too expensive.
- Other approaches are more easily implemented, but present other challenges. Scare kites can be effective, but birds can acclimate to them and the kites are vulnerable to high winds. Streamers and gull sweeps are effective for some birds, but they can flip gear and are ineffective on calm days.
- There are promising strategies that require further evaluation before full-scale adoption and implementation.
 - Zip tie “ticklers” attached to gear have been shown to keep birds away from floats. This is cost effective, but it is unknown whether or not the birds will acclimate, and it could exacerbate the environmental impact of using plastic in shellfish farming.
 - Making floating gear that is tough for birds to land and stand on has potential, but effective designs need to be developed, evaluated, and demonstrated before farmers invest in new gear.
 - Ultrasonics repellants are an option; however, since birds hear within the same wavelengths as humans, this may not be as effective as needed.
 - Broadcasting bird distress calls can be effective, but the calls are species-specific, and birds may eventually acclimate to the sound.

Participants also discussed the following:

- The Interstate Shellfish Sanitation Conference (ISSC) guidance uses coliform counts to manage shellfish harvest area water quality, but participants were not aware of illnesses associated with consuming shellfish contaminated by bird waste. (These could not even be found on a U.S. Centers for Disease Control website)
- Farmers noted that the need to address the impacts of birds is usually seasonal and varies by farm location and species, so a one-size-fits-all approach will probably not suffice.
- Floating cages attract birds, including protected species, because they attract bait species that feed around them. This could encourage nearby nesting which in turn might attract protected species and result in new regulatory actions that limit capacity for farming. This must be considered when developing approaches to minimize the impacts of birds.

Next Steps and Recommendations

- USDA has an excellent facility for conducting bird experiments on freshwater ponds, and this capacity should be extended to include open water shellfish farms.

Production Innovation and Technology

U.S. aquaculture is a very dynamic and diverse industry in terms of technology use and development. The types of technologies applicable to different species and production systems vary widely. Technology that is appropriate for one type of aquaculture product (and its associated market system and price point) is quite different from technology that is needed and feasible for another. U.S. aquaculture producers have demonstrated their ability to innovate and create feasible businesses when economic conditions are ripe for technology adoption. In many cases, it is not feasible to adopt some innovations without certain complementary technologies (i.e., hybrid catfish raised in split ponds complimented by intensive aeration).

USDA must ensure that research programs are grounded in real-world scenarios and priorities of commercial aquaculture. It is essential for programs to ensure that what is being considered is applicable to feasible commercial production of the species under consideration.

National Institute for Food and Agriculture (NIFA)

NIFA is the primary extramural funding agency within the USDA and provides support for aquaculture research through several competitive and capacity programs. In supporting product innovation and technology, NIFA engages in the SBIR Program and includes an Aquaculture program area (SBIR 8.7 – Aquaculture). This program is open for applications from U.S.-based small businesses and solicits funding in two phases each year. The first phase grants an award of up to \$100,000 for 8 months and the second phase grants an award of up to \$600,000 for 24 months. The success rate for phase 1 submissions is ~15 percent of submitted proposals, and phase 2 eligibility is open only to previous phase 1 awarded projects. The phase 2 program has a success rate of ~50 percent.

Small Business Innovation Research (SBIR)

The 2020-2021 SBIR 8.7 Aquaculture program has five current program area priorities: Reproductive Efficiency, Genetic Improvement, Integrated Aquatic Animal Health, Improved Production Systems and Management Strategies, and Algal Production Systems. The program has funded between 8 and 11 awards per year since 2015 with between \$1.3 and \$3.1 million dollars per year awarded (Figures 1 and 2).



Figure 1: Number of SBIR 8.7 Aquaculture awards for each Fiscal Year (FY) from 2015 to 2020.

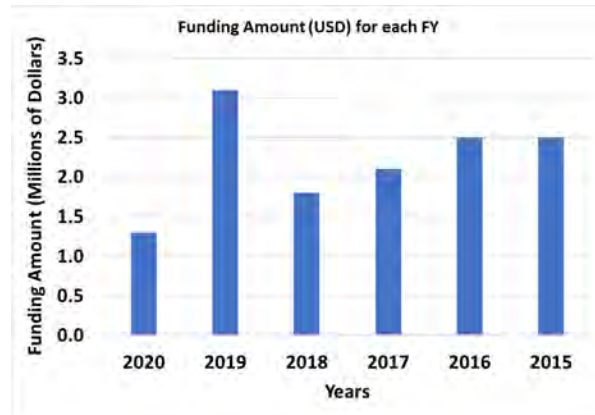


Figure 2: Total SBIR 8.7 Aquaculture funding for each fiscal year (FY) from 2015 to 2020.

Agricultural Research Service (ARS)

ARS is the USDA’s chief scientific in-house research agency charged with finding solutions to agricultural problems that affect Americans every day from field to table. Technology transfer and industry adoption is a critical component of ARS programs. For aquaculture, this means conducting research and delivering technologies that improve domestic aquaculture production efficiency and product quality while minimizing impacts on natural resources. The current ARS research focus is primarily on catfish, salmonids, hybrid striped bass, oysters, shrimp and warmwater marine finfish. Examples of product innovation include:

- New genome-enabled breeding tools and improved genetics distributed to the industry
- New vaccines and aquatic animal health therapeutics
- New diet formulations based on sustainably sourced ingredients
- Systems designs and engineering technologies, including split-pond systems and recirculating aquaculture technologies

Economic Research Service (ERS)

ERS is a statistical agency that conducts research to understand and anticipate trends and emerging issues in agriculture, food, the environment, and rural America. It tracks the adoption of major farm innovations and assesses their impacts on productivity and use of natural resources. ERS periodically updates an index of total factor productivity for the agricultural sector and conducts research on how investment in agricultural R&D and other factors influence long-term trends in agricultural productivity and competitiveness.

Listening Session Information

On November 20, 2020, the USDA hosted a Deep Dive session centered on the topic of *Product Innovation and Technology* as it relates to aquaculture development. The session was co-chaired by Tim Sullivan and Chris Green, both representatives of NIFA. The other relevant agencies in this session were all part of the REE mission area at USDA, with ARS represented by Caird Rexroad and ERS represented by Keith Fuglie. The listening session had 69 participants. Email affiliations indicated that 14 attendees were from USDA, 11 were from other government agencies, 13 were from academia, and 31 were from the commercial sector.

The organization of the listening session included 20 minutes of background on the relevant agencies and their roles in aquaculture product innovation, followed by two separate break-out sessions. The first session covered two questions:

- What USDA activities are having a particularly positive impact?
- What role should USDA play in the continued development of technology?

The second session covered three questions:

- What are the most pressing issues that USDA's product innovation and technology work should focus on?
- What can USDA do to make its work in product innovation more accessible to the aquaculture community?
- Where would you like to see U.S. aquaculture in 10 years and what do you think USDA can do to facilitate this vision?

General Stakeholder Feedback

What USDA activities are having a particularly positive impact?

There were three major programs highlighted in this breakout session.

There was a consensus that the ARS genetic breeding program has had considerable impacts on aquaculture for multiple species. It was critical for expanding aquaculture and many would like to see it enlarged in size and scope.

NIFA's SBIR Program has had a critical impact on technology and system development and was identified as vital for solving key issues in ways that reach the community.

Stakeholders agreed that the RAC program was fundamental to aquaculture development and a key component of USDA's public-private cooperation in aquaculture. The regional nature of the program was a significant strength. Lastly, many would like to see the program expanded in size and scope.

What role should the USDA play in the continued development of technology?

Three major points were discussed generally in response to this question.

Participants noted the need for continued education and the necessity of educating the public at an early age about aquaculture and its strengths and benefits. This can create a future that benefits from increased acceptance of farmed seafood as well as a generation that understand the process and might support work to continue aquaculture expansion and solve its future problems.

USDA should focus on extension and a "missing link" that is sometimes present between new methods, tools, and technology, and their use by farmers in the field. Extension personnel in many ways fill this gap and over time their ranks have decreased due to budgetary restrictions. This hinders aquaculture success and the ability to progress from showing the efficacy of a product to its adoption by the aquaculture community. Strengthening extension positions around the country is seen as a key act for aquaculture in this regard.

USDA needs to avoid becoming caught up in the “next big thing” and instead should focus continually on prioritizing funding to address true impediments to aquaculture development. USDA should focus on the hard work and the difficult ideas that would have the biggest impact on real producers’ lives and livelihoods, such as prioritizing automation and developments that reduce hourly labor and continuing to focus on basic research that drives production, including matching feed formulations to life stages, closing life cycles in culture, and improving disease resistance and nutritional quality.

What are the most pressing issues that USDA’s product innovation and technology work should focus on? What can USDA do to make its work in product innovation more accessible to the aquaculture community? Where would you like to see U.S. aquaculture in 10 years and what do you think USDA can do to facilitate this vision?

Five general themes emerged during this discussion: 1) reducing labor and time, 2) genetic research, 3) diversity of USDA portfolio, 4) market advantage, and 5) declining aquaculture extension ranks nationally.

Reducing labor and time: The technological development of aquaculture and modern production of seafood is complex. Seafood producers are constantly monitoring and adjusting their production systems, and this constant process creates a heavy workload and maximizes needed hourly labor. It is necessary to address these issues without increasing producer workloads. This requires a focus on technology and technological solutions, and smart and useable solutions. These involve automated technology, sensor technology, and non-invasive sampling, which provide the tools to conduct essential work and ensure producers have the time and freedom to continue operations.

Genetic Research: The continued development of genetics as a field and the continual success of genetic breeding programs have vastly advanced aquaculture over the past 30-40 years. There is still much that genetic breeding programs can accomplish for the U.S. aquaculture industry, particularly in breeding for desired traits. This includes traits that are economically desirable (color, taste, texture, etc.) and traits that solve critical issues, including disease resistance and aligning feed and nutritional requirements.

Diversity of USDA’s portfolio: In the area of the USDA’s funding and research portfolio, differing opinions were heard about what the focus should be. However, all noted that that portfolio needed to be diverse to represent the unique nature of the U.S. aquaculture industry. The USDA needs to continue to support existing markets while also helping to develop the expansion of new sectors. USDA should focus on all possible production areas—land-based, coastal, and offshore—rather than focusing on just one or a few. Likewise, the USDA should support all the possible production types, including finfish, shellfish, aquatic plants, and aquaponics and hydroponics. Lastly, many comments were made about the need to protect small farms and small businesses and not focus on large producers only.

Market advantage: Aquaculture and seafood production systems operate in a highly competitive, global market. It was noted several times that USDA should consider ways to provide market advantages to U.S. producers through its product innovation work. USDA and its partners should focus on nutrition, sustainability, and health to highlight the exceptional nature of U.S. farmed seafood. This, along with unique labeling and education initiatives, could greatly advance expanding the presence of U.S. farmed seafood in the domestic and international markets.

Declining Extension Personnel: Over the past 20 years, because of university budget restrictions, aquaculture extension agents have undergone a continual cycle of retirements without replacement. In many parts of the country, extension agents are now covering both terrestrial and aquatic programs, even though they may have little or no experience with aquaculture. As noted in the sections above, extension personnel are fundamental and critical links between research conducted around the country and industry stakeholders. This link is integral to “on farm” success and to the impact of USDA and the research communities. Mechanisms to support the recruitment, retention, and development of aquaculture extension positions (Full Time Equivalent) should be a definitive priority.

Next Steps and Recommendations

The listening session highlighted several broad and overarching themes.

- USDA should continue to support, develop, and expand existing programs that received positive feedback as being significant for aquaculture development. These programs should be shaped over the future in ways that address several the key issues raised. For NIFA, this may take the place of adjusted program area priorities for the aquaculture-specific requests for applications (Regional Aquaculture Centers, Special Research Grants Program for Aquaculture, and the Small Business Innovative Research for Aquaculture) to address automation, non-invasive sampling, genetic breeding program development, closing life-cycles in culture, nutrition and life stage matching, and critical disease issues.
- USDA should support activities that expand the educational and extension impact where possible. NIFA aims to use its Aquacontacts listserv to increase outreach and synergy and plans to support the NAA research highlight initiative moving forward. Education and extension should be conducted strategically to improve the linkages between research and stakeholder communities and to help educate the public about the benefits and strengths of U.S. aquaculture. It is important to do this (through supporting labeling, sustainability, and health research) in a way that improves market potential for U.S. products.

Leveraging programs at USDA and within other federal agencies to support and bolster extension positions should be a current and future priority. The steady decline in the perceived importance of extension positions at universities throughout the country is a severe impediment to aquaculture development and synergy across the aquaculture community.

Product and Consumer Marketing

Over the years, U.S. aquaculture producers have created markets and supply chains that sustain their businesses. However, they have done so without the safety nets available to other types of agriculture and in the absence of the types of market and cost data available to other types of agriculture. Research is needed to reduce processing and packaging costs, and market analysis is needed to inform product development and the implementation of current programs to enhance product value through regulation (e.g., Organic Label) and farm-raised seafood promotion.

Marketing and Regulatory Programs (MRP)

The MRP mission area facilitates domestic and international marketing of U.S. agricultural products and ensures the health and care of animals and plants. MRP agencies are active participants in setting national and international standards.

Agricultural Marketing Service (AMS)

Within the MRP mission area, AMS administers programs that create domestic and international marketing opportunities for U.S. seafood producers. AMS also provides the aquaculture industry with valuable services to ensure the quality and availability of wholesome food for consumers across the country. One of the ways AMS supports the aquaculture industry is by purchasing fish and seafood items for distribution through federal nutrition assistance programs, including the National School Lunch Program and household nutrition assistance programs. Figure 3 shows purchases of fish and seafood made by AMS for 2015 through 2020.⁴

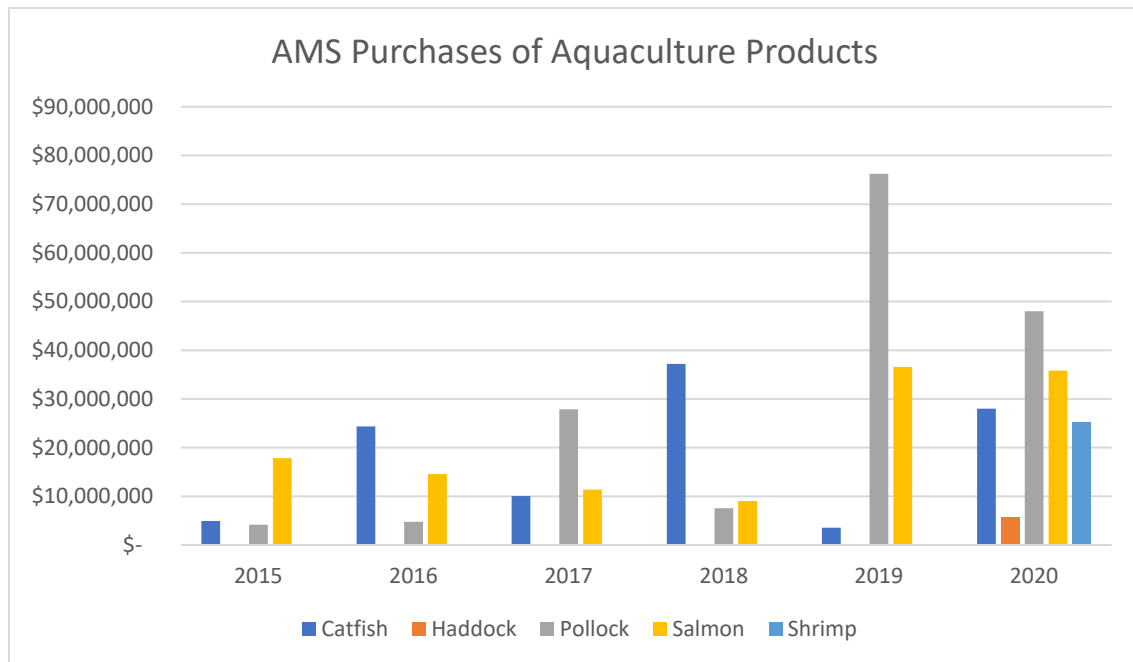


Figure 3. AMS Purchases of Aquaculture Products.

⁴ Purchases of wild-caught fish, including salmon and tuna, are not shown.

In 2020, in response to the COVID-19 pandemic, AMS began purchasing shrimp and various groundfish to support industries that traditionally rely heavily on sales to restaurants and other institutions.

Listening Session Information

The *Product and Consumer Marketing Deep Dive Listening Session* was held on November 17, 2020. The listening session had 62 participants. Email affiliations indicated that 20 attendees were from USDA, 8 were from other government agencies, 10 were from academia, and 24 were from the commercial sector.

The session began with an overview of the larger *Aquaculture is Agriculture Colloquium*. It then convened two breakout sessions, including one focused on federal nutrition assistance programs and one focused on USDA Process Verified Programs.

Key points discussed during the federal nutrition assistance programs breakout included:

- The types of aquaculture products procured by AMS and the programs through which they are distributed;
- Entitlement purchases (those that occur regularly throughout the year) and Section 32 purchases (traditionally those done in response to industry requests to remove product from the marketplace);
- Requirements for companies to become eligible to sell food to AMS; and
- Details about the quantities of food typically purchased, delivery periods, and similar logistical items.

Key points discussed during the USDA Process Verified Programs breakout included:

- The nature of AMS Process Verified Programs (industry/companies develop marketing standards, AMS verifies them);
- The flexibility of standards (they may be broad or narrow);
- Examples of current Process Verified Programs, including those for product traceability, origin, and identification; and
- Potential items to promote for the U.S. aquaculture industry, including domestic production, biosecurity standards, and antibiotic use practices.

The session concluded with a presentation about the AMS National Organic Program and the process for developing organic standards.

Stakeholder Feedback, Next Steps, and Recommendations

Based on information gathered from session participants, AMS will continue working on several fronts, including:

- Working with industry to further expand the pool of approved vendors for aquaculture items procured by AMS and to explore the potential for purchasing new forms of aquaculture products. AMS colleagues at the Food and Nutrition Service (FNS) are interacting with federal nutrition program recipients to garner feedback about preferences

and demand. AMS is working directly with trade associations and with individual companies to facilitate future purchases of aquaculture products.

- Working with industry to facilitate development of Process Verified Programs. AMS can assist industry in understanding program requirements, providing feedback on draft programs, and, ultimately, independently auditing against final programs.
- Continuing to encourage industry to complete the development of organic standards for aquaculture products. While there currently are no organic standards for aquatic animals, AMS and the National Organic Program appreciate that there is interest in establishing these standards within the aquaculture community. Organic aquaculture is not currently on the Regulatory Agenda for rulemaking, but participants indicated they will continue to evaluate future rulemaking opportunities over time with the new Administration. Current rulemaking priorities are Strengthening Organic Enforcement, Origin of Livestock, and ongoing National List rules, because these have the broadest impact on the organic community.

Supporting Aquaculture

The one common theme across all sectors of U.S. food and fiber production is risk, which can take many forms. Environmental risks include drought, floods, storms, and fires. Market risks include production and pricing, supply and demand, changing consumer tastes and preferences, government programs, trade issues, or access to affordable development and working capital. Risk is inherent in all aspects of food, feed and fiber production, and the ability to understand, assess, and address risk is essential for a business to thrive. Environmental and market risks are outside the scope of this section; the discussion focuses only on financial risk and opportunities to mitigate that risk.

Farmers, ranchers, foresters, and fishermen have multiple options for managing the risks they face and need to determine which one strategy or combination of strategies work best for their operation. Risk tolerance varies from operation to operation and most producers incorporate a variety of strategies and tools. Through its multiple agencies, USDA offers programs that can be used and leveraged as part of an enterprise risk management plan.

Rural Development (RD)

The mission of RD is to help improve the economy and quality of life in rural America. The agency promotes economic development by supporting loans to businesses through banks, credit unions, and community-managed lending pools. RD offers technical assistance and information to help agricultural producers and cooperatives get started and improve the effectiveness of their operations and provides technical assistance to help communities undertake community empowerment programs.

While RD maintains a wide portfolio of programs, three programs can provide direct support to aquaculture and aquaponic operations:

- Business and Industry Loan Guarantee (B&I): The B&I program offers loan guarantees to lenders for their loans to rural businesses. Through leveraging borrowed funds, this program improves the economic health of rural communities by increasing access to business capital. The USDA loan guarantee enables commercial lenders to provide affordable financing for rural businesses. The program can support business conversion, enlargement, repair, modernization, or development, as well as the purchase and development of land, buildings, and associated infrastructure for commercial or industrial properties. Working capital expenses, including the purchase and installation of machinery and equipment, supplies, or inventory, are also eligible uses of funds. Program support can be used to build or expand a seafood processing facility, purchase vessels and equipment, or procure refrigerated vehicles for transportation.
- Value Added Producer Grant (VAPG): The VAPG program can support seafood, shellfish, or aquatic plant producers by providing grant funds for a feasibility study or business plan for value-added product. The planning grant can help an entrepreneur identify opportunities and risks before making significant investments in a project. Additionally, the program can provide grant funds for working capital to assist with processing costs, marketing and advertising expenses, and some inventory and salary expenses. An example of a program application would be a fisherman or fish farm

seeking to market a value-added seafood product for the retail market. VAPG funds could be used for the feasibility study and for working capital to market a branded product.

- Rural Energy for America Program (REAP): REAP provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements. Agricultural producers may also apply for new energy efficient equipment and new system loans for agricultural production and processing. REAP can support farmers of fish, shellfish, and aquatic plants as well as the small rural businesses that support these producers. REAP can assist an aquaculture producer reduce some financial risk by supporting a more energy efficient operation. REAP could support the replacement of energy inefficient pumps or filtration systems on a fish farm or support the installation of solar powered equipment. Additionally, the program can support the replacement or installation of insulation, lighting, doors and windows, and cooling and refrigeration units in a seafood processing facility or warehouse.

Risk Management Agency (RMA)

RMA provides insurance policies to help aquaculture producers manage risk. Currently RMA offers three insurance products for aquaculture producers.

- Group Risk Plan (GRP) Oysters: This program is a risk management tool to insure against widespread loss of production of oysters in a county. GRP Oysters is currently available in nine counties in Louisiana.
- Aquaculture Dollar Plan Clams: This program provides inventory-based stock mortality insurance for clam producers in select counties in Massachusetts, South Carolina, and Virginia.
- Whole-Farm Revenue Protection (WFRP): WFRP provides a risk management safety net for all commodities on the farm under one insurance policy. The whole-farm revenue protection plan is available to alligator, baitfish, clams, fish, oysters, trout, aquatic plants, and watercress producers across the country.

Farm Service Agency (FSA)

FSA provides financial support for aquaculture activities through the following programs:

- Noninsured Crop Disaster Assistance Program (NAP) provides a risk management tool for aquacultural species not covered by RMA, which are:
 - Any species of aquatic organisms grown as food for human consumption;
 - Fish raised as feed for fish that are consumed by humans; and
 - Ornamental fish propagated and reared in an aquatic medium.
- The Emergency Assistance for Livestock, Honeybees and Farm-Raised Fish Program (ELAP) provides assistance to eligible farm-raised fish producers for:
 - Death losses, in excess of normal mortality, of eligible bait fish or game fish caused by an eligible adverse weather or loss condition incurred in the county where the eligible adverse weather or loss condition occurred; and
 - Purchased or produced farm-raised fish feed losses for feed that was intended to be fed to eligible farm-raised fish and was damaged because of an eligible adverse

- weather or loss condition in the county where the eligible adverse weather or loss condition occurred.
- Direct Farm Loans are available for those operations that produce eligible aquatic organisms for food.
 - Direct Farm Ownership (FO) Loans provide assistance to eligible aquaculture operations to purchase real estate for land-based operations. Loans can be made in participation with other lenders, as a down payment, or for the full purchase price if no more than the maximum loan amount, which is currently \$600,000. Loan terms can go to a maximum of 40 years but are based on loan type and repayment ability.
 - Direct Operating Loans (OL) are for the purchase of equipment and supplies necessary to run an aquaculture operation. The length of time is determined by the type of security and the repayment and may be from 1 to 7 years.
 - Guaranteed Farm Ownership and Operating Loans are loans made by local lenders for similar purposes as the Direct Loans. The loans have higher limits than those made by FSA directly and are backed up to 95 percent by FSA against loss.
 - The Farm Storage Facility Loan (FSFL) Program provides low-interest financing for aquaculture producers to build, upgrade, or acquire, permanently affixed or portable, new, or used farm storage and handling facilities, equipment, and handling trucks to store and handle eligible commodities they produce. FSFLs may also be used to purchase storage and handling trucks and/or equipment for maintaining and monitoring the eligible commodity. Aquaculture species, for FSFL purposes, are defined as any species of aquatic organisms grown as food for human consumption, or fish raised as feed for fish that are consumed by humans.

Listening Session Information

On November 16, 2020, USDA's Rural Development, Risk Management Agency, and Farm Service Agency hosted the *Supporting Aquaculture Deep Dive Listening Session*. Each agency provided a short overview of their programs for aquaculture producers, and then hosted breakout sessions for aquaculture producers and other stakeholders where USDA solicited feedback on programs and the way it interacts with the aquaculture industry. The listening session had 80 participants. Email affiliations indicated that 23 attendees were from USDA, 18 were from other government agencies, 13 were from academia, and 31 were from the commercial sector.

General Stakeholder Feedback

What is USDA doing now to help you manage risk?

Compared to dairy, swine, and poultry, aquaculture producers are not as closely connected with USDA, but potentially need what USDA is doing even more.

Several programs from USDA do work for catfish industry, but tweaks are needed.

There is a good working relationship between industry and USDA.

Guaranteed loan programs mitigate financial risks for infrastructure and other investments.

What gaps exist in aquaculture risk management that USDA should address?

Agencies have a strong foundation and framework to apply to aquaculture. One challenge is training personnel to have the expertise and experience to interact with the aquaculture industry.

After recent floods in the U.S. Midwest, few aquaculture producers qualified for disaster assistance due to flooding. Most had to apply for coverage and compensation from private insurance, not federal programs.

There is significant demand for crop insurance, and existing programs should be updated and enhanced.

What is the biggest obstacle for USDA to be viewed as one of the federal leads for supporting and advancing aquaculture?

Aquaculture must compete with terrestrial farmers for USDA support.

USDA regulatory actions and oversight around aquaculture is scattered, and there is also diverse industry and diverse federal oversight (NOAA/USDA/FDA). The complex nature of government is a huge problem in terms of oversight over aquaculture.

Fewer and fewer aquaculture extension specialist positions are being filled, so institutional memory within land grant universities and connections to stakeholders/industry is being lost.

Many sectors have misconceptions of aquaculture. Some state regulators do not perceive aquaculture as farming; instead, they view it as management of a natural resource/public good and sometimes believe it is unsustainable and harmful for the environment.

How can USDA strengthen work with stakeholders/partners across such a diverse industry?

Expand aquaculture stakeholder meetings and committees and increase the frequency of meetings.

Help industry convey aquaculture information to reduce misconceptions held by the public as well as across USDA. Begin and support an aquaculture literacy program across all levels, enhance education/training for extension, and continue discussions with state agriculture agencies to convey consistent information.

Connect with state level organizations and industry associations who can provide grant application assistance, and conduct targeted outreach efforts to improve awareness of and access to USDA programs.

When working with USDA, what works for you?

Working groups to discuss aquaculture risks and issues

Aquaculture stakeholder meetings

Honor the Harvest events sponsored by US Farmers & Ranchers in Action, in which farmers meet to manage climate change as a collaboration for the future

Continued participation in Aquaculture America and the World Aquaculture Society

Expanding USDA attendance at annual species-specific meetings (Catfish Farmers of America, U.S. Trout Farmers of America)

Next Steps and Recommendations

Rural Development:

- Will continue to deliver programs and ensure they are inclusive of aquaculture and aquaponics;
- Will work at state, regional, and national levels to promote aquaculture as an eligible application for rural business programs; and
- Will work to broaden stakeholder engagement to include aquaculture producers.

Risk Management Agency:

- Will work to update and enhance its insurance products for aquaculture producers; and
- Will work at regional and national levels to explain its programs to stakeholders and to develop strong relationships with aquaculture producers.

Farm Service Agency:

- Will continue to educate county, state, and national staff that aquaculture is agriculture;
- Will continue to encourage stakeholders to become active in their local county offices by establishing a relationship and/or running for the county committee; and
- Will review programs, such as NAP, to be inclusive of aquaculture producers.

Appendix 1: Aquaculture is Agriculture Webinar Agenda

December 11, 2020

- 9:00 am ***Welcoming and Opening Remarks***
Mary Dee Beal, Senior Advisor to the Secretary
Dr. Scott Hutchins, Deputy Under Secretary for Research, Education, and Economics
Dr. Chavonda Jacobs-Young, ARS Administrator, USDA Acting Chief Scientist
- 9:30 am ***Aquaculture Aligns with the Ag Innovation Agenda and the Science Blueprint***
Dr. Peggy Biga, Office of the Chief Scientist
- 9:50 am ***USDA's Role in Updating the National Aquaculture Development Plan***
Dr. Jeffrey Silverstein, Agricultural Research Service
- 10:10 am ***Aquaculture Intersects with Agriculture***
Dr. Dan Northrup, Benson Hill
- 10:30 am ***Economic Development through Aquaculture***
Andrew Jermolowicz, Rural Development
- 10:50 am ***What U.S. Aquaculture Needs from USDA: Aquatic Plants***
Stephanie Showalter-Otts, J.D. University of Mississippi School of Law
- 11:10 am ***What U.S. Aquaculture Needs from USDA: Finfish***
Jim Parsons, Cooke USA
- 11:30 am ***What U.S. Aquaculture Needs from USDA: Shellfish***
Bill Dewey, Taylor Shellfish
- 11:50 am ***Breakout Session Reports***
Dr. Caird Rexroad, Agricultural Research Service
- 12:00 pm ***Aquaculture Production Research***
Dr. Amrit Bart and Christopher Green, National Institute for Food and Agriculture
- 12:10 pm ***Aquatic Health***
Dr. Kathleen Hartman, Animal and Plant Health Inspection Service
- 12:20 pm ***Environmental Management***
Dr. Gene Kim and Jan Surface, Natural Resources Conservation Service
- 12:30 pm ***Production Innovation and Technology***
Dr. Tim Sullivan, and Christopher Green, National Institute for Food and Agriculture
- 12:40 pm ***Product and Consumer Marketing***
Dr. Carl Schroeder, Agricultural Marketing Service
- 12:50 pm ***Supporting Aquaculture***
Andrew Jermolowicz, Rural Development; Christopher Vazquez, Farm Service Agency; and Alex Sereno, Risk Management Agency

1:00 pm

Closing

Dr. Peggy Biga, OCS

Appendix 2: Listening Session and Webinar Participation

These tables provide the number of registrants that signed up for each event, the total number of participants who joined the event, and the number of participants who were from USDA, other government agencies, academia, or other organizations (allied stakeholder organizations, private companies, or non-governmental organizations).

Listening Sessions

	Env Mngmt	Aquatic Health	Supporting Aquaculture	Product and Consumer Marketing	Product Innovation and Technology	Aquaculture Production Research	Total Unique
Registrants	111	144	156	124	143	173	
Participants	80	109	85	62	69	79	265
USDA.gov	21	31	23	20	14	22	63
Other.gov	25	21	18	8	11	11	52
.edu	7	17	13	10	13	14	43
Other	27	40	31	24	31	32	107

Webinar

Registrants	421
Participants	303
USDA.gov	112
Other.gov	46
.edu	60
Other	85

Appendix 3: USDA Agency Programs Supporting Aquaculture

USDA participates in interdepartmental coordination activities through the National Science and Technology Council's (NSTC) Subcommittee on Aquaculture (SCA), serving as Co-chair and providing leadership on various Task Forces. USDA coordinates activities within the Department through its Working Group on Aquaculture to:

- *Continually Improve USDA Customer Service to Aquaculture Community;* and
- *Provide USDA Support for a Federal Economic Development Initiative on Aquaculture.*

USDA primarily supports aquaculture through programs administered by 15 agencies across the following seven mission areas.

Food Safety (FS) Mission Area

Food Safety ensures that the Nation's commercial supply of meat, poultry, and egg products is safe, wholesome, and properly labeled, and packaged. This mission area also plays a key role in the President's Council on Food Safety and has been instrumental in coordinating a national food safety strategic plan among various partner agencies, including the Department of Health and Human Services and the Environmental Protection Agency.

Food Safety and Inspection Service (FSIS) protects the public's health by ensuring the safety of meat, poultry, and processed egg products. Through the 2008 and 2014 Farm Bills, FSIS inspects siluriformes, including catfish, under the Federal Meat Inspection Act.

Marketing and Regulatory Programs (MRP) Mission Area

Marketing and Regulatory Programs facilitates domestic and international marketing of U.S. agricultural products and ensures the health and care of animals and plants. MRP agencies are active participants in setting national and international standards.

Agricultural Marketing Service (AMS) administer programs that create domestic and international marketing opportunities for U.S. producers of seafood. AMS also provides the aquaculture industry with valuable services to ensure the quality and availability of wholesome food for consumers across the country.

- Under the [1996 Commodity Promotion, Research and Information Act](#), both the Secretary and industry organizations could propose [checkoff programs](#) that would support research and/or marketing programs.
- AMS could continue procuring aquaculture commodities for federal nutrition assistance programs.
- AMS could develop organic standards for aquaculture under the [National Organic Program](#).

Animal and Plant Health Inspection Service (APHIS) includes protecting and promoting U.S. agricultural health and administering the Animal Health Protection Act.

- APHIS serves as the lead Federal agency for preventing, controlling, and eliminating aquatic animal diseases and for oversight of aquatic animal health programs. The Animal Health Protection Act gives the Secretary of Agriculture the authority to regulate imports,

exports, and interstate commerce of all animals and their pests/pathogens in case they pose a risk to domestic livestock.

- APHIS is the competent authority to lead and negotiate import and export animal health requirements in order to protect domestic livestock and natural resources.
- APHIS houses the Chief Veterinary Medical Officer (CVO) for the United States. The CVO is responsible for reporting detections of all World Organisation for Animal Health-listed pathogens.
- APHIS serves as the lead federal agency for developing methods and performing control activities to reduce the economic impact of wildlife, and protecting aquaculture and natural fisheries.
- The Secretary has the authority to hold, seize, treat, or prohibit and restrict the movement of any farm-raised animals, including those cultured in the exclusive economic zone.

Food, Nutrition, and Consumer Services Mission Area

Food, Nutrition, and Consumer Services works to harness the Nation's agricultural abundance to end hunger and improve health in the United States. Its agencies administer federal domestic nutrition assistance programs and the Center for Nutrition Policy and Promotion, which links scientific research to the nutrition needs of consumers through science-based dietary guidance, nutrition policy coordination, and nutrition education.

Food and Nutrition Service (FNS) administers 15 nutrition assistance programs, spending more than \$100 billion annually, that leverage America's agricultural abundance to ensure children and low-income individuals and families have nutritious food to eat. This includes the allowable purchase of seafood by program participants, and working with AMS on the purchase, procurement, and distribution of domestic foods for domestic feeding programs, including domestic seafood products. FNS also works with the Department of Health and Human Services to publish and promote the Dietary Guidelines, which provide food-based recommendations, including on seafood and seafood products, to promote health, help prevent diet-related chronic diseases, and meet nutrient needs.

Farm Production and Conservation (FPAC) Mission Area

Farm Production and Conservation is the Department's focal point for the nation's farmers and ranchers and other stewards of private agricultural lands and non-industrial private forest lands. FPAC agencies implement programs designed to mitigate the significant risks of farming through crop insurance services, conservation programs and technical assistance, and commodity, lending, and disaster programs.

Farm Service Agency (FSA) provides financial support for aquaculture activities through the following programs:

- Noninsured Crop Disaster Assistance Program provides a risk management tool for aquacultural species not covered by RMA, which are:
 - any species of aquatic organisms grown as food for human consumption
 - fish raised as feed for fish that are consumed by humans
 - ornamental fish propagated and reared in an aquatic medium.
- The Emergency Assistance for Livestock, Honeybees and Farm-Raised Fish Program (ELAP) provides assistance to eligible farm-raised fish producers for:

- Death losses, in excess of normal mortality, of eligible bait fish or game fish caused by an eligible adverse weather or loss condition incurred in the county where the eligible adverse weather or loss condition occurred; and
 - Purchased or produced farm-raised fish feed losses for feed that was intended to be fed to eligible farm-raised fish and was damaged because of an eligible adverse weather or loss condition in the county where the eligible adverse weather or loss condition occurred.
 - For more information on ELAP-Farm Raised Fish, please view [FSA's ELAP's Farm-Raised Fish Fact Sheet](#).
- Direct Farm Loans are available for those operations that produce eligible aquatic organisms for food.
 - Direct Farm Ownership (FO) loans provide assistance to eligible aquaculture operations to purchase real estate for land-based operations. Loans can be made in participation with other lenders, as a down payment, or the full purchase price if no more than the maximum loan amount, which is currently \$600,000. Loan terms can go to a maximum of 40 years but are based on loan type and repayment ability.
 - Direct Operating Loans (OL) are for the purchase of equipment and supplies necessary to run an aquaculture operation. The length of time is determined by the type of security and the repayment and may be from 1 to 7 years.
 - Guaranteed Farm Ownership and Operating Loans are loans made by local lenders for similar purposes as the Direct Loans. The loans have higher limits than those made by FSA Directly and are backed up to 95 percent by FSA against loss.

The Farm Storage Facility Loan (FSFL) Program provides low-interest financing for aquaculture producers to build, upgrade, or acquire permanently affixed or portable, new, or used farm storage and handling facilities, equipment, and handling trucks to store and handle eligible commodities they produce. FSFLs may also be used to purchase storage and handling trucks and/or equipment for maintaining and monitoring the eligible commodity. Aquaculture species, for FSFL purposes, are defined as any species of aquatic organisms grown as food for human consumption, or fish raised as feed for fish that are consumed by humans. For more information on the FSA FSFL Program, please view the [Fact Sheet](#).

[*Natural Resources Conservation Service \(NRCS\)*](#) provides technical expertise, conservation planning, and financial assistance for farmers, ranchers, and forest landowners wanting to make conservation improvements to their land.

Technical assistance for aquaculture producers is provided in the areas of:

- Agriculture engineering for aquaculture infrastructure
- Water quality technical assistance for both clean water inputs and nutrient management outputs
- Energy conservation engineering
- Water management engineering for water conveyance systems
- Wildlife enhancement – both terrestrial and aquatic opportunities

Financial assistance for eligible aquaculture producers is provided through a variety of programs, including:

- The [Environmental Quality Incentives Program](#) (EQIP) provides financial and technical assistance to agricultural producers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, improved or created wildlife habitat, and mitigation against increasing weather volatility.
- [Conservation Innovation Grants](#) (CIG) are competitive grants that drive public and private sector innovation in resource conservation. CIG projects inspire creative problem solving that boosts production on farms, ranches, and private forests—ultimately, they improve water quality, wildlife habitat, and other resource concerns.
- The [Regional Conservation Partnership Program](#) (RCPP) promotes coordination of NRCS conservation activities with partners that offer value-added contributions to expand our collective ability to address on-farm, watershed, and regional natural resource concerns. Through RCPP, NRCS seeks to co-invest with partners to implement projects that demonstrate innovative solutions to conservation challenges and provide measurable improvements and outcomes tied to the resource concerns they seek to address.

[Risk Management Agency](#) (RMA) provides insurance policies to help aquaculture producers manage risk. Currently RMA offers three insurance products for aquaculture producers.

- Group Risk Plan (GRP) Oysters: This program is a risk management tool to insure against widespread loss of production of oysters in a county. GRP Oysters is currently available in nine counties in Louisiana.
- Aquaculture Dollar Plan Clams: This program provides inventory-based stock mortality insurance for clam producers in select counties in Massachusetts, South Carolina, and Virginia.
- Whole-Farm Revenue Protection (WFRP): WFRP provides a risk management safety net for all commodities on the farm under one insurance policy. The whole-farm revenue protection plan is available to alligator, baitfish, clams, fish, oysters, trout, aquatic plants, and watercress producers across the country.

Trade and Foreign Agricultural Affairs (TFAA) Mission Area

Trade and Foreign Agricultural Affairs' (TFAA) role is to provide our farmers and ranchers with opportunities to compete in the global marketplace. TFAA is the Department's lead on trade policy with primary responsibility to ensure USDA speaks with a unified voice on international agriculture issues domestically and abroad. Within TFAA, the Foreign Agricultural Service is the lead U.S. agency tasked with promoting exports of U.S. agricultural products through market intelligence, trade policy, trade capacity building, and trade promotion programs. This work is carried out by staff in Washington as well as a global network of 93 offices covering 171 countries. Within TFAA, the U.S. Codex Office coordinates U.S. participation in the Codex Alimentarius Commission, a United Nations body that sets international food standards while protecting consumer health and ensuring fair trade practices.

[Foreign Agricultural Service](#) (FAS) links U.S. aquaculture to the world to enhance export opportunities and global food security. FAS supports activities that benefit the shellfish industry, and, by extension, the aquaculture segment, mostly via state run trade organizations.

Research, Education, and Economics (REE) Mission Area

Research, Education, and Economics is dedicated to the creation of a safe, sustainable, competitive U.S. food and fiber system, as well as strong communities, families, and youth through integrated research, analysis, and education.

[National Institute of Food & Agriculture \(NIFA\)](#) addresses national needs for [aquaculture research, education, extension, and technology transfer](#) to support U.S. aquaculture production through:

- The Regional Aquaculture Center (RAC) program, established by statute in 1985
- Funding aquaculture extension educators via Cooperative Extension at Land Grant Universities
- NIFA's research investment addresses diverse freshwater and marine aquaculture research areas and species

[Economic Research Service \(ERS\)](#) anticipates trends and emerging issues in agriculture, food, the environment, and rural America and conducts high-quality, objective economic research to inform and enhance public and private decision making. ERS provides [monthly data on the domestic aquaculture](#) industry and U.S. trade in aquaculture products.

[National Agricultural Statistics Service \(NASS\)](#) conducts both the [Census of Agriculture](#) and the [Census of Aquaculture](#), which provide comprehensive pictures of the aquaculture sector at state and national levels every 5 years. Annually, NASS also publishes three aquaculture reports: The February [Catfish Production](#) Report, the July [Catfish Processing](#) Report, and the February [Trout Production](#) Report.

[Agricultural Research Service \(ARS\)](#) conducts intramural research and delivers technologies that improve domestic aquaculture production efficiency, animal health nutrition, genetic improvement, and product quality while minimizing impacts on natural resources. Current research includes shellfish and freshwater and marine finfish farmed across a diverse array of production systems. Research is conducted under [National Program 106 Aquaculture](#).

Rural Development (RD) Mission Area

RD helps improve the economy and quality of life in rural America through loans, grants, and loan guarantees to help create jobs and support economic development and essential services. RD also promotes economic development by supporting loans to businesses through banks, credit unions, and community-managed lending pools. RD offers technical assistance and information to help agricultural producers and cooperatives get started and improve the effectiveness of their operations. Finally, RD provides technical assistance to help communities undertake community empowerment programs.

[Rural Business-Cooperative Service \(RBS\)](#) offers programs to help businesses grow and job training for people living in rural areas. These programs help provide the capital, training, education, and entrepreneurial skills that can help people living in rural areas start and grow businesses or find jobs in agricultural markets and in the bio-based economy.

Rural Housing Service (RHS) offers a variety of programs to build or improve housing and essential community facilities in rural areas. RHS offers loans, grants, and loan guarantees for single- and multi-family housing, childcare centers, fire and police stations, hospitals, libraries, nursing homes, schools, first responder vehicles and equipment, housing for farm laborers and much more.

Rural Utilities Service (RUS) provides financing to build or improve infrastructure in rural communities. This includes water and waste treatment, electric power, and telecommunications services. These services help expand economic opportunities and improve the quality of life for rural residents.