2

Federal Aquaculture Funds and Primary Functions

OVERVIEW

The National Aquaculture Act authorized funds to each of the three federal agencies for the fiscal years 1981 through 1993 for the purpose of carrying out its provisions. Despite two subsequent reauthorizations (the National Aquaculture Improvement Act of 1985, and the Food, Agriculture, Conservation and Trade Act of 1990), no federal funding has been appropriated under the National Aquaculture Act.

At least $60 million in aquaculture funding was distributed among 25 federal agencies in 1994.[1] An additional 20 programs may have the potential of providing support to the aquaculture industry; in some cases, these programs are beginning to actively solicit aquaculture projects (46).

Federal aquaculture funding arises as an issue in discussions regarding many aspects of aquaculture. Some sectors of the industry assert that there is insufficient federal funding for research aimed at solving the industry's immediate problems, such as aquatic animal health (funding for drug approval), biotechnology (funding for development of improved stocks), and predation (funding for development of new technologies to diminish predation).[2] Other sectors argue for increased federal emphasis on research areas unlikely to be taken up by the private sector, such as recirculating and offshore production technologies.

FEDERAL FUNDING LEVELS

In 1994, aquaculture received at least $60 million in financial assistance from the federal government, excluding monies spent on fish hatcheries (table 2-1).[3] The U.S. Department of Agriculture (USDA) was responsible for almost half of this $60 million ($28.7 million, or 47 percent of the total), while the Department of Commerce (DOC) spent 23 percent of the total ($13.9 million) and the Department of Interior (DOI) spent 12 percent of the total ($7 million).[4] Departments and agencies responsible for the remaining 18 percent ($10.7 million) include: Department of Energy, Agency for International Development, Environmental Protection Agency, Food and Drug Administration, National Science Foundation, and Tennessee Valley Authority.

From 1988 to 1994, federal funding for aquaculture increased by 75 percent ($26 million). This increase in spending occurred

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[1] Table 2-1 lists aquaculture funding for 19 agencies; seven agencies were unable to separate out their aquaculture funding.

[2] For an analysis of aquatic health, biotechnology, and predation issues, see U.S. Congress, Office of Technology Assessment, *Selected Technology Issues in U.S. Aquaculture* (Washington, DC: Office of Technology Assessment, September 1995).

[3] In 1994, approximately $61 million was spent on U.S. fish hatcheries. The Fish and Wildlife Service spent $39.9 million, or 65 percent; the National Marine Fisheries Service spent $18.6 million, or 30 percent; and the Bureau of Indian Affairs spent $2.9 million, or 5 percent (table 2-2).

[4] All annual expenditures for aquaculture presented here must be viewed as approximations. OTA could not identify exact amounts of federal funding devoted to aquaculture for several reasons. First, aquaculture may be included within several budget categories for an agency making it difficult to single out aquaculture expenditures. Second, aquaculture expenditures may be summarized by different individuals in different ways from year to year. The variability in definitions, diversity in species and techniques, and lack of uniformity in reporting, makes obtaining exact amounts impossible.

TABLE 2-1: Federal Funding for U.S. Aquaculture, 1988-1994

Dept.	Agency	1988	1989	1990	1991	1992	1993	1994
USDA	AMS[1]	$15,000	$60,000	$58,254	$0	$91,500	$113,173	$81,140
	APHIS[2]	254,126	323,920	803,285	613,326	644,248	683,889	814,093
	ARS/ERS[3]	2.4 million	3.3 million	4.3 million	5.9 million	7.2 million	7.1 million	7.1 million
	CSREES[4]	9 million	10.3 million	10.3 million	16.6 million	16.4 million	18.8 million	19.5 million
	FAS/ICD[5]	141,322	29,020	235,020	165,000	244,609	694,498	757,470
	NRCS[6]	500,000	500,000	500,000	500,000	500,000	500,000	500,000
	Total	12.3 million	14.5 million	16.2 million	23.8 million	25.1 million	27.9 million	28.7 million
DOC	NMFS[7]	2.5 million	4 million	6.5 million	7.7 million	7.8 million	8.8 million	10 million
	SG[8]	4.5 million	3.9 million	4.3 million	4.2 million	4.3 million	4 million	3.9 million
	Total	7 million	7.9 million	10.8 million	11.9 million	12.1 million	12.8 million	13.9 million
DOD	ACOE[9]	1.7 million	1.1 million	180,000	0	0	0	0
DOE	BPA[10]	638,000	500,000	503,000	238,000	412,000	485,000	593,000
	BSD[11]	1.2 million	1 million	400,000	200,000	400,000	500,000	600,000
	Total	1.8 million	1.5 million	903,000	438,000	812,000	985,000	1.2 million
DOI	FWS[12]	2.1 million	2.3 million	3.4 million	4.5 million	6.6 million	7.8 million	2 million
	NBS[13]							5 million
AID	AID[14]	2.5 million	2.5 million	3.4 million	3.6 million	3.5 million	2.5 million	1.5 million
EPA	EPA[15]	500,000	500,000	500,000	500,000	500,000	500,000	500,000
HHS	FDA[16]	6 million	6 million	6 million	6 million	6 million	6 million	6 million
NSF	NSF[17]	394,000	824,000	203,000	186,000	319,000	321,000	1,089,000
TVA	TVA[18]	0	0	0	2-3 million	200,000	400,000	500,000
TOTAL	=====	$34.3 million	$37.1 million	$41.6 million	$53-54 million	$55.1 million	$59.3 million	$60.3 million

NOTES: Funding for the Agricultural Research Service (ARS) and the Economic Research Service (ERS) have been combined at the request of ERS. Sea Grant figures include funding for the National Coastal Resources Research and Development Institute.

SOURCES: [1]Hatamiya, L., Administrator, Agricultural Marketing Service, U.S. Department of Agriculture, personal communication, November 1994. [2]Langston, A., Animal & Plant Health Inspection Service, U.S. Department of Agriculture, personal communication, August 1994. [3]Michels, K., Budget and Program Management Staff, Agricultural Research Service, U.S. Department of Agriculture, personal communication, July 1994; Harvey, D., Economic Research Service, U.S. Department of Agriculture, personal communication, November 1994. [4]U.S. Department of Agriculture, Cooperative State Research, Education, and Extension Service, Current Research Information System, "Aquaculture Related Research: National Summary for CSRS\SAES\OCI," February 1994; Jensen, G., Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, personal communication, October 1994; Broussard, M., Principal Aquaculture Scientist, Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, personal communication, November 1994; Jensen, G., National Program Leader, Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, personal communication, October 1994. [5]Wicks, R.J., Acting Director, Dairy, Livestock and Poultry, Foreign Agricultural Service, U.S. Department of Agriculture, letter to M. Burkett-Yancey, Director, Legislative Affairs, July 1994; Beck, D., Foreign Agricultural Service/International Cooperation and Development, U.S. Department of Agriculture, February 1995. [6]Teels, B.M., Wetland Staff Co-Leader, Natural Resources Conservation Service, U.S. Department of Agriculture, personal communication, October 1994. [7]Parsons, D., National Aquaculture Coordinator, National Marine Fisheries Service, U.S. Department of Commerce, personal communication, May 1994; Parsons, D., National Aquaculture Coordinator, National Marine Fisheries Service, U.S. Department of Commerce, personal communication, September 1994 ($8.8 + $1.2 million--Fishing Industry Grant Program, i.e., the financial assistance program for the New England Fisheries). [8]U.S. Department of Commerce, National Oceanic and Atmospheric Administration, "The National Sea Grant College Program Annual Report FY 89;" U.S. Department of Commerce, National Oceanic and Atmospheric Administration,

almost entirely among the Departments of Agriculture, Commerce, and Interior. Over this seven year period, the Department of Agriculture experienced an increase of 135 percent (from $12.3 million to $28.7 million) in aquaculture funding; Department of Commerce funding rose almost 100 percent (from $7 million to $13.9 million); and Department of Interior had the largest percentage increase--235 percent (from $2.1 million to $7 million).[5]

Among the 25 federal agencies dedicating funds to aquacultural activities,[6] 13 fund aquaculture research, 12 distribute funding for aquaculture support activities, and seven allocate resources to regulate the industry (table 2-3). The majority of aquaculture fund-ing is directed to research. For example, USDA's 1993 total "system-wide" funding for aquaculture research was at least $42 million (13,61).[7]

Congress has provided support programs to address specific economic and infrastructure barriers to growth in the fishing industry, to traditional agriculture, and to small community and rural development. Many support programs include aquaculture in their mandates; other programs, while currently not providing support to aquaculture, do not exclude aquaculture from possible support (46).

At least seven agencies regulate the aquaculture industry. Certain agencies, such as the Animal and Plant Health Inspection Service, the Natural Resources Conservation Service, the Army Corps of Engineers, and the Food and Drug Administration, have clear regula-tory roles concerning the aquaculture industry. Other responsibilities may be held jointly; for example, the National Marine Fisheries Ser-vice and the Fish and Wildlife Service monitor bird and mammal predation activity on aqua-culture operations. The Environmental Protec-tion Agency has more diffuse responsibilities relating generally to pollution control and waste management.[8]

POTENTIAL AQUACULTURE FUNDING PROGRAMS

OTA identified 20 additional federal agency programs that might have potential for

National Sea Grant College Program, "Projects '90," March 1991; U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Sea Grant College Program, "Projects '91," February 1992; U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Sea Grant College Program, "Projects '92," February 1993; U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Sea Grant College Program, "Projects '93," July 1994; McVey, J., Program Director, Aquaculture, Sea Grant, U.S. Department of Commerce, personal communication, February 1995; Olson, S.G., Deputy Director, National Coastal Resources Research and Development Institute, U.S. Department of Commerce, personal communication, December 1994. [9]Roper, W.E., U.S. Army Corps of Engineers, U.S. Department of Defense, personal communication, February 1994. [10]Parsons, D., National Aquaculture Coordinator, National Marine Fisheries Service, U.S. Department of Commerce, personal communication, May 1994; Gislason, J., Fishery Biologist, Bonneville Power Administration, U.S. Department of Energy, personal communication, July 1995. [11]Sprague, S., Manager, Aquatic Species, Biofuels Systems Division, U.S. Department of Energy, personal communication, March 1994. [12]Nickum, J., National Aquaculture Coordinator, Fish and Wildlife Service, U.S. Department of Interior, personal communication, May 1994; Nickum, J., National Aquaculture Coordinator, Fish and Wildlife Service, U.S. Department of Interior, personal communication, March 1995. [13]Nickum, J., National Aquaculture Coordinator, Fish and Wildlife Service, U.S. Department of Interior, personal communication, March 1995. [14]Rea, H., Office of Agriculture, U.S. Agency for International Development, personal communication, September 1994; U.S. Agency for International Development, "The Status of Fisheries and Aquaculture Development Assistance Programs," August 1993.[15]Bastian, R., Environmental Scientist, Environmental Protection Agency, personal communication, August 1994. [16]Billy, T., Director, Office of Seafood, Food and Drug Administration, personal communication, June 1994. [17]Mitchell, J., Senior Associate, Division of Ocean Sciences, National Science Foundation, personal communication, August 1994. [18]Behrends, L., Tennessee Valley Authority, personal communication, May 1994.

[5] In 1994, DOI funding for aqua-culture was divided between the Fish and Wildlife Service and the National Biological Service. 1994 funding decreased slightly from 1993 when DOI aquaculture funding peaked at $7.8 million.

[6] There are 19 agencies with known aquaculture funding amounts. There are six other agencies, as well as six programs, with unknown funding allocations to aquaculture (the seventh program is the US-Israel Science and Technology Grants Program, initiated in 1995, for which funding is known) (box 2-1).

[7] "System-wide" funding includes matching funds from federal and state agencies and a small contribution percentage from the aquaculture industry.

[8] For further information, see Rubino, M.C. and Wilson, C.A., *Issues in Aquaculture Regulation* (Bethesda, MD: Bluewaters, Inc, October 1993.

TABLE 2-2: Federal Funding for Hatcheries, 1988-1994
(in millions of dollars)

AGENCY	1988	1989	1990	1991	1992	1993	1994
National Marine Fisheries Service[a]	$8.3	$9.3	$9.3	$10.3	$13	$9.6	$18.6
Fish & Wildlife Service[b]	$12.5	$12.9	$14.1	$17.5	$40.6	$47.2	$39.9
Bureau of Indian Affairs[c]	$3.7	$3.7	$4	$4.4	$3.6	$3	$2.9
TOTAL	**$24.5**	**$25.9**	**$27.4**	**$32.2**	**$57.2**	**$59.3**	**$61.4**

a Funding for the Columbia River hatcheries.

b Funding for primarily salmonid production (90 percent salmonid; 10 percent nonsalmonid production).

c Funding for more than 100 fish hatchery operations on Indian reservations throughout the country.

SOURCES: (a) D. Parsons, National Aquaculture Coordinator, National Marine Fisheries Service, U.S. Department of Commerce, personal communications, November 1993 and May 1994; "Committee Approves Plan which includes $18.6 Million for Columbia River Hatcheries," Aquaculture News 2(10):12, August 1994: (b) National Research Council, Marine Aquaculture (Washington, DC: National Academy Press, 1992); J. Nickum, National Aquaculture Coordinator, Fish and Wildlife Service, U.S. Department of Interior, personal communications, May 1994 and March 1995; and T.D. Royal, "Potential Sources of Federal Assistance and Financial Aid For Aquaculture," unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, July 22, 1994; (c) G. Rankel, Program Manager, Fish, Wildlife and Recreation Program, Bureau of Indian Affairs, U.S. Department of Interior, personal communication, August 1994.

providing support to the aquaculture industry (table 2-4). Programs have been selected based on their potential to assist new aquaculture companies. For example, support programs aimed at farmers or fishermen may have the potential of providing assistance to aquaculturists.

The four USDA programs identified focus on loans and price supports,[9] and the eight DOC programs identified generally address the decline of fisheries or employment and capital needs in rural communities. Departments that do not currently fund aquaculture--the Departments of Labor, Treasury, and Housing and Urban Development, and the Internal Revenue Service--may have the potential of aiding aquaculture through grants, financing, and tax credits. It is not known how much money these programs could contribute to aquaculture (47).

The programs identified as potential aquaculture funding sources may not have been used by aquaculturists in the past for several reasons. First, the industry may be unaware that these programs could be beneficial to them. Thus, aquaculturists have made few, if any, attempts to obtain assistance from these government programs. Second, the government agencies themselves may be unaware that they could provide assistance to the aquaculture industry. Thus, government programs may not be marketed to the aquaculture industry.

FEDERAL AQUACULTURAL ACTIVITIES AND FUNDING

Federal agencies involved in aquaculture research, support, and regulation are described below. Under each department, the agencies are listed in order of funding amount devoted to aquaculture. If funding amount for aquaculture is unknown, or spending for aquaculture is less than $100,000 per year, the agency is listed under the heading "Other."

TABLE 2-3: Federal Agency Aquaculture Activity Breakdown

9 The USDA aquaculture coordinator notes that there are other USDA agencies, including under the mission areas of Natural Resources and the Environment; Food, Nutrition, and Consumer Services; Food Safety; and Marketing and Regulatory Programs that have programs that could be, but are not currently applied to aquaculture (41).

Category	Research	Support	Regulation
Agencies	CSREES	CSREES	APHIS
	ARS	FAS/ICD	NRCS
	FAS/ICD	APHIS	ACOE
	NMFS	AMS	FDA
	SG	CCC	NMFS
	FWS	CFSA	FWS
	NBS	ERS	EPA
	AID	NMFS	
	BSD	FCA	
	BPA	OJT	
	NSF	RHCDS	
	TVA	SBA	
	ACOE		

NOTES: See list of acronyms.

SOURCE: Office of Technology Assessment, 1995.

U.S. DEPARTMENT OF AGRICULTURE (USDA)

Total 1994 USDA Aquaculture Funding: $28.7 million

U.S. Department of Agriculture funding for aquaculture activities steadily increased by 135 percent, from $12.3 million to $28.7 million between 1988 and 1994. Whether this trend will continue in 1995 is unknown.[10]

USDA Research

The U.S. Department of Agriculture (USDA) is the agency currently most active in aquaculture research. Two areas in particular--aquatic animal health and production systems--receive the most aquaculture funding (61).[11] The current research base is very diverse in terms of funding mechanisms, areas of science, and cultured species.

In fiscal year 1994, USDA expended $16.5 million on aquaculture research. Approximately $12.5 million in aquaculture research was supported under Partnership Formula Programs (e.g., Hatch Act, McIntire-Stennis Cooperative Forestry Program, Evans-Allen Program),[12] Grants Programs (e.g., the National Research Initiative, Special Research Grants),[13] and direct federal administration. For the most part these funds are administered by the Cooperative States Research, Education, and Extension Service (CSREES). The Regional Aquaculture Centers shared the remaining $4 million, which was divided evenly among the five centers (box 2-2) (76). The USDA research funding sources typically employ joint funding between CSREES and other federal agencies,[14] state agencies, and a few industry groups (12).

In 1993, total joint funding for USDA aquaculture research was at least $42 million (13,61). The highest proportion ($23.8 million, or 57 percent) of aquaculture research funding was allocated to aquatic animal health and aquaculture production systems (61).[15] The species receiving the most joint funding were catfish and marine shrimp ($9.6 million

[10] USDA Secretary, Mike Espy, testified before the Senate Appropriations Committee and outlined the USDA FY 1995 budget. In FY 1995, USDA is hoping to devote $17.9 million to aquaculture activities. This would be a decline of 38 percent in funding for aquaculture. Of this amount, $15.1 million is proposed for research, $2.3 million for extension and statistics, and $500,000 for disease control (76).

[11] The Current Research Information Service identifies eight research areas: Genetic Resources; Integrated Aquatic Animal Health Management; Reproduction, Growth, and Nutrition; Aquacultural Production Systems; Product Quality; Marketing and Economics; Other; and Unclassified.

[12] The Animal Health and Disease Program is another Partnership Formula Program listed by USDA's Cooperative State Research, Education, and Extension Service (CSREES) as funding aquaculture research.

[13] The 1890 Capacity Building Grants Program and the Small Business Innovation Research Program are two Grants Programs listed as other sources of funding for aquaculture research by CSREES.

[14] Contributing federal agencies include USDA's ARS, NSF, DOE, DOD, AID, NIH, HHS, NASA and TVA (12). See list of acronyms.

[15] Other research areas: Genetic Resources; Reproduction, Growth and Nutrition; Production Quality; Marketing and Economics; Other; and Unclassified.

NOTES: See Appendix A for list of Acronyms.TABLE 2-4: Federal Agencies/Programs with Potential for Providing Support to Aquaculture

Agency/Program[a]	Focus	How Program Is Adaptable
Export Enhancement Program (USDA)	Helps U.S. farmers compete with products from countries that subsidize production, especially the European Union. Intended to challenge unfair trade practices. Benefit is cash bonus to qualifying exporter.	Aquaculture is not designated, but there are policy guidelines for selecting new commodities.
Federal Crop Insurance Corporation (USDA)	Provides a source of cost effective crop insurance for avoidable production losses.	FCIC has underwritten the inventory of aquaculture operations.
Food and Nutrition Service (USDA)	Service provides artificial price supports by purchasing surplus production for federal food and nutrition programs.	Service may purchase aquaculture products.
Rural Business and Cooperative Development Service[2] (USDA)	The financial assistance provided by this program is designed to make rural areas more economically competitive and improve the standard of living of its residents.	Making loans and grants available for infrastructure and working capital for aquaculture projects located in rural areas may improve the standard of living and make areas more economically competitive.
Business Development Assistance (DOC/EDA)	Available to individuals and private corporations for financial assistance of activities that create substantial new long term employment.	By providing loans and guarantees similar to the Small Business Administration, aquaculture projects may be developed in economically depressed areas, providing long term employment.
Fishing Vessel Capital Construction Fund (DOC/NMFS & IRS)	Assists fishermen in the construction, repair, or purchase of fishing vessels.	May assist in building equity and capital formation with before tax dollars.
National Fish and Seafood Promotion Council (DOC)	Established to strengthen the competitive position of the U.S. in domestic and international marketplaces through marketing and promotion.	The Council's mandate includes promotion of aquaculture products. However, funds have never been appropriated for the Council.

TABLE 2-4: Federal Agencies/Programs with Potential For Providing Support To Aquaculture (cont'd).

Agency/Program[a]	Focus	How Program Is Adaptable
Office of Sustainable Development and Intergovernmental Affairs (DOC)	Created by the Secretary of Commerce in 1994, the agency's purpose is to protect fish stocks in the New England area while minimizing adverse economic impacts on local fishermen. At least $60 million has been allocated to the agency.	Aquaculture is being examined as a potential area to finance for oyster and clam culture mitigation purposes.
Public Works and Development Facilities Grants and Loans (DOC & EPA)	Available for the improvement of public infrastructure for the express purpose of encouraging long term economic growth in distressed economies.	Possibility for aquaculture oriented industrial parks or other public infrastructure projects that may provide long term employment to low income families.
Special Economic Development and Adjustment Assistance Program (DOC & EPA)	Designed to assist localities that have experienced sudden and severe economic dislocation resulting in actual or threatened unemployment.	Funds available in conjunction with local government for infrastructure and work force training. May be applicable in coastal areas where wild catch fishermen could participate in aquaculture programs.
Trade Adjustment Assistance (DOC/EDA)	Provides training and income assistance to workers who have lost their jobs due to federal trade policy.	May be an opportunity to retrain commercial fishermen to work on aquaculture operations. To qualify, participants must have been displaced by imports.
Non-competitive, Discretionary Grants (DOL)	These grants are made to organizations to fund research and development, and demonstration projects, as well as provide technical assistance and training.	May be a vehicle for providing technology transfer and a trained work force to areas unaccustomed to aquaculture.
Overseas Private Investment Corporation Programs (DOS)	Provides project financing and other investor services overseas. While providing economic assistance, the program increases U.S. global competitiveness and creates U.S. based jobs by increasing domestic exports.	Aquaculture may be eligible, as an agricultural activity. May be used to finance U.S. companies in overseas production of species not suitable to grow in the U.S.
Export-Import Bank of the U.S. (DOT)	Responsible for 1) assisting domestic exporters compete in foreign markets, and 2) facilitating commercial export financing.	May be useful for aquaculture producers of species with export potential.

TABLE 2-4: Federal Agencies/Programs with Potential For Providing Support To Aquaculture (cont'd).

Agency/Program[a]	Focus	How Program Is Adaptable
Investment Tax Credit (DOT & IRS)	This tax credit is available as a percentage of the cost of rehabilitation expenditures on a certified historic building.	There are numerous aquaculture processing facilities and warehouses located in coastal communities in the U.S. that, if rehabilitated, may qualify for this credit and be suited for hatchery and nursery phases, recirculating systems, or processing.
Targeted Jobs Tax Credit (DOT & IRS)	A tax credit for wages paid to targeted groups, which are composed primarily of the handicapped and those from economically disadvantaged families.	May be a source of payroll subsidy for operations located in economically depressed areas with qualifying employees (less than 70% of the Bureau of Labor Statistics lower living standard).
Community Development Block Grants (CDBG) (HUD)	The program was established to provide grants through state and local governments to aid in the development of viable communities.	The *State and HUD Administered Small City Program* is the CDBG grant program that may be most suitable to aquaculture. It is designed to encompass communities that are small and/or rural communities. Loans are made directly to for-profit businesses to retain jobs and maintain economic viability.
Fishing Industry Loan Restructuring Initiative (SBA)	Intended to mitigate effects of governmental actions (e.g., catch limits).	May assist coastal processors to convert from wild-catch to aquaculture products.
504 Loan Program (SBA)	Provides funding for Certified Development Companies, which make loans to companies that promote economic development by creating or retaining jobs, being located in a distressed area, or promoting minority business development.	Aquaculture operations located in economically distressed areas or that could promote minority business development may be eligible for loans used for the purchase, construction, or improvement of fixed assets.

SOURCE: Office of Technology Assessment, 1995.

Box 2-1: Agency Listing and Corresponding Aquaculture-Related Activity

U.S. Department of Agriculture

USDA Research

- Cooperative State Research, Education, and Extension Service
- Agricultural Research Service
- Foreign Agricultural Service/International Cooperation and Development
- USDA Support
- Cooperative State Research, Education, and Extension Service
- Animal and Plant Health Inspection Service
- Foreign Agricultural Service/International Cooperation and Development
- Agricultural Marketing Service
- Commodity Credit Corporation*
- Consolidated Farm Service Agency*
- Economic Research Service

USDA Regulation

- Animal and Plant Health Inspection Service
- Natural Resources Conservation Service

Department of Commerce

DOC Research

- National Marine Fisheries Service (NMFS)
- Sea Grant (SG)
- SG's National Coastal Resources Research and Development Institute

DOC Support

- (US-Israel Science and Technology Grants Program)
- (Fisheries Obligation Guarantee Program)
- (NMFS' National Training Branch Seafood Inspection Workshops (e.g., HACCP))
- (Northeast Fishing Industry Grants Program)
- (US-Japan Cooperative Program in Natural Resources)

Department of Interior

DOI Research

- Fish and Wildlife Service
- National Biological Service

DOI Regulation

- Fish and Wildlife Service

Food and Drug Administration--Regulation

Agency for International Development--Research

Department of Energy

DOE Research

- Biofuels Systems Division
- Bonneville Power Administration

National Science Foundation--Research

Environmental Protection Agency--Regulation

Tennessee Valley Authority--Research

Other Agencies

Research

- Army Corps of Engineers
- (Small Business Innovative Research Program)

Support

- (Community Development Block Grants Program)
- Farm Credit Administration*
- Office of Job Training*
- Rural Housing and Community Development Services*
- Small Business Administration*

NOTE: Agencies are listed in order of their funding allocation to aquaculture-related activities. Programs are listed in parentheses.

* Funding unknown.

Box 2-2: USDA Regional Aquaculture Centers

In 1987 and 1988, five Regional Aquaculture Centers (RACs) were established in the United States: the Southern RAC administered through Mississippi State University; the Western RAC administered through the University of Washington; the Northeastern RAC administered through the University of Massachusetts Dartmouth; the North Central RAC administered through a joint effort between Michigan State University and Iowa State University; and the Tropical and Subtropical RAC administered through a joint effort between the University of Hawaii and the Oceanic Institute (75).

Under the direction of the Department of Agriculture's Cooperative State Reseach, Education, and Extension Service (CSREES), these regional centers were created for aquaculture research, development, and demonstration purposes. Since their establishment, the Centers have conducted nearly 100 regional projects; approximately 50 of these projects have been completed. Projects are selected based on priorities identified by the aquaculture industry in each region and the Centers' Industry Advisory Councils. Areas of priority research include aquatic animal health and disease control, genetics, finfish nutrition, domestication of finfish and shellfish broodstocks, aquaculture waste management, economics and marketing, production technology, and aquaculture product quality and safety. Recent annual appropriations have averaged $4 million, which is apportioned evenly among the five centers (64,75).

SOURCE: Office of Technology Assessment, 1995.

or 23 percent, and $5.1 million or 12 percent, respectively) (62).[16]

Cooperative State Research, Education, and Extension Service (CSREES)[17]

1994 CSREES Aquaculture Research Funding: $17.7 million

The Cooperative State Research, Education, and Extension Service (CSREES) is responsible for USDA functions related to agricultural research, extension, and education programs. The Service seeks "to enhance the knowledge and technology base necessary for the continued growth of the domestic aquaculture industry as a form of production agriculture" (12). Aquaculture funding is allocated through Formula Funds, Special Grants, and the Regional Aquaculture Centers (RACs). Funding also is channeled through CSREES to the USDA Office of Aquaculture, the director of which chairs the Joint Subcommittee on Aquaculture.

CSREES formula fund allocations are provided to state governments, and competitive grants are administered through the Aquaculture Special Grant Program and National Research Initiative (NRI). CSREES Special Grants are provided to aquaculture research projects considered of national importance by Congress, and research in the private sector is supported through the USDA Small Business Innovation Research Program (SBIR). In addition, aquaculture funding is provided through the Regional Aquaculture Centers (RACs) for university research and extension activities (13).

CSREES administers eight programs in animal systems research.[18] In 1981, aquaculture research was funded at the lowest level of the eight animal commodity programs. From 1981 to 1991, funding for aquaculture research increased by about 250 percent, the

[16] This excluded the category of "nonspecific," which receives the most funding. The nonspecific category classifies research programs that are broad and not specific to a particular species. Examples might include projects on aquaculture marketing, water quality in aquaculture systems, closed system design, and waste management in aquaculture systems. Also projects that covered four or more species are classified in this category because they have broad application and are not species specific (14). Other categories of species: Trout, Other Salmonids, Crawfish, Oysters, Clams/Mussels, Striped Bass, Tilapia, Other Shellfish, Other Finfish, Baitfish, Plants, Other (e.g., alligator and snapping turtles), and Unclassified.

[17] Legislation (P.L. 103-354) in October 1994 authorized reorganization of USDA. The Cooperative State Research, Education, and Extension Service (CSREES) was created by merging the Cooperative State Research Service (CSRS) and the Extension Service (ES).

[18] Beef cattle, dairy cattle, poultry, swine, aquaculture, sheep and wool, other animals, and non-commodity specific.

largest percent increase of the eight groups. In 1991, aquaculture research was apportioned the second largest amount of funding; the largest amount going to beef cattle research (13).

Agricultural Research Service (ARS)[19]

1994 ARS Aquaculture Research Funding: $7 million

As USDA's largest in-house research agency, the Agricultural Research Service (ARS) "has major responsibilities for conducting and leading the national agricultural effort" (51). Its research mission is to develop new knowledge and technology that will ensure an abundance of high-quality agricultural commodities and reasonably-priced products. ARS focuses on the development of technical information and products. The research applies to a wide range of goals, commodities, natural resources, fields of science, and geographic, climatic, and environmental conditions (51).

ARS conducts aquaculture research on marine and freshwater species "of national and regional importance" (51). Research is carried out on quantitative and molecular genetics, breeding, nutrition, disease diagnostics and control, water quality and use, and production systems, as well as processing, off-flavors, food texture and taste, packaging, food safety, and value-added products (51).

Foreign Agricultural Service/International Cooperation and Development (FAS/ICD)[20]

1994 FAS/ICD Aquaculture Research Funding: $500,000

The Foreign Agricultural Service/ International Cooperation and Development (FAS/ICD) conducts collaborative research in forestry and agriculture, including aquaculture, with other countries. The objective of research funded by FAS/ICD is to obtain "new knowledge and technology beneficial to the United States and cooperating countries" (63). FAS/ICD has five programs with aquaculture research components, including collaboration with India, China, Israel, and Egypt.[21]

USDA Support

Cooperative State Research, Education, and Extension Service (CSREES)

1994 CSREES Aquaculture Support Funding: $1.8 million

In addition to funding research, the Cooperative State Research, Education, and Extension Service (CSREES) supports development and delivery of educational programs and provides technical assistance to aquaculturists through the Cooperative Extension System. Programs are implemented in partnership with federal, state, and county levels of government,[22] and provide for the transfer of new science-based knowledge and technologies to the aquaculture industry (28).

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[19] ARS was established on November 2, 1953, pursuant to authority vested in the Secretary of Agriculture by 5 U.S.C. 301, Reorganization Plan No. 2 of 1953, and other authorities (51).

The research performed by ARS is authorized by the Department of Agriculture Organic Act of 1862 (7 U.S.C. 2201, 2204), the Research and Marketing Act of 1946, amended (7 U.S.C. 427, 1621), the Food and Agriculture Act of 1977, as amended (7 U.S.C. 1281 note), the Food Security Act of 1985 (7 U.S.C. 3101 note), and the Food, Agriculture, Conservation, and Trade Act of 1990 (7 U.S.C. 1421 note) (51).

USDA reorganization dictated that ARS absorb the National Agriculture Library (NAL) and, thus, the Aquaculture Information Center (14).

[20] The Foreign Agricultural Service (FAS) and the Office of International Cooperation and Development (OICD) merged in October 1994 to create the Foreign Agricultural Service/International Cooperation and Development (FAS/ICD).

[21] 1) The Foreign Currency Research Program (P.L. 480) includes research, such as genetic studies of marine shrimp between the University of Houston and India; 2) the lnternational Collaborative Research Program includes research, such as the paddlefish project between Kentucky State University and China; 3) the U.S.-Israel Binational Agricultural Research and Development Fund (BARD); 4) the Scientific and Technical Exchange Program; and 5) the AID-Funded Egyptian Program (1; 6; 63).

[22] Some of this funding may be directed to extension activities funded jointly by CSREES and the Department of Commerce's Marine Advisory Services (MAS).

CSREES funds various projects related to producer-based quality assurance programs, such as producing Hazard Analysis Critical Control Point (HACCP) processing implementation manuals. CSREES also has initiated a worldwide computer database at Purdue University called AquaNIC (Aquaculture Network Information Center), which serves as an online aquaculture network information center. In past years, CSREES has participated in some special grants projects for aquaculture extension, for example, a hybrid striped bass project through University of Maryland, and development of an aquaculture technical series through a cooperative agreement with the University of Georgia (29).

Animal and Plant Health Inspection Service (APHIS)

1994 APHIS Aquaculture Support Funding: unknown percentage of $800,000

The Animal and Plant Health Inspection Service (APHIS) provides several animal and plant health protection services specifically to aquaculturists. The agency's Animal Damage Control provides on-site assistance with bird and mammal predation on aquacultural farms. APHIS' National Veterinary Services Laboratories (NVSL) in Ames, Iowa, provides diagnostic assistance such as veterinary consultations for diagnosing infections and toxicological problems of aquatic organisms (63). APHIS funding specifically targeted at aquaculture support activities is an unknown percentage of its 1994 aquaculture budget of $800,000.

Foreign Agricultural Service/International Cooperation and Development (FAS/ICD)

1994 FAS/ICD Aquaculture Support Funding: $240,000

The Foreign Agricultural Service/ International Cooperation and Development (FAS/ICD) represents U.S. agricultural interests overseas, including aquacultural interests. The agency assists U.S. exporters develop and obtain information on foreign markets. Responsibilities include counseling new entrants on the agricultural export business, helping companies identify and assess foreign markets, demonstrating how potential exporters can establish contacts with foreign buyers, and providing advice on the best marketing and distribution approach for foreign markets (46,63).

Two FAS/ICD programs directly benefit aquaculture species. The Foreign Market Development Program (FMD) provided The Catfish Institute (TCI) with 1992 funding for catfish market research in Japan and the United Kingdom (77). The second program is the Market Promotion Program (MPP)[23] provides financial resources for the promotion of aquaculture product exports. Aquaculture products promoted have included farm-raised crawfish and catfish. For example, since the mid-1980s, the Southern United States Trade Association has received funds to coordinate and conduct export promotions for catfish and crawfish in countries such as Japan, Sweden, Norway, Finland, and the United Kingdom (77). In FY 1993, MPP funding for seafood promotion totaled $8 million (17). The share devoted to aquaculture totaled $210,000 (46,77).

Other USDA Support Agencies

Other 1994 USDA Aquaculture Support Funding: each agency less than $100,000 or amount spent unknown

The **Agricultural Marketing Service (AMS)** provides marketing assistance to aquaculture through the Federal-State Marketing Improvement Program (FSMIP). FSMIP provides competitive matching grants through the state Departments of Agriculture. Objectives of FSMIP include analyzing markets, improving product marketing, overcoming marketing barriers, and reducing

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23 The Market Promotion Program (MPP) succeeded the Targeted Export Assistance (TEA) Program in FY 1991 as authorized by the 1990 Food, Agriculture, Conservation and Trade Act.

producer and consumer marketing costs. An example of an aquaculture marketing research study is "U.S. Trout Markets: A Survey of Wholesale and Retail Distributors of Fresh Water Farm-Raised Rainbow Trout" conducted by the Idaho Department of Agriculture (30,31,63). In 1994, the amount of AMS funding devoted to aquaculture was about $80,000 (26).

The **Commodity Credit Corporation (CCC)** is responsible for protecting farm income and prices, maintaining sufficient supplies of agricultural commodities, and facilitating distribution of commodities. The Corporation uses the personnel and facilities of the Consolidated Farm Service Agency (discussed below) and the Foreign Agricultural Service/International Cooperation and Development to carry out its activities (39). There are two CCC programs that support aquaculture.The purpose of the GSM-102 Export Credit Guarantee Program is to facilitate U.S. agricultural exports by providing U.S. lenders, mostly commercial banks, with U.S. government guarantees. These guarantees encourage U.S. banks to extend credit to foreign banks. In January 1995, USDA authorized $60 million in credit guarantees for sales of U.S. agri-cultural commodities to countries in the Central America Region[24] under the CCC's Export Credit Guarantee Program. Presently, $40 million has been allocated to this program. In March 1995, USDA amended provisions of the program to include meat and aquaculture feed as eligible commodities. One of the requirements of aquaculture feed is that it must be certified as containing only U.S. ingredients (30).

The **Consolidated Farm Service Agency (CFSA)**[25] disburses payments to aquaculture producers under the Crop Loss Disaster Assistance program designated in the 1990 Farm Bill. CFSA funding of disaster benefits began in 1992; however, specific funding amounts for aquaculture are unknown (44).

The **Economic Research Service (ERS)** provides economic and social science information and analysis to improve "the performance of agriculture and rural America" (63). ERS publishes reports analyzing the production and demand for agricultural commodities. Specifically, the biannual "Aquaculture Situation and Outlook Report" provides information on the supply, demand, pricing, and trade for aquacultural products (63).

USDA Regulation

Animal and Plant Health Inspection Service (APHIS)

1994 APHIS Aquaculture Regulation Funding: unknown percentage of $800,000

The Animal and Plant Health Inspection Service is responsible for licensing all veterinary biologics (e.g. vaccines, diagnostic kits), regulating biologic imports, and certifying biologics for export and interstate transportation. APHIS also provides some export certification for aquacultured animals.[26] APHIS funding specifically targeted at aquaculture regulatory activities is an unknown percentage of its 1994 aquaculture budget of $800,000.

Natural Resources Conservation Service (NRCS)

1994 NRCS Aquaculture Regulation Funding: $500,000

The Natural Resources Conservation Service's (NRCS)[27] role has evolved from a

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[24] Including Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

[25] In October 1994, a new Consolidated Farm Service Agency (CFSA), also called the Farm Service Agency, took responsibility for administering the farm functions of the Agriculture Stabilization and Conservation Service (ASCS), the Farmer's Home Administration (FmHA) and the Federal Crop Insurance Corporation (FCIC) (58).

[26] For further information, see Office of Technology Assessment, *Selected Technology Issues in U.S. Aquaculture* (Washington, DC: Office of Technology Assessment, September 1995).

[27] In October 1994, the new Natural Resources Conservation Service (NRCS) absorbed all programs of the Soil Conservation Service (SCS) and all conservation programs of the Agriculture Stabilization and Conservation Service (ASCS), except the

more traditional role of advising and assisting farmers to a newer role of regulatory enforcement (57). With regard to aquaculture, the primary objective of NRCS is to ensure protection of the soil and water resource base. This objective is accomplished through careful resource assessment during facility planning and construction. NRCS assists an initial resource assessment by furnishing data on water quality and quantity, and soils. The agency also provides planning assistance, training sessions, and field demonstrations (63).

DEPARTMENT OF COMMERCE (DOC)

Total 1994 DOC Aquaculture Funding: $13.9 million

DOC Research

National Marine Fisheries Service (NMFS)

1994 NMFS Aquaculture Research Funding: $10 million

The National Marine Fisheries Service (NMFS) is administered through the Department of Commerce's (DOC) National Oceanic and Atmospheric Administration (NOAA). NMFS conducts aquaculture research with its own funding, with other agency funds (e.g., CSREES, National Science Foundation and Bonneville Power Administration), and by funding aquaculture research carried out by other agencies and universities (e.g., through Saltonstall-Kennedy grants). (See box 2-3 for a discussion on the NMFS Laboratories involved in aquaculture research).

The Saltonstall-Kennedy (S-K) Program provides research and development grants to organizations that carry out projects (e.g., related to harvesting, processing, and marketing of fishery products) generally benefiting the fishing industry. The S-K fund is capitalized through collection, under customs laws, of import duties on fish and fish products. Funds equaling 30 percent of the gross duty receipts are allocated to the S-K Program.

In 1993, total duties collected on fishery imports were $204.7 million, and $61.4 million was transferred to the S-K Fund (67). At least $6 million was devoted to fifty-five S-K projects (50).[28] Eleven percent, or $711,000, of available funds were devoted to aquaculture (32,42). Funding was distributed to seven aquaculture research projects; the project receiving the most funding was a study on new medications to support U.S. fish farming (42).

Sea Grant

1994 Sea Grant Aquaculture Research Funding: $3.9 million[29]

The Sea Grant College Program, administered through DOC/NOAA, provides funding for aquaculture research through approved Sea Grant institutions that provide matching funds. Projects are selected based on the strength of the individual participating institution, the issues of regional and, often, national importance, and the priorities set for research, education, and service by the National Sea Grant Office (69).

In 1993, 80 aquaculture-related projects were funded. These projects are divided into six categories: 1) aquaculture systems and engineering; 2) genetics and selective breeding; 3) physiology and endocrinology; 4) nutrition; 5) disease/parasites; and 6) policy and economics. From 1988 through 1993, the

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Conservation Reserve Program (CRP) and the Agricultural Conservation Program (ACP) (58).

[28] In 1993, $55 million of the S-K transferred funds was appropriated by Congress to offset the appropriation requirements of the Operations, Research, and Facilities (ORF) account. ORF is NOAA's major appropriation (67).

[29] This includes funding for the National Coastal Resources Research and Development Institute (NCRI), and may include extension funding through the Marine Advisory Services (MAS).

Box 2-3: NMFS Laboratories Involved in Aquaculture Research

The National Marine Fisheries Service (NMFS) has been involved in research and development programs relevant to aquaculture for almost one hundred and 25 years. Today, each of four regional Fisheries Science Centers supports several laboratories that specialize in research on species, production systems, and other topics of particular import to that region. The Centers contribute to stock enhancement activities as well as to the U.S. commercial aquaculture industry.

Southeast Fisheries Science Center: SFSC conducts research on identification of regional species for development; spawning, reproduction, and hatchery techniques; and research designed to seek regulatory approval of therapeutants for key marine species. Commercial aquaculture has particularly benefited from the Galveston Laboratory's research on development of marine shrimp hatchery techniques, including the "Galveston Method" of producing viable fertilized eggs. The Galveston Laboratory currently is conducting shrimp aquaculture research on the effects of environmental factors, such as temperature and salinity, on growth and survival of native shrimp species, and on natural and artificial diets for various shrimp species.

Northwest Fisheries Science Center: NWFSC conducts a variety of aquaculture research for freshwater and marine finfish. The extensive public salmon hatchery system in the Pacific Northwest has required research and development support from NWFSC for decades, particularly in the areas of fry and juvenile fish evaluation, management of captive broodstock of endangered species, feed development, and disease diagnosis and prevention.

The NWFSC established the Manchester Laboratory and companion facilities at Montlake and the University of Washington's Big Beef Research Station to develop commercially viable culture systems for Pacific salmon. Together these facilities have developed into a "center of excellence" for development of salmonid culture systems. Although emphasis has been on salmon species, cooperative studies with University of Washington scientists has allowed Center scientists to maintain expertise in marine fish and shellfish culture, including rearing a number of native species through a part of their life history.

Northeast Fisheries Science Center: Techniques for bivalve and algal culture developed at the Milford Laboratory in Connecticut are used worldwide by the shellfish aquaculture industry. In addition to extensive work on basic shellfish biology and reproduction, the Milford Laboratory has begun research on marine finfish species with culture potential. The Narragansett RI laboratory has a twenty-five year history of rearing marine finfish species to at least larval stages. At present, research studies are concentrating on cod and haddock as potential aquaculture species.

Alaska Fisheries Science Center: Three year-round research stations have freshwater and marine aquaculture research facilities (Little Port Walter, Osprey Bay, and Auke Creek). Current work is focusing on salmonid genetics, broodstock development, hybridization, and research on life histories.

SOURCE: Unless otherwise noted, information is derived from J. Erbacher, International Trade Specialist, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Silver Spring, MD, fax memorandum, "Information on NMFS Fisheries Science Center Labs," to the Office of Technology Assessment, U.S. Congress, Washington, DC, August 31, 1995.

two categories, "physiology and endocrinology" and "genetics and selective breeding," received more funding than other project areas (40 to 60 percent of total funding) (69,70,71, 72,73).

Traditionally, salmon, marine shrimp, hard clams, and oysters have received the greatest species' research emphasis. Algae research also has been funded at high levels (69). The largest aquaculture programs, in terms of dollars allocated and project numbers, have been carried out in Hawaii, Texas, Washington, and California. In 1993, 40 percent of Sea Grant projects (33 out of 80), accounting for 45 percent of total funding, took place in these states (69,73).

The **National Coastal Resources Research and Development Institute (NCRI)** is federally funded, and university-based. It has its own legislative mandate, but is neither an agency nor a private, non-profit entity. NCRI reports and is administered by the National Sea Grant Office on a year-to-year basis. As in years past, NCRI was zeroed out of NOAA's

proposed budget for the upcoming fiscal year (1996), and its future is uncertain.

NCRI promotes public and private sector partnerships to implement advances in sustainable development and to increase the competitiveness of American coastal businesses. Since 1986, NCRI has funded 33 aquaculture development projects in 15 states. These projects are designed to facilitate commercial ventures of economically important species of finfish, shellfish, and seaweeds. Most of NCRI's research has been directed at new production technologies, although several projects have addressed legal and industry financing issues. In 1994, funding devoted to aquaculture was $205,000 (40).

DOC Support

US-Israel Science and Technology Grants Program

1995 US-Israel Grants Program Aquaculture Support Funding: $1.5 million*[30]*

In 1993, President Bill Clinton and Prime Minister Yitzhak Rabin established the US-Israel Commission to strengthen both countries' private- sector economies by promoting collaborative high-technology research. For the first US-Israel Science and Technology Grants Program, more than 100 proposals were considered.[31] Three grants were awarded; one grant involves two U.S. and two Israeli companies in a joint aquaculture technology venture. The four-year project, "Year-Round Production of High Performance Offspring for Rearing in Aquaculture," will focus on developing new fish and shrimp breeding and rearing technologies to promote efficient year-round production of farmed seafood. In February 1995, it was announced that the aquaculture technology joint venture will receive approximately $3 million in government grants, split evenly among the four companies. The partners must match the grant money, raising the amount of project money to roughly $6 million (3,4,53).

Other DOC Support Programs

Other 1994 DOC Aquaculture Support Funding: each agency less than $100,000 or amount spent unknown

The **Fishing Obligation Guarantee (FOG) Program**[32], administered by NMFS, enables fisheries interests access to the bond and institutional investment market. By bearing all credit risk, the Program guarantees private lenders that loans for the construction, repair, or purchase of commercial fishing vessels will be repaid. Aquaculture was specifically included in this program by the National Oceanic and Atmospheric Administration Act of 1991.[33] All structures as well as equipment and land for aquaculture are included. A significant amount of the Program's fiscal year 1995 credit authority ($25 million) may involve aquaculture (23,68).

The **National Training Branch** is the training and education arm for NMFS' Seafood Inspection Program. This branch of NMFS provides training services for NMFS inspection personnel, a variety of seafood education workshops for the industry (e.g., Hazard Analysis Critical Control Point workshops),[34] and specialized programs for retail and food service professionals (2).

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[30] The first year of funding for this program will be 1995.

[31] Proposals were from a variety of fields, such as aerospace, pharmaceuticals, electronics and health care.

[32] The program is authorized by title XI of the Merchant Marine Act of 1936, as amended (46 U.S.C 1271-1279, *et. seq.*).

[33] Section 304 of Public Law 102-567 amended section 1101(k) of the Merchant Marine Act, 1936 (46 App. U.S.C. 1271(k)), broadening the definition of the term "fishery facility" to include any building, land, equipment, or vessel used for aquaculture purposes.

[34] The Hazard Analysis Critical Control Point (HACCP) system identifies possible seafood spoilage hazards, puts systems in place to prevent the hazard, and finally, establishes methods for documenting the hazard prevention process. In July 1992, NMFS launched a voluntary, seafood inspection program based on HACCP principles. In January 1994, the Food and Drug Administration proposed to make HACCP systems mandatory for all seafood (66). In 1995, the European Union announced its intent to require all seafood products produced for export to the European Union on or after January 1, 1996, to be processed using HACCP controls (22).

The **Northeast Fishing Industry Grants (FIG) Program**, administered by NMFS, addresses the most pressing needs of fishermen affected by the decline of traditional fisheries in the Northeastern United States and by federal regulatory actions. Fishermen, who require assistance in developing alternative employment or new business opportunities, may obtain grants to address employment impacts associated with reduced fishing opportunities. NMFS indicates that aquaculture may be considered an alternative employment option for these displaced fishermen (19).

Under DOC's **US-Japan Cooperative Program in Natural Resources**, U.S. and Japanese counterpart panels on aquaculture were formed in 1969. The panels include spe-cialists from the federal departments most con-cerned with aquaculture. Efforts have focused on exchanging aquaculture-related information that could benefit both countries (65).

DEPARTMENT OF INTERIOR (DOI)

Total 1994 DOI Aquaculture Funding: $7 million

The Fish and Wildlife Service (FWS) participates in several aquaculture-related activities. The agency conducts aquaculture research, provides private sector services (including fish health inspections at fish farms), and contributes to the salaries of the national and regional aquaculture coordinators. Since its inception in 1994, the National Biological Service (NBS) has conducted research applicable to aquaculture (37).

The Department of Interior (DOI) also has an extensive hatchery system; in 1994, almost $43 million was devoted to hatchery production (see table 2-2). The Fish and Wild-life Service spent almost $40 million operating hundreds of federal fish hatcheries; and the Bureau of Indian Affairs dedicated almost $3 million to oversee at least 100 fish hatcheries on Indian reservations. The fish hatchery sys-tem is beyond the scope of this analysis; how-ever, hatchery research with applications for commercial aquaculture has been included in this analysis.

DOI Research

Fish and Wildlife Service (FWS)

1994 FWS Aquaculture Research Funding: $2 million

In FY 1994, most of the fisheries research centers/laboratories under Fish and Wildlife Service (FWS) jurisdiction were transferred to the National Biological Service (NBS). Those laboratories that remained under FWS authority became known as technology centers. The purpose of these centers is to conduct applied research to support the FWS fish hatchery system. For example, the Bozeman laboratory is conducting research on fish feeds for threatened and endangered species brought into captivity. Findings may be useful to both the public and private aquaculture sectors (38).

FWS also administers Dingell-Johnson funding to state fish and game departments for projects relating to management and restoration of any species that has material value to sport or recreational fisheries.[35] Funding has been made available specifically for research into problems of fish management or culture affecting fish resources (46).

National Biological Service (NBS)

1994 NBS Aquaculture Research Funding: $5 million

The National Biological Service (NBS) conducts research relevant to aquaculture at many of its laboratories. However, the NBS budget does not list aquaculture as a research area; the federal hatcheries are the focus of most NBS laboratory research related to aquaculture (38).

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[35] Dingell-Johnson funding was authorized by the Federal Aid in Fish Restoration Act of 1950 (16 U.S.C. 777-777k).

Several NBS laboratories target aquaculture species and topic areas. The Fish Farming Experimental Laboratory in Stuttgart, Arkansas conducts research targeting cultured species, such as catfish, baitfish, and minnows. The Southeastern Fish Cultural Laboratory in Marion, Alabama also conducts research on aquaculture topics, such as factors limiting commercial fish farming (37).[36]

The National Fisheries Leetown Center conducts multi-disciplinary research germane to aquaculture at laboratories in West Virginia, Idaho, Pennsylvania, and New York. Recent research projects have focused primarily on striped bass and salmonids (33). The National Fisheries Research Centers in Seattle, Washington, and LaCrosse, Wisconsin, conduct hatchery research pertaining to fish culture and health, focusing on issues such as drug and chemical approval (38).

DOI Regulation

Fish and Wildlife Service

1994 FWS Aquaculture Regulation Funding: $30,000

Fish and Wildlife Service (FWS) regulatory funding is spent on aquaculture-related predation-kill permitting (issuance of permits for killing birds and mammals that depredate aquaculture facilities). There is no central database or uniform reporting procedures to track FWS kill permit data; data is reported separately from each region. The majority of funding has been spent in two areas: field work and investigations, and permit issuance and administration. A third category was hearings and appeals. The majority (65 percent, or $20,777) of FWS regulatory funding was spent in Region 5 (the northeastern United States). In contrast, Region 7 (Alaska) spent no monies on regulatory activities (9,10,11).[37]

The FWS also is responsible for enforcing the Lacey Act of 1981, which protects indigenous species and prevents trade of threatened and endangered species.[38] The Act has been used by some state governments to prevent the culture of aquaculture species that the state considers a game fish, or a threatened or endangered species. State governments also have used the Act to prevent importation of potentially "injurious" certain species (e.g., grass carp) (48). Funding for enforcement of the Lacey Act with regard to aquaculture is unknown.

FOOD AND DRUG ADMINISTRATION (FDA)

Total 1994 FDA Aquaculture Funding: $6 million

FDA Regulation

The Food and Drug Administration (FDA), administered by the Department of Health and Human Services, is the primary authority in setting and enforcing regulatory guidelines concerning food safety. Agency resources are dedicated to research, and surveillance (inspections) and compliance (training). FDA is responsible for monitoring and regulating the use of drugs in aquaculture (8,63).

FDA published proposed regulations in 1994 requiring much of the seafood industry to adopt Hazard Analysis and Critical Control Point (HACCP) procedures. In addition, FDA is responsible for evaluating state shellfish sanitation programs under the National Shellfish Sanitation Program (NSSP), which is a cooperative federal-state-industry effort (59).

FDA estimated its 1994 aquaculture budget to be 15 percent of its total seafood-related annual budget.[39] In 1993, $1.95 million was

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[36] Both of these laboratories are currently under legislative consideration for transferal to USDA.

[37] For a discussion of kill permitting, see U.S. Congress, Office of Technology Assessment, *Selected Technology Issues in U.S. Aquaculture* (Washington, DC: Office of Technology Assessment, September 1995).

[38] Title 16, U.S.C. 3371

[39] The FY 1994 FDA budget for all seafood activities is $40.5 million. A conservative estimate of the seafood consumed in the United States that is aquaculturally grown is 15 percent. FDA uses these figures as an index to roughly say that $6 million per year of the $40.5 million is spent on aquaculture produced seafood (8).

spent *specifically* on aquaculture in the following three areas: research on drugs, color additives, and pesticides;[40] pesticide and drug surveillance and compliance; and petition review. Sixty-six percent of these funds targeted drugs (8).

AGENCY FOR INTERNATIONAL DEVELOPMENT (AID)

Total 1994 AID Aquaculture Funding: $1.5 million

AID Research

The AID Bureau for Research and Development (BRD), within the Agency for International Development (AID), funds aquaculture research at U.S. institutions. BRD supports U.S. institutions linked to particular subject areas and/or geographical regions through cooperative agreements. U.S. institution expertise is applied to foreign technical services in specialized areas, such as aquaculture (60).

AID's Collaborative Research Support Program (CRSP) provides a forum for researchers from U.S. institutions to work with other experts on global issues affecting development. From 1982-1990, one CRSP project had a total funding of $11.3 million devoted to research of pond dynamics/aquaculture.[41] The project's purpose was to define aquaculture's potential as a dependable source of employment and inexpensive animal protein. Seven U.S. institutions[42] and three developing countries--Honduras, Rwanda, and Thailand--were involved (60).

DEPARTMENT OF ENERGY (DOE)

Total 1994 DOE Aquaculture Funding: $1.2 million

DOE Research

The **Biofuels Systems Division (BSD)** of the Department of Energy (DOE) has spent $4.3 million over the last seven years (1988-1994) on a focused energy-aquaculture project. In 1994, funding was $600,000. Since 1982, this Division has worked on developing technologies to transform aquatic biomass (plant material and waste products) into alternative liquid fuels for transportation. For example, one study investigated the production of diesel fuel from the mass culture of microscopic algae (52,74).

The primary goal of the BSD program is to reduce the cost of alternative fuels to competitive levels by the year 2000. The technical plan for 1992 through 1996 concentrates on two major areas: land and water-based biomass production systems, and the biological and thermochemical conversion of biomass feedstocks (74).

Bonneville Power Administration (BPA) is a federal entity, administered by DOE, set up to distribute power generated at federal dams on the Columbia River. From 1988 to 1994, BPA provided funds for salmonid research and restoration conducted by the National Marine Fisheries Service (43). In 1994, BPA funding for aquaculture was approximately $600,000; $460,000 was spent on the NMFS Redfish Lake Sockeye Salmon Captive Broodstock Rearing and Research Project, and $133,000 was spent on the NMFS Cle Elum Sockeye Restoration Project (25).

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[40] Research was conducted into the metabolism of aquaculture therapeutants and pesticides, into methods for detection of parent compound residues, and into the metabolites from therapeutant, pesticide, and feed additive use. In addition, there are specific field compliance assignments issued from the Center for Food Safety and Applied Nutrition (CFSAN) for aquaculture drug residue testing in domestic and imported aquaculture produced foods.

[41] Breakdown: AID contribution, $7.449; university match, $1.668; host country contribution, $2.218.

[42] Oregon State University (management entity), Auburn University, University of Hawaii, University of Michigan, Michigan State University, University of Arkansas at Pine Bluff, and the Consortium for International Fisheries and Aquaculture Development.

NATIONAL SCIENCE FOUNDATION (NSF)

***Total* 1994 NSF Aquaculture Funding: $1.1 million**

NSF Research

The National Science Foundation (NSF) has a Small Business Innovation Research (SBIR) Program that annually solicits research proposals from small business firms on scientific or engineering issues that could lead to public benefit. NSF receives about 2000 SBIR proposals annually and funds more than 200 of them (35).

Aquaculture proposals are a very small portion of NSF's SBIR Program; however, it is the major means of NSF aquaculture funding. NSF usually receives about 16 proposals a year; one to four of these aquaculture projects are funded. Marine/Estuarine Aquaculture is the topic area that receives most of the aquaculture-related proposals.[43] However, certain other topic areas (e.g., engineering) could be appropriate, depending upon the nature of the proposed research (35).

In addition, NSF funds a range of basic research proposals that affect aquaculture. These awards, however, are rarely identified as "aquaculture" proposals. Research areas such as environmental engineering and marine biotechnology could potentially receive aquaculture-related proposals (35).

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Total 1994 EPA Aquaculture Funding: $500,000

EPA Regulation

The Environmental Protection Agency (EPA) has primary responsibility for promulgating and enforcing regulations aimed at reducing water pollution, a source of many seafood-borne contaminants (59). EPA regulates discharges of pollutants into U.S. waters under the Clean Water Act, requiring a National Pollutant Discharge Elimination System (NPDES) permit for point source discharges. Since 1979, when regulations for "concentrated aquatic animal production facilities" were published (48), most aquaculture facilities discharges are under the regulatory oversight of EPA.

EPA has six programs related to aquaculture regulation: 1) pollutant discharge permits, 2) pesticide registration, 3) water quality/effluent guidelines, 4) waste water treatment, 5) wetlands management, and 6) residual wastes. These programs focus on permitting, registering, and setting specific guidelines for resource use and discharge elimination. There are few, if any, specific aquaculture research projects; those that do exist usually are found in the discharge permits and pesticide registration programs (5).

TENNESSEE VALLEY AUTHORITY (TVA)

Total 1994 TVA Aquaculture Funding: $500,000

TVA Research

In the 1970s and 1980s, the Tennessee Valley Authority (TVA) conducted research on catfish, freshwater shrimp, and tilapia. In 1989, a refocused budget eliminated these programs. In 1991, TVA constructed a research and development facility in Alabama and initiated a research program on the use of constructed wetlands for wastewater treatment. Appropriated funds since 1991 have been used to cover salaries and operations. TVA envisions that constructed wetlands may be used in treating waters discharged from aquaculture operations (7).

OTHER FEDERAL AGENCIES/PROGRAMS

Funding for aquaculture-related activities can be found in several additional agencies and program areas. Below are seven programs that

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[43] Initially, NSF had two SBIR aquaculture categories--freshwater and marine/estuarine. Now, the latter is the only NSF-SBIR aquaculture category (35).

support aquaculture, two through research and five through technical and financial assistance.

Research

The **Army Corps of Engineers' (ACOE)** interest in aquaculture stems from its mandate to protect the navigability of public waterways. The Corps is the only agency that has the statutory authority to issue permits for offshore aquaculture operations. Under Section 10 of the Rivers and Harbor Act, ACOE is responsible for permitting all aquaculture operations carried out in navigable waterways. Funding levels for ACOE permitting of aquaculture operations is unknown.

Much of the sediment dredged annually by the Corps is placed in dredged material containment areas (DMCAs), located on private land. Acquisition of land to establish DMCAs is difficult because of high real estate values, long-term nature of this use, and the public perception that dredged material is not aesthetic. To overcome these barriers to acquiring new DMCAs, the Corps has worked to develop integration of dredging material with other uses. Aquaculture is estimated to have high potential in this area (54).

Aquaculture is promising as a compatible activity because aquaculture ponds and DMCAs share many design characteristics. Common features include levees to retain water, relatively impervious soils, and water discharge control structures. Both types of operations have similar regulatory and permitting requirements, and include locations adjacent to coastal waterways (54). From 1986 to 1990, the Corps invested a total of $4.4 million in containment area aquaculture research. For example, the Corps conducted a demonstration project, studying marine shrimp culture in two active DMCAs near Brownsville, Texas (45,54).

The **Small Business Innovative Research (SBIR) Program** is administered by the Small Business Administration (SBA) in conjunction with a parent agency. Eleven agencies have SBIR programs.[44] Established in 1982, the SBIR program is responsible for strengthening the research and development role of small, innovative companies (55). It is intended to be a source of technical innovation, to provide opportunities for small businesses to contract with the federal government, and to increase commercialization of technology resulting from federal research and development (46).

Projects are funded in three stages: testing of scientific merit (phase I), development of projects that showed greatest merit in phase I (phase II) and commercialization of promising technology, which generally involves the use of nonfederal funds (phase III) (46,55). Specifically related to aquaculture, the NSF-SBIR provides funding to small business firms for research into scientific and engineering issues that could lead to public benefit, including research on marine/estuarine aquaculture (36). USDA and DOC also could single out aquaculture for SBIR funds.

Support

The **Community Development Block Grants (CDBG) Program** was authorized by the Housing and Community Development Act of 1974. Administered by Housing and Urban Development, the program was established to provide grants through state and local governments to aid in the development of viable communities. Since 1975, Congress has appropriated over $62 billion for CDBG (46).

The state and HUD Administered Small City Program, receiving 30 percent of CDBG appropriations, is the CDBG grant program

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[44] Five agencies account for over 90 percent of SBIR awards: Department of Defense (DOD), the Department of Energy (DOE), the Department of Health and Human Services (HHS), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF). The other six agencies, accounting for the remainder of SBIR awards, are: U.S. Department of Agriculture (USDA), the Department of Commerce (DOC), the Department of Education (DOEd), the Department of Transportation (DOT), the Environmental Protection Agency (EPA), and the Nuclear Regulatory Commission (NRC) (55).

most applicable to aquaculture. The Small City Program is designed to encompass small and/or rural communities well suited to and served by aquaculture projects. Small City Program funds were used as seed money for a Freshwater Prawn (*Macrobrachium rosen-bergii*) farm in Puerto Rico in 1984 (46).

The **Farm Credit Administration (FCA)** was established as an independent agency in the executive branch of the federal government (12 U.S.C. 2241 *et seq*. 1971). The FCA sets rules and governs lending institutions of the Farm Credit System, to ensure adequate credit for producers and harvesters of "food"[45] products. Credit is available for long-term mortgage loans associated with production, basic processing, and marketing, as well as several types of insurance associated with production (46).

In 1993, FCA loans were made to aquaculture facilities raising species such as catfish, shrimp, tilapia, trout, crawfish, clams, and tropical fish. Farm Credit Banks also made loans to hatchery operations and commercial fishing units, which are not easily separated out from the loans made to aquaculture facilities. Five Farm Credit Banks made 592 loans, equaling $111 million, to aquaculture, hatchery and fishing operations. The Farm Credit Bank of Texas, in particular, has made substantial loans to aquaculture operations. In 1993, the bank made 114 loans to catfish producers for a total of $38.7 million (15,21,27,34,49).

The **Office of Job Training Program**, under the Department of Labor's Employment and Training Administration, administers the Job Training Partnership Act (JTPA) (29 U.S.C. 1501). Block grants are made to each state or territory to train or retrain economically disadvantaged workers, dislocated workers, and others who face significant barriers to employment.

The Program is a source of aquaculture technology transfer, work force training, and technical assistance for aquaculture operations in economically distressed areas (46). Two specific programs have been used to support aquaculture development: 1) The Economic Dislocation and Worker Adjustment Assistance Act was an amendment to Title III of the JTPA. Funding is allocated at the discretion of the Secretary of Labor to alleviate, for example, national economic problems such as massive layoffs in one industry or region. In FY 1994, $1.118 billion went to this program. In relation to aquaculture, two shellfish culture projects in the state of Florida benefited from this program. 2) The Defense Conversion Assistance and Diversification Program was authorized in 1990 (PL 101-510 and 101-511) and will expire in 1997. Funds are channeled through the Department of Defense to assist displaced defense workers. In FY 1994, $150 million was allocated to this program. Allied Signal[46] is currently providing free technical assistance to aquaculturists under this program (46).

Rural Housing and Community Development Services (RHCDS),[47] administered through USDA, serves as a temporary source of credit and technical support for rural farmers in need of assistance for improving, establishing or maintaining a family-sized farm.[48] The agency makes direct

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[45] Tropical fish operations have also received FCA funding (21).

[46] Allied Signal is a defense contractor. During the past few years, they have downsized and, in order to mitigate the impacts, they have looked for other industries in need of their technical expertise. The Office of Job Training allows Allied Signal employees to apply their engineering and environmental monitoring knowledge to the aquaculture industry. Employing environmental monitoring skills (previously used at nuclear facilities) to aquaculture industry water and contamination problems is one example. Other projects have included designing oxygenation systems, sensors to track fish numbers, and instruments to gauge water quality (16; 47).

[47] USDA reorganization of the Farmer's Home Administration (FmHA), into the Rural Housing and Community Development Services, began in October 1994 and is mandatory by October 1995. The former FmHA operated under the Consolidated Farm and Rural Development Act (7 U.S.C. 1921). The new agency falls under the jurisdiction of the Rural Economic and Community Development Office, under USDA (46; 47).

[48] The definition of a farm as it applies to loan making programs is "a tract or tracts of land, improvements, and other appurtenances considered to be farm property, which is used or

loans and guarantees loans made by other lenders for farm operations and farm ownership. Farmers may qualify for agency assistance until they are able to meet the financial requirements to qualify for loans through private lenders (18).

Between October 1, 1991 and July 31, 1993, approximately 289 RHCDS aquaculture loans were made,[49] totaling almost $38 million (56).[50] Mississippi alone received 35 percent, or 101, of all loans made during this period. Loans ranged in amounts from $2,500 to $400,000.[51] The majority of these loans (approximately 71 percent) were made for catfish production. Loans also were made for bass, minnows, baitfish, trout, oysters, salmon, lobsters, clams, crawfish and alligators (18).

"Animal aquaculture" small businesses are eligible for **Small Business Administration (SBA)** support. Assistance can be in the form of loan guarantees, business development counseling (including education and training opportunities), and support from SBA's Office of Advocacy. From 1983 through 1993, 20 loans[52] were made to animal aquaculture small businesses, equaling a total of $3.8 million(24).[53]

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will be used in the production of livestock, including the production of fish under controlled conditions" (18).

[49] The information collected by survey is not guaranteed to be all-inclusive. Aquaculture is eligible for four of the eight types of loans: Operating Loans, Emergency Loans, Farm Ownership Loans, and Soil and Water Conservation Loans.

[50] Loan limits were set at $200,000 for direct loans and $300,000 or $400,000 for guaranteed loans (56).

[51] This includes both direct and guaranteed loans.

[52] There are three types of loans:

1) The *Business Loan Program* is authorized by the Small Business Act to make loans available to small businesses (15 U.S.C. 631 *et seq*. 1953). To qualify as a small business, a company must be independently owned and not be dominant in its field of operations. Candidates are required to have been rejected by conventional sources of debt financing. Financing is primarily provided by private lenders with SBA loan guarantees. Direct loans also are available to eligible borrowers: businesses located in areas of high unemployment or businesses owned by low income individuals, handicapped individuals, Vietnam veterans, or disabled veterans. This program also provides disaster assistance for small businesses and agricultural cooperatives that sustained substantial economic injury from a natural disaster (13 CFR Part 123).

2) *Small Business Investment Companies* are authorized by the Small Business Investment Act of 1958 to provide venture capital financing to small businesses (15 U.S.C. 661-696). These companies provide unsecured equity financing for small businesses and specialize in investment associated with higher risks.

3) *Local Development Company Loans* (LDCL) are available to any public or nonprofit group to improve the local economy (13 CFR Part 108). These funds can be used for infrastructure improvements that benefit small businesses. The LDCL must provide 10 percent of the projected costs in the form of a stock, bond, or other cash equivalent (46).

[53] As of April 15, 1994, six of the 20 loans had failed, resulting in a high failure rate of 30 percent.

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